Proceedings of the 63rd

Nigerian Library Association Conference
On the 5th Industrial Revolution and the
Future of Library and Information Service Delivery
in a Changing World, Benin City 6th-11th July, 2025

HEARTBEAT 2025

VOLUME 2



Proceedings of the 63rd

Nigerian Library Association Conference
On the 5th Industrial Revolution and the
Future of Library and Information Service Delivery
in a Changing World, Benin City 6th-11th July, 2025

HEARTBEAT 2025

VOLUME 2



MEMBERS OF THE EDITORIAL TEAM

1. **EDITOR-IN-CHIEF**
Prof. Ahmad A. Balarabe
Department of Library and Information Science
Faculty of Education and Extension Services
Usmanu Danfodiyo University
PMB 2346, Sokoto, Sokoto State
+2348035073556
aabalarabe7@gmail.com

EDITORS
Prof. Augonus Nnamdi Uhegbu
Department of Library and Information Science
Abia State University Uturu, Abia State
+2348038726760

Prof. Manir Abdullahi Kamba
Department of Library and Information Science
Bayero University Kano, Kano State
+2347068753355

Prof. Adeyinka Tella
Department of Library and Information Science
University of Ilorin, Kwara State.
+2347038641278

Dr. Lawal Umar
Department of Library and Information Science
Umaru Musa Yar"adua University Katsina
+2348032965156

Dr. Akinniyi Ayobami Adeleke
University Librarian,
Tekena Tamuno Library, Redeemer's University,
P.M.B. 230, Ede, Osun State.

Dr. Adegbore Adebayo Muritala
Department of Library, Archival and Information Studies,
Faculty of Education, University of Ibadan
+2348032154904

Dr. Chidi Nwosu
Department of Library and Information Science
+2348037069773

Dr. Kolawole Akinjide Aramide
Department of Library, Archival and Information Studies,
Faculty of Education, University of Ibadan

Dr. Aliyu G. Tsafe
University Librarian
Federal University Gusau, Zamfara State
+2348035978591

Dr. Aliyu Abdulkadir
University Librarian
Nasarawa State University Keffi
+2348131082564

Dr. Fatimah Jibril ABDULDAYAN
Department of Library and Information Science,
Federal University of Technology Minna Niger State
+2347068155501

Dr. Whong Fidelia Mbowheing
Kashim Ibrahim Library
Ahmadu Bello University Zaria
+2348035927624

NIGERIAN LIBRARY ASSOCIATION,
National Library of Nigeria
Sanusi Dantata House
Central Building District
PMB 1, Garki
Abuja

ISBN:978-978-48760-0-2

ALL RIGHTS RESERVED.
No part of this publication may be reproduced, distributed or stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the copyright owner or the publishers.

Published by
Jopa Digital Publications
Nh1 Lagos Street By Muri Kaduna
+234 703 0086 011

Preface

The world stands at the precipice of a transformation as profound as the agricultural, industrial, and digital revolutions that preceded it. We are entering the era of the 5th Industrial Revolution, a paradigm shift characterized by the synergistic integration of advanced technologies like artificial intelligence, blockchain technology, Internet of things, pervasive connectivity, biotechnology, and robotics, all underscored by a renewed focus on human-centricity and sustainability. This revolution, unlike its predecessors, is not merely about what technology can do, but about how it can augment human potential, foster creativity, and address some of the most pressing challenges facing our planet.

For centuries, libraries have served as the custodian of knowledge, the arbiters of information, and the vibrant hubs of community engagement. From the scrolls of Alexandria to the digital repositories of today, their fundamental mission has remained constant: to connect people with the information they need to learn, grow, and thrive. But as the 5th Industrial Revolution gather pace, the very definition of "information" and "service" is undergoing a radical re-evaluation in library and information profession. In line response to the above, the Nigerian Library Association held her 63rd National Conference at Benin City, Edo State from 6th to 11th July, 2025 with the Theme ***"The 5th Industrial Revolution and the Future of Library and Information Service Delivery in a Changing World"***. It is a theme that is considered very apt in the face of rising competitiveness in the information market and the quest for professional identity and relevance among library and information professionals in Nigeria.

This book is an invitation to librarians, information professionals, educators, policymakers, and indeed, anyone invested in the future of knowledge, creation, access, and use to contemplate the profound implications of this new era. More importantly, this book is a call to action, it further argues that the 5th Industrial Revolution, far from rendering libraries and librarians obsolete, presents an unprecedented opportunity for them to reassert their indispensable role in society. By embracing innovation, adapting their services, and reimagining their physical and digital spaces, libraries can evolve into dynamic, intelligent, and deeply human-centered institutions. We explore how libraries can leverage AI for personalized learning, become incubators for digital literacy and critical thinking, champion data ethics, and foster collaborative environments that bridge the digital divide.

The conference tagged **"Heartbeat 2025",** attracted 227 papers on the various sub-themes of the conference theme. Each submission was reviewed by selected experts/professionals in the relevant areas of Librarianship and Information Science. After each paper was subjected to scrutiny by the reviewers, 164 papers were selected and presented at the Conference. The selected papers were assembled in this book of proceedings. The papers in this book aims to provide a compass for navigating this uncharted territory, offering insights, provocations, and potential pathways forward in the areas of artificial intelligence, internet of things, blockchain technology, cybersecurity, robotics among other areas. We specially thank the participants of the 63rd NLA National Conference 2025, for their unalloyed cooperation, loyalty, support and contributions over the years. Our hope is that it will spark conversations, inspire innovation, and ultimately contribute to a future where libraries remain vibrant, essential pillars of informed and empowered communities in the age of the 5th Industrial Revolution and beyond.

Dr. Lawal Umar

Vice President & Chairman, National Organizing Committee

Table Contents

		PAGE
1.	A Revolution without Evolution? The 5th Industrial Revolution, Artificial Intelligence, and Inclusive Library and Information Services - Abdurrahman Bello Onifade & Juliet Chinedu Alex-Nmecha	1
2.	A Study on Perception and Implementation of Persistent Identifiers in Nigerian Universities - Salihu T. Salihu (CLN); Fatimah Jibril Abduldayan (PhD, CLN) & Matthew Simon Otache	12
3.	Academic Libraries as Dynamic Partners and Knowledge Hubs for Research Productivity and Professional Development for Academics - Abdullahi Olayinka Isiaka; Benjamin Adebisi Bamidele; Adelani Rotimi Ibitoye & Abdullahi Adebola Yusuf	27
4.	Access and Utilization of Information and Communication Technology (ICT) Facilities for Academic Performance of Undergraduate Students in Private University Libraries in Abuja, Nigeria - Aji, Kingsley Olawale	36
5.	Adoption and Use of Emerging Technologies for Reference Services in Academic Libraries of Private Universities in Edo State, Nigeria - Efosa Egharevba (CLN); Bonnie Obeka Obande (CLN); Vincent Osamuyimen Ekhaguosa (CLN) & Musa Bilal Ado (CLN)	44
6.	An Empirical Analysis of Repackaging Library Services and Strategies in the 5th Industrial Revolution for Attracting and Retaining User Interest in Southeast Nigeria - Dr Adizetu A. Ali & Tochukwu Victor Nwankwo	52
7.	An Evaluative Analysis of the Perceived Role of Librarian Spotlight Africa (LSA) Advocacy Programmes in Promoting Librarianship in Africa - Sylvester Israel EBHONU (CLN); Ramatu A Haliru (CLN) & Bolaji David Oladokun	66
8.	**Application of Artificial Intelligence for Delivering of Library and Information Service in Selected Libraries in Abuja -** Ibrahim, Mariam Gambo; Prof. Echezona, R.I & Akaaka, Dooshima	75
9.	Artificial Intelligence (AI) and the Revolutionising of Academic Libraries: A Study of Early Career and Experienced Librarians in Ekiti State, Nigeria - Olabode OLAJIDE (CLN) & Rotimi James OMOLEHIN	84
10.	Artificial Intelligence and the Future of Library and Information Service Delivery in Academic Libraries in Nasarawa State, Nigeria - Prof. Abiodun O. Iyoro & Dr. Kingsley Emmanuel Enyi	96
11.	Artificial Intelligence and the Future of Library and Information Service Delivery in the 5th Industrial Revolution in Nigeria - Odunlade, Racheal Opeyemi (PhD) CLN; Ojo, Joshua, Onaade (PhD) CLN & Ajayi, Taiwo Bosede, (PhD) CLN	106
12.	Artificial Intelligence Competency and Ethical Considerations: A Strategy for Sustainable Adoption Among Librarians in Nigeria - Yusuf Ayodeji AJANI; Lawal Umar, PhD & Adeyinka Tella	114
13.	Artificial Intelligence-Driven Innovations in Open-Access Book Publishing: The Federal University of Technology Minna BookHub Initiative - Dr. Fatimah Jibril Abduldayan & Prof. Kovo Abdulsalami Sanni	127
14.	Assessment of the Availability of Innovative Technologies for Information Service Delivery: A Study of Unity Schools' Libraries in Rivers State - Chidaka Okachukwu Nymezu & Juliet C. Alex-Nmecha	136
15.	Availability and Use of Technology Devices for Service Delivery in Federal University Libraries in North Central of Nigeria - Mercy Enefu Okwoli (PhD, CLN); Solomon Obotu Akor (CLN) & Babarotimi Opeyemi Oluwaseun	142

16. Awareness and Utilization of Artificial Intelligence Tools for Research Productivity by Masters Students of Distance Learning Center, Ahmadu Bello University, Zaria - **Whong, Fidelia Mbowheing; Esew Michael, Adedokun Aderonke Olubukola, PhD & Avajah, Ngozika** **152**

17. Blockchain and Information Security in Libraries of the 5th Industrial Revolution: A Systematic Review - Adeyinka TELLA & Firdausi Abdullahi **161**

18. Comparative Analysis of Library Services and Resources Usage among Biology Education Undergraduates in Two Universities in Benue State, Nigeria - Kate AGBO; Charles Terwuese TSENONGU (CLN, PMIIM) & Bonnie Obeka OBANDE (CLN) **170**

19. Continuous Professional Development (CPD) Initiatives for Academic Librarians in the Fifth Industrial Revolution: A Systematic Review - Fati Abubakar, (Ph.D); Hussaini MUSA, (Ph.D); Musa, Imam Shakarau; Ladan Dogara; Murjanatu Abduhamid Jibbo, PhD & Goshie, Rhoda Wusa, PhD **177**

20. Cybersecurity Awareness and Competencies of Librarians in Digital Information Services Delivery in University Libraries in Katsina State, Nigeria - Safiyya Kabir Ifo; Lawal Umar, PhD & Muhammad Kabir Abubakar, PhD **185**

21. Cybersecurity Behaviour in Library 5.0: Opportunities, Challenges, and Future Trends for Libraries - Juliet Chinedu Alex-Nmecha & Bolaji David Oladokun **193**

22. Digital Proficiency and Institutional-Based Support as Determinants for Reference Services Delivery in University Libraries in North Central States of Nigeria - Abdullahi Olayinka Isiaka; Abdullahi Adebola Yusuf; Biliamin Abiola Aremu & Benjamin Adebisi Bamidele **200**

23. Effects of Computer Drill, Practice and Demonstration Strategy on Junior Secondary School Student's Retention in Basic Science and Technology in Abuja Municipal Area Council - Adalikwu, M. T., PhD & Aji Kingsley Olawale **210**

24. Enhancement of Adaptive Pedagogies in Academic Institutions through Librarians' Proficiency in Evaluation of Open Educational Resources (OER) in South-East Nigeria - Dr. Lucy Ndidiamaka OKONKWO (CLN) **219**

25. Equipping Libraries and Information Science Professionals with Skills for Optimum Production in the 5th Industrial Revolution - Dr. Eunice Uchechi Edom CLN & Prof. Basil Onyeoziri Edom CLN **229**

26. Evaluation of Impact of Internet of Things (IoTs) on Utilization of Libraries by Postgraduate Students at the National Open University of Nigeria - Hassana IBRAHIM MLS, CLN & Dr. Angela Ebele OKPALA, CLN **236**

27. Evaluation of Information Governance Implementation in Nigerian Academic Libraries: Adherence to Information Management Standards - Jika Saidu Muhammad PhD; Yakubu Attahiru Liman PhD; Modibbo Umar Muhammad; Shuaibu Umar; Mathias Hussaini & Abubakar Umar **243**

28. Evaluation of Library Security Mechanism, Mutilation and Theft of Library Collections in Selected Academic Libraries in Oyo State - Jamiu Oladele MUHAMMED (PhD); Abdullahi A. BAKARE (PhD) & Adebola Aderemi OLATOYE (PhD) **252**

29. Exploring Librarians' Readiness of Positioning Academic Libraries for Research Services in the 5th Industrial Revolution (5IR) - Shuaib Agboola OLARONGBE, Ph.D; Kennedy Arebamen EIRIEMIOKHALE, Ph.D; Aliyu Tsafe GADANGA, Ph.D; Abdulakeem Sodeeq SULYMAN & Hadizat Keji ABDULRAHAMAN **267**

30. Exploring Metadata Management in the Age of Artificial Intelligence, Challenges, Opportunities, and Future Trends for Libraries: A Content Analysis - Diseiye Oyighan; Ejiro Sandra Ukubeyinje & Bolaji David Oladokun **274**

31. Exploring the Artificial Intelligence (AI) in Library and Information Services in Africa: An Analytical Review - Muhammad Kabir ABUBAKAR **281**

32. Exploring the Librarians Perception on Wikipedia as a Reference Tool in Kaduna State - Ramatu A. Haliru; Rukkayya Mohammed Yunusa & Sakinat Ja'afar **288**

33. Exploring the Possibilities of Fifth Industrial Revolution Technologies for Sustainable Library Advocacy among Librarians in Nigeria - Vincent C. Opara; Juliet C. Alex-Nmecha (PhD) & Innocent Iwezor Ordu (PhD) **293**

34. Exploring the Role of Polytechnic Library as Strategic Collaborator for the Next-Generation Research Initiatives - Dr Olatoye, Adebola Aderemi CLN, MNLA; Professor Olaojo, Pius Olatunji JP; FNLA & ADEOLA, Folake Folasade **301**

35. Exploring Undergraduates' Perceptions and Anxieties Towards Artificial Intelligence Integration into Blended Learning in Kwara State University, Malete, Nigeria - Prof. Kamal Tunde OMOPUPA; Shuaib Agboola OLARONGBE, Ph.D; Kennedy Arebamen EIRIEMIOKHALE, Ph.D; Florence Olabisi AJANI, Ph.D; Abdulakeem Sodeeq SULYMAN; & Iskil Arisekola Bolaji **307**

36. Factors Influencing the Adoption of Robotic Technologies in Libraries of Industry 5.0 - Columbus O. Udofot& Bolaji David Oladokun **316**

37. Impact of Artificial Intelligence on Libraries in the 5th Industrial Revolution: Empowering Librarians for the Future - Gift Ihunanya Nwosu (CLN); Ikenna Cyril Ihejirika (CLN) & Helen Omolara Aribatise **324**

38. Implementing Ethical AI-Powered Reference Services at Federal University Lokoja Library: A Librarian's Perspective - Omoniyi Yinka Martins; Mohammed Saidu & Dr. A. M. Rabiu **332**

39. Integrating the Internet of Things (IoT) towards Enhancing Operational Efficiency and User Satisfaction in Academic Libraries - Abubakar, Usman; Nura Mohammed Musa & Dr. Shehu. U. Mabera **341**

40. Integration of Artificial Intelligence Technologies in Libraries for Inclusive Information Provision in a Changing World - Vincent C. Opara (CLN); Doreen Ebelechukwu Omofomwan (CLN) & Ikegwuiro Patience Uloaku **349**

41. Integration of Big Data Analytics for Fraud Detection in Nigerian Financial Institutions: A Case Study of Central Bank of Nigeria, Kano Branch - ESEW, Michael; WHONG, Fidelia Mbowheing; LARNYOH, Wilhemina & OLUWATOBI Victor Ogunsemi **358**

42. Integration of Blockchain Technology for Library Security: Prospects and Challenges - Yusuf Bako & Abubakar Muhammad Sadauki **367**

43. Internet-Based Adaptive Pedagogies for Effective Utilization of Open Educational Resources: Enhancing Collaboration and Learning Communities among Distance Learners in the National Open University of Nigeria - Dr. Lucy Ndidiamaka Okonkwo; Dr. Angela Ebele Okpala; Dr. Mercy Enefu Okwoli & Babarotimi Opeyemi Oluwaseun **372**

44. Knowledge Management in Nigerian Libraries in the 5th Industrial Revolution - Prof. Basil Onyeoziri Edom CLN & DR. Eunice Uchechi Edom CLN **382**

45. Knowledge Sharing Strategies for Information Service Provision among Librarians in Military University Libraries in Northern Nigeria - Abdulwasiu Ahmad Ismail & Lawal Umar, PhD **389**

46. Leveraging 5th Industrial Revolution for Sustainable Library Tasks in Academic Libraries in Nigeria: The Place of Digital Inclusion - Stanley Omondiale Unuabor, Ph.D; Adekunjo Olalekan Abraham, CLN & Adedoyin Oluwatosin Esan, Ph.D **399**

47. Leveraging Chatbot for Service Delivery in the age of 5th Industrial Revolution: Awareness and Perspectives of Academic Librarians in Kwara State, Nigeria - Dr. Abdulmumin Isah & Dr. Mulikat Yetunde Abdulkareem **406**

48. Leveraging Open Educational Resources for Inclusive Education in the 5th Industrial Revolution - Mrs. Nwabunkeonye Nkechi Joy, CLN & Promise Chinyere Awa, CLN **413**

49. Leveraging the 5th Industrial Revolution for Sustainable Library Services Delivery - KAJANG, Victor S. (CLN); EGWUIBE, Martina O. (CLN); ZAKI, Suzanah D. (CLN) & IKEGWUIRO, Patience U. (CLN) **418**

50. Librarians' Perception in Leveraging on the 5th Industrial Revolution Technologies for Sustainable Rural Library Development - Vincent C. Opara; Gift Ihunanya Nwosu & Promise Chinyere Awa **423**

51. Librarians' Perceptions of the Opportunities and Challenges of Using Generative Artificial Intelligence (Gen AI) for Library Services in Nigeria - Kennedy Arebamen EIRIEMIOKHALE, Ph.D.; Florence Olabisi AJANI, Ph.D.; Shuaib Agboola OLARONGBE, Ph.D.; Abdulakeem Sodeeq SULYMAN; Bukola Olutola JAMES & Iskil Arisekola Bolaji **431**

52. Libraries as Dynamic Partners for the Future of Research and Development (R&D) - Ifeoma Abigail Ajie *Ph.D. CLN;* Ukoha O. Igwe *Ph.D., CLN &* Patricia Ngozi Ofodu *Ph.D (CLN* **441**

53. Library and Information Science Education and Training in the 5th Industrial Revolution: An Analytical Review - Prof. Katamba A. Saka; Hussaini Musa (PhD) & Musa Baba Adamu (PhD) **447**

54. Library and Information Science (LIS) Education and Training in Nigeria in the 5th Industrial Revolution: The Skills Requirements - Prof. Bappah Magaji Abubakar & Amina Suleiman Hamza (CLN) **456**

55. Library and Information Science Education and Training in the 5th Industrial Revolution - Nura Mohammed Musa; Abubakar Usman & Dr. S.U. Mabera **461**

56. Library Educators' Perceptions of Artificial Intelligence Technologies for Research Writing in Tertiary Institutions in South-South and South-East, Nigeria - Esther David Josiah Okai, PhD; Bolaji David Oladokun; Daniel Toriste O. Kolawole; Justice Nnamdi Okorie, PhD & John Obioma Okamgba **467**

57. Marketing Library and Information Services in the 5th Industrial Revolution - WHONG, Fidelia M. (PhD, CLN); GIMBA, Grace N. (CLN); ONUNKA, Okeoma (CLN) & KAJANG, Victor S. (CLN) **475**

58. Open Educational Resources in the 5th Industrial Revolution: Awareness and Utilization in two Selected Higher Institutions in Kaduna State - Yohanna, Zugwai Isah; Ikegwuiro, Patience Uloaku; Anate, Michael Gbenga & *Egwuibe, Martina O.* **479**

59. Open Educational Resources in the Fifth Industrial Revolution: A Review - Smart Eromosele Ambrose (Ph.D); Adedoyin Oluwatosin Esan (Ph.D) & Stanley Omondiale Unuabor (Ph.D) **487**

60. Open Science: Redefining the Role of Libraries as Hubs for Knowledge Justice and Innovation in the 5th Industrial Revolution - Ajayi Taiwo Bosede, PhD, CLN.; Ojo Joshua Onaade, PhD, CLN; Oyeniyi Wosilat Omolara, CLN & Otuyalo Atinuke Modupe, CLN. **495**

61. Preparing Librarians in Academic Libraries for the 5th Industrial Revolution in Delta State, Nigeria - Prof. Esoswo Francisca OGBOMO (CLN) **503**

62. Prospect of Artificial Intelligence (AI) on Library and Information Service Delivery in Academic Libraries - Maxwell, Ezinne Charity PhD (CLN) & Omoniyi, Olayinka Martins **513**

63. Readiness and Competencies of Librarians for Embracing the 5th Industrial Revolution in Nigeria - Ngozi Perpetua Osuchukwu & Victor Wagwu **522**

64. Regenerating Africa's Research and Scholarly Publishing Through A Systematic Review: What Does the Future Holds for 5IR? - Famuyiwa, Shola Temitope & Tella, Adeyinka **531**

65. Skills Development for Library and Information Science Sustainability in the 5th Industrial Revolution (5IR): A Survey - Abdulakeem Sodeeq SULYMAN; Aliyu Tsafe GADANGA, Ph.D; Kennedy Arebamen EIRIEMIOKHALE, Ph.D.; Shuaib Agboola OLARONGBE. Ph.D.; Idris Ibrahim SALEH & Dotun Emmanuel OLUSANYA **543**

66. Skills Gap Analysis for the Sustainability of Librarianship in the Era of the Fifth Industrial Revolution (5IR) - Yusuf Ayodeji AJANI; Roseline Ifeoma ECHEZONA & Abdulganiy Okanla AHMED **553**

67. Strategies for Empowering Information Professionals in the Fifth Industrial Revolution Era for Sustainable Library Services in Nigeria - Amina Suleiman Hamza (CLN) & Prof. Bappah Magaji Abubakar **565**

68. Sustainable Development Goals (SDGs) and the 5th Industrial Revolution: The Role of E-Libraries in Achieving a More Equitable Information Access - Idoko Nkechi Anthonia Ph.D, CLN, Jp; EDEH, Emmanuel Ekene (MLIS) & OBANDE, Bonnie Obeka (CLN) **573**

69. The 5th Industrial Revolution and the Future of Public Libraries in Nigeria: Benefits, Challenges ad Strategies - Maifata, Nurudeen Mu'azu (PhD); Enyi, Kingsley Emmanuel (PhD) & Philip Chike Chukwunonso Aghadiuno (PhD) **583**

70. The 5th Industrial Revolution and the Role of Artificial Intelligence in Academic Libraries: A Review - Yakubu Attahiru Liman, PhD; Jika, Saidu Muhammad PhD; Muhammad Modibbo Umar; Umar Shuaibu & Olusegun Victor Olaogun **593**

71. The Future of Information Literacy: Preparing Users for the Challenges of the 5th Industrial Revolution - Gift Ihunanya Nwosu (CLN) & Eberechi Ejuh **602**

72. Readiness of Libraries and Librarians for the 5th Industrial Revolution in Open and Distance Learning Environments - Smart Eromosele Ambrose; Ifeoma Abigail Ajie & Patricia Ngozi Ofodu **611**

73. The Rise of Robots in Library and Information Service Delivery: Essential Skills and Knowledge for Librarians in the Era of Industry 5.0 - Lawal Umar; Bolaji David Oladokun & Charity Ezinne Maxwell **626**

74. The Role of Artificial Intelligence in Enhancing Research Productivity: A Systematic Literature Review - Umar Shuaibu; Yakubu Attahiru Liman, PhD; Jika, Saidu Muhammad, PhD; Hussaini Mathias; Abubakar Umar & Shuaibu Adamu **634**

75. The Use of Resources in Teaching Organization of Knowledge in the Digital Era in Library Schools in South West, Nigeria - Samuel Oke Ogunniyi, Ph.D; Olabode Olajide, Ph.D & Rotimi Adesina Egunjobi, Ph.D **642**

76. Transformative Initiatives for Health Librarianship Service Delivery through Digital tools in Selected University teaching hospitals in Nigeria - Yemisi Oluremi OLADAPO (PhD) & Prof. Adeyinka TELLA **651**

77. Transforming Librarianship and Information Service Delivery in the 5th Industrial Revolution through Innovative Technology: A Case Study of Donald Ekong Library, University of Port Harcourt - Victor Wagwu PhD (CLN); Caroline A. Okoro PhD (CLN) & Angela Ebele Okpala PhD (CLN) **662**

78. Transforming Librarianship and Information Service Delivery through Innovative Technologies - KAJANG, Victor S. (CLN); OBUEZIE, Adaora C. (PhD) & ABDULAZIZ, Hadiza A. (CLN) **670**

79. Transforming Librarianship and Information Services Delivery in the era of 5th Industrial Revolution: Prospects and Implications for the Future - Dr. Mulikat Yetunde Abdulkareem & Dr. Abdulmumin Isah **675**

80. Transforming Library and Information Services Delivery Through Innovative Technology: Trends and Opportunities - Abubakar Muhammad Sadauki & Yusuf Bako **680**

81. Up-Skilling Libraries and Information Science Professionals for the 5th Industrial Revolution - Caroline A. Okoro PhD (CLN); Ngozi Perpetua Osuchukwu PhD(CLN) & Ihuoma Sandra Babatope PhD((CLN)) **685**

82. Utilisation of 5th Industrial Revolution Technologies for Information Service Delivery in University Libraries in Rivers State - Dr. Juliet C. Alex-Nmecha & Dr. Oluchi C. Okeke **692**

A Revolution without Evolution? The 5th Industrial Revolution, Artificial Intelligence, and Inclusive Library and Information Services

[1]Abdurrahman Bello Onifade; [2]Juliet Chinedu Alex-Nmecha
National Open University of Nigeria, Lagos; Rivers State University, Port Harcourt

Abstract

The 5th Industrial Revolution (5IR) is characterised by the convergence of artificial intelligence (AI) and human-centred innovation, posing both opportunities and challenges for library and information service delivery. While AI has the potential to revolutionise library services by enhancing accessibility, efficiency, and inclusivity, its successful implementation requires a fundamental shift in skills, infrastructure, and professional readiness. The purpose of this study is to contribute to the discourse on sustainable AI adoption and inclusive library and information services in Nigeria within the 5IR revolution. This study explored whether Nigerian librarians and information professionals are adequately prepared for this transformation, questioning if the revolution is occurring with(out) the necessary evolution in policies, infrastructures, skills, and practices. The study used a mixed-methods approach and adopted a descriptive survey research design to assess the awareness, barriers, skills and training needs associated with AI adoption in the delivery of library and information services, specifically in academic libraries. Questionnaires and interviews were the instruments for data collection. Quantitative data collected were analysed using descriptive statistics while qualitative insights were thematically analysed to provide deeper perspectives on the phenomena. Both datasets were triangulated to identify the areas of convergence and divergence. The findings from the study will reveal the extent of AI integration in academic libraries in Nigeria, the barriers to its adoption, and the level of inclusivity in AI-driven services. The study will provide recommendations for capacity-building initiatives, policy frameworks, and technological investments needed to bridge the gap between the ongoing revolution and librarians' preparedness. The findings revealed that while awareness of AI is relatively high among librarians, particularly in federal and private universities, and some academic libraries have begun AI integration into library and information services, such as cataloguing and resource selection, a lack of trained staff and institutional funding, infrastructural deficits, poor internet connectivity and unreliable power supply remain critical barriers to its adoption. The study recommended that public-private partnerships be explored to stimulate infrastructural development and structured training initiatives be institutionalized for librarians and information professionals to equip them with advanced knowledge and skills to evolve through the AI revolution.

Keywords: Artificial Intelligence (AI), 5th Industrial Revolution (5IR), Inclusive Librarianship, Information Services

1. Introduction

The Fifth Industrial Revolution (5IR) signifies a transformative era defined by the harmonious integration of artificial intelligence (AI) and human expertise, prioritising societal well-being alongside technological progress (Mourtzis, 2021). Unlike past industrial revolutions which emphasised automation and industrial efficiency, the 5IR centres on human-machine collaboration, ensuring that advancements in AI and digitalisation promote inclusive growth, ethical innovation, and equitable access to knowledge (Özdemir & Hekim, 2018; IFLA, 2020). This paradigm shift has profound implications for library and information services (LIS), as AI presents opportunities to enhance service delivery, optimise workflows, and expand accessibility for diverse user groups (Cox, 2023).

There are signals that AI-driven technologies, such as intelligent chat-bots, automated metadata generation, and predictive analytics, can revolutionise routine operations within the field of LIS (Deng, 2022). For instance, AI-powered tools can streamline cataloguing processes, reducing manual labour while improving accuracy (Yang *et al.,* 2025). Additionally, natural language processing (NLP) systems enable voice-assisted search functionalities, making libraries more accessible to visually impaired and differently abled patrons (IFLA, 2024). Furthermore, machine learning algorithms have been used to facilitate personalised content recommendations, tailoring services to individual user preferences and enhancing engagement (Jansen *et al.,* 2020). However, the successful implementation of these AI-driven innovations depends on supportive institutional policies, adequate infrastructures, and staff professional readiness, especially in terms of skills and embracing change, factors often lacking in academic settings of developing societies like Nigeria.

In Nigeria, academic libraries face significant challenges in adopting AI, such as limited funding, inconsistent power supply, and a shortage of required digital skills among librarians and information professionals (Adeleke & Olorunsola, 2021). While global trends have shown rapid AI integration in LIS, Nigeria's progress remains slow, raising concerns about the possibility of a widening digital divide (Oyediran-Tidings et al., 2022). Without strategic interventions by stakeholders in the LIS field, especially in academic libraries, the country risks experiencing a “revolution without evolution”; a situation whereby advancements in AI overtake institutional capacity, leaving libraries, their custodians and users behind (Eke, 2023). Therefore, this study investigates whether Nigerian librarians and information professionals adequately evolve with the transition happening through this revolution and how inclusive, sustainable AI adoption can be achieved in academic libraries.

1.2 Statement of the Problem

The 5IR presents an unprecedented opportunity for libraries to leverage AI for improved service delivery, yet its realisation in Nigeria remains uncertain due to several systemic challenges. While AI has demonstrated significant potential to enhance efficiency, accessibility, and inclusivity in academic libraries globally, uncertainties characterise the meaningful adoption of AI in Nigeria, revealing critical gaps that need to be practically filled. The Federal Government of Nigeria, through the National Centre for Artificial Intelligence and Robotics (NCAIR) and the National Information Technology Development Agency (NITDA), acknowledges that AI can catalyse new possibilities for economic development, but also creates unique challenges for governments, particularly in areas such as ethical applications, algorithmic transparency, data privacy and potential labour market displacements (NCAIR, 2024). A primary concern is the skills deficit among librarians and information professionals, with many lacking adequate trainings in AI applications, data analytics, and digital literacy, which are essential for navigating the evolving information landscape (Nwosu et al., 2023). This issue is compounded by the absence of comprehensive policy frameworks that govern AI implementation in library and information services (LIS), leaving libraries without clear guidelines for technological integration (Adeyemi & Adetoro, 2022). Furthermore, persistent infrastructure challenges, including erratic power supply, poor internet connectivity, and chronic underfunding, create substantial barriers to AI adoption, limiting the capacity of librarians and information professionals to harness these innovations effectively (Olanrewaju & Ajayi, 2021). This study therefore seeks to investigate whether library and information services in academic libraries in Nigeria are genuinely evolving with the transformation revolution of AI or superficially rhetorical of digital transformation without the necessary parallel evolution in policy development, infrastructural support, and professional skills. This is to ensure that the revolution does not exacerbate existing inequalities in information access, thereby undermining the inclusive potential of AI-driven library and information services in the country.

1.3 Research Questions

This study is guided by the following research questions:

1. What is the current level of awareness among Nigerian librarians regarding AI-driven library services?
2. What are the most critical barriers inhibiting AI adoption in Nigerian academic libraries?
3. To what extent do Nigerian librarians possess the necessary digital skills to implement AI technologies in library services?
4. What strategies can Nigerian academic libraries employ to design inclusive AI-powered services?

1.4 Significance of the Study

This study holds important implications for multiple stakeholders in Nigeria's library and information sector. First, it provides critical insights for policymakers by identifying gaps in current regulatory frameworks and infrastructure needed to support AI integration in libraries. The findings will inform the development of national AI policies tailored to library contexts, addressing issues of digital equity and technological access. For library professionals, the research contributes to ongoing professional development initiatives by pinpointing specific skill gaps in AI literacy and data management. The results will guide training programmes to equip librarians with competencies needed for 5IR readiness, ensuring they can effectively harness emerging technologies while maintaining inclusive service standards.

Furthermore, the study is significant in revolutionising library and information service delivery in Nigeria, highlighting practical strategies to balance technological advancement with equitable access. Specifically, through an in-depth examination of barriers to AI adoption, the research provides insights into how the implementation of AI-powered services can accommodate diverse user needs, including users with disabilities. Additionally, the study bridges theoretical discussions about the 5IR with practical applications in Nigeria's library and information sector. The mixed-methods approach adopted in this study offers valuable quantitative and qualitative insights into challenges and culturally appropriate implementation strategies, making it relevant for different developing societies.

2. Literature Review

2.1 An Overview of the 5th Industrial Revolution (5IR)

The concept of 5th Industrial Revolution is a future-forward industrial transformation where human creativity and empathy are paired with intelligent systems to create value in more socially responsible and meaningful ways. The 5IR recognises that while automation and AI can optimise processes, human intuition, ethics, and emotional intelligence remain irreplaceable assets. Thus, 5IR strikes a balance between high-tech development and high-touch engagement; considering humans as partners working in diverse organisations (George & George, 2020). In the 5IR, humans and robots work collaboratively to advance human well-being in different areas, based on various characteristics. These characteristics include the energy revolution and a highly sophisticated organisational culture where collaborative robots (cobots) are deployed to carry out routine activities, make decisions and primarily improve the quality and production processes of organisations (Pathak et al., 2019; Shijia, 2021). This innovative development represents a unique opportunity for advanced human–machine systems to promote a dynamic evolution characterised by unprecedented progress.

While the Fourth Industrial Revolution (4IR) championed hyper-connectivity of smart devices that connect humans across most parts of the globe, the 5IR amplifies and streamlines this connectivity by substituting smart devices with brain-computer interfaces, indicating an evolutionary change in human engagement with technological innovations (Noble et al., 2022; Noack, 2020). Particularly, the 5IR holds a potential to empower humanity with advanced technological solutions needed to address different global challenges, creating a viable socioeconomic society where sustainable development is achievable with access to inclusive information infrastructures and services (Ziatdinov et al., 2024). The human-AI collaboration focus differentiates 5IR from previous industrial revolutions by prioritising augmentation over automation and placing societal wellbeing alongside economic growth as key outcomes (Mourtzis, 2021).

A central concept to the 5IR is the emphasis on human-centred design, which considers technological advancement as a tool for enhancing human potential rather than merely optimising productivity (Nahavandi, 2019). This design approach comes in several ways, such as adaptive interfaces that learn from human behaviour, AI systems that complement human decision-making, and technologies designed to address inequality rather than exacerbate it (Buhalis et al., 2022). The 5IR design is particularly invaluable to service-oriented institutions like libraries, where the human-centric approach of the 5IR aligns with the values of equitable access and knowledge democratisation while delivering library and information services (Adeyemi & Adetoro, 2022; Buhalis et al., 2022).

2.2 AI Applications in Library and Information Services

The integration of artificial intelligence (AI) in library and information services has transformed the traditional operations of acquisition, organisation and dissemination, enhancing both efficiency and user experience. Automated systems, such as AI-powered cataloguing and classification tools, have significantly reduced manual workloads while improving accuracy in metadata generation (Yang et al., 2025). Machine learning algorithms can analyse vast collections to auto-tag resources, predict acquisition needs, and detect outdated materials, streamlining collection management (Deng, 2022). Similarly, chatbot technologies have been implemented in academic libraries in the United States and Singapore, to provide 24/7 reference services, handling routine queries while freeing librarians for complex user consultations (Jansen et al., 2020). These AI tools demonstrate great potential to optimise workflows when adopted in resource-constrained environments like Nigeria (Eke, 2023).

Beyond operational improvements, AI has created more innovative solutions for inclusive library and information service delivery. The use of natural language processing (NLP) systems has enabled multilingual search functionalities and broken language barriers for non-native speakers (IFLA, 2024). Library and information projects that include assistive technologies, such as voice-to-text converters and screen readers powered by AI, have made libraries more accessible to visually impaired users (Cox, 2023). For instance, the AI4All initiative in South African libraries has demonstrated valuable results, showcasing how locally adapted AI tools can improve accessibility for marginalised communities (Oyediran-Tidings et al., 2022). However, such advancements require robust infrastructure and digital literacy, areas where many academic libraries in Nigeria lag due to insufficient skills, irregular internet access and unreliable power supply (Adeleke & Olorunsola, 2021).

There is a distinct pattern to follow in AI adoption in libraries, which has shown disparities between the Global North and South. While academic libraries in developed economies have leveraged predictive analytics for personalised recommendations and robotic process automation for administrative tasks, libraries in developing societies often face systemic barriers (Yang et al., 2025). A 2023 IFLA report highlighted that only 12% of African libraries have implemented AI-driven services, compared to 68% in North America (Cox, 2024). This gap underscores the need for contextualised approaches that consider local challenges, such as funding shortages and skill gaps among staff (Nwosu et al., 2023). Case studies from Kenya and India suggest that low-cost, scalable AI solutions, such as offline-accessible chatbot systems could offer viable pathways for Nigerian libraries (Eke, 2023; Oyediran-Tidings et al., 2022).

2.3 Implementation Challenges

The adoption of artificial intelligence (AI) in library and information services faces significant implementation barriers, particularly in resource-constrained environments like Nigeria. A primary challenge lies in the digital skills gap among library and information professionals. Recent studies reveal that only 23% of Nigerian librarians possess basic competencies in AI applications or data analytics, with even fewer trained in emerging areas like machine learning or natural language processing (Nwosu et al., 2023). This skills deficit is compounded by inadequate professional development opportunities, as most continuing education programmes focus on traditional librarianship rather than technological competencies (Adeyemi & Adetoro, 2022). Without targeted training initiatives guided by institutional policies and governance frameworks, this knowledge gap can exacerbate existing inequalities in service delivery.

The lack of policy and governance structure for AI adoption in Nigeria's library and information sector is another challenge threatening its implementation. Nigeria currently lacks specific guidelines for implementing these technologies in library institutions, unlike more technologically advanced nations that have developed comprehensive frameworks for AI integration in library and information services (Adeyemi & Adetoro, 2022). This policy vacuum creates uncertainty around key issues such as data

privacy, algorithmic bias, and intellectual property rights, which are critical considerations when deploying AI-driven services (Deng, 2022). Without clear regulatory standards, libraries may remain hesitant to invest in AI solutions, fearing potential ethical or legal repercussions (IFLA, 2024). The absence of coordinated national strategies also means individual institutions must navigate these challenges independently, leading to fragmented, conflicting and often unsustainable approaches to technological innovation (Eke, 2023).

Furthermore, the limitations of infrastructure present another critical barrier to AI integration in Nigerian academic libraries. While many academic libraries in Nigeria are built with aesthetic ambience, there are infrastructural challenges that impede the deployment of AI technologies and services, such as erratic electricity supply, limited bandwidth, and outdated hardware systems (Olanrewaju & Ajayi, 2021). A 2022 survey of 15 Nigerian university libraries found that 87% experienced daily power outages, while 63% lacked the minimum computing resources needed to run basic AI applications (Adeleke & Olorunsola, 2021). These systemic infrastructure deficits not only hinder initial implementation but also undermine the sustainability of any AI initiatives, as maintenance and upgrades become financially unaffordable for most institutions (Oyediran-Tidings et al., 2022).

2.4 Case Studies of AI Adoption in Comparable Contexts

Examining practical implementations of artificial intelligence (AI) in libraries across comparable environments provides valuable insights for Nigerian institutions. In Kenya, the Jomo Kenyatta University of Agriculture and Technology pioneered an AI-assisted chatbot service in 2021 to handle frequently asked questions, achieving a 40% reduction in routine staff workload while maintaining 92% user satisfaction rates (Jebet & Gichugu, 2025). This system, built using open-source tools and trained on local language datasets, demonstrates how cost-effective AI solutions can address resource constraints common across African institutions (Balnaves, 2024). Similarly, the University of Cape Town experimented the use of machine learning for automated subject indexing of African scholarly content, achieving 85% accuracy while significantly improving discoverability of local research outputs (Brokensha et al. 2023). These case studies illustrate how carefully targeted AI applications can yield substantial benefits for effective delivery of library and information services without requiring extensive infrastructure.

Within Nigeria academic libraries, emerging AI pilot projects reveal both possibilities and challenges. For instance, the University of Lagos has experimented with computer vision for rare book preservation, which achieved promising results but revealed the shortage of specialised technical staff capable of maintaining such systems (Mitric et al., *2024)*. Likewise, the University of Lagos library has deployed cloud-based intelligent humanoid robots with capacities to do face recognition, book shelf management, surveillance technology, open API, data management, advert & promotion, research, customizable entry validation; yet, there are indications that library management needs to undertake extensive awareness campaigns about the AI robots among patrons to ensure significant influence (UNILAG, 2020; Adekanye, 2024). Additionally, Covenant University's AI-powered recommendation system, integrated with their institutional repository, increased faculty publication usage by 22% within six months (Adeleke & Olorunsola, 2021). However, the CU project also encountered significant hurdles, including frequent power outages that disrupted machine learning processes and necessitated expensive backup systems. These experiences pinpoint the importance of aligning AI ambitions with local capacity and infrastructure realities.

A comparative analysis of AI adoption in library and information service delivery has shown that successful implementations of AI should begin with carefully defined problems rather than attempting comprehensive AI overhauls (Balnaves, 2024). Also, AI solutions that leverage open-source tools and local language datasets prove more sustainable than proprietary systems; and this effectiveness of such solutions rely on substantial staff training components alongside technological deployment (Patel & Kumar, 2023; Brokensha et al. 2023). These patterns suggest that the path to AI integration should prioritise targeted, context-sensitive applications over ambitious system-wide transformations.

3. Methodology

This study employed a mixed-methods research design to comprehensively examine AI revolution vis-à-vis staff evolution in Nigerian academic libraries. Quantitative data were collected through structured questionnaires, developed with Google Forms and received 25 responses from librarians across various institutions [See Table 1]. These data were analysed using descriptive statistics (frequencies, percentages) to identify patterns and trends in AI adoption. Qualitative insights were obtained through semi-structured interviews with three purposively selected professionals (a federal university librarian, a state university librarian, and a departmental head in a private university), which explored institutional challenges, policy gaps, and implementation strategies in greater depth. While the limited sample size affects generalisability, the purposive selection of information-rich cases and methodological triangulation strengthen the study's credibility. The three-week data collection period (3 – 25 April, 2025) enabled iterative analysis, where preliminary questionnaire findings informed interview probing, creating a dynamic feedback loop between quantitative and qualitative data streams.

The interviews, lasting 30-45 minutes each, were transcribed and analysed thematically to identify recurring concepts and institutional perspectives. The interviews were grounded in ethical considerations, such as obtaining informed consent, ensuring participant anonymity, and securing data storage. The integration of both data types followed a complementary approach, where quantitative results established trends while qualitative findings provided deeper, contextual explanations. Similarly, thematic analysis of interviews helped interpret statistical anomalies in the survey data.

4. Results

4.1 Quantitative Results

Table 1: Type of institution

Institution	Response Rate (%)
College of Education	2 (8%)
Federal Universities	11 (46.2%)
State Universities	4 (16%)
Private Universities	5 (20%)
Polytechnic	3 (12%)

The data in Table 1 shows the distribution of respondents by type of institution. The highest response rate came from federal universities, accounting for 46.2% of the total respondents. This was followed by private universities with 20%, state universities with 16%, and polytechnics with 12%. Colleges of education had the lowest response rate, contributing 8% of the responses. This distribution highlights a stronger representation of librarians from federal universities in the study.

4.1.2 Current Level of AI Awareness among Librarians and Information Professionals in Academic Libraries (RQ1)

Table 2: Overall Awareness of AI Applications

Familiarity Level	Percentage (%)
Extremely/Very familiar	32%
Moderately familiar	41%
Slightly/Not familiar	27%

The data presented in Table 2 reveal overall awareness of AI applications appears relatively high, with a combined 73% of respondents indicating they are either extremely, very, or moderately familiar with AI. Specifically, 32% report being extremely or very familiar, while 41% are moderately familiar. However, a notable 27% of the respondents remain slightly or not familiar at all with AI, suggesting there is still a considerable knowledge gap within the academic libraries.

Table 3: Awareness by Types of Institution

Institution	Very/Extremely Familiar
Federal Universities	38%
Private Universities	24%
State Universities	20%
Polytechnics	13%
Colleges of Education	5%

When broken down by institution type as shown in Table 3, familiarity levels vary significantly. Respondents from federal universities show the highest levels of awareness (38% very/extremely familiar), followed by those from private universities (24%). In contrast, polytechnics and colleges of education report lower levels of familiarity, at 13% and 5% respectively. This indicates a potential disparity in exposure to AI technologies based on institutional affiliation.

Table 4: Familiarity with Specific AI Technologies

Technology	Very/Extremely Familiar
Chatbots/Virtual Assistants	52%
AI-Powered Search Engines	45%
Automated Metadata	38%
Predictive Analytics	29%
OCR Technologies	21%

In terms of specific AI technologies as shown in Table 4, chat-bots/virtual assistants are the most widely recognised, with 52% of respondents indicating high familiarity. AI-powered search engines (45%) and automated metadata generation tools (38%) also show notable awareness. However, more advanced or specialised tools such as predictive analytics (29%) and OCR technologies (21%) are less well-known, pointing to a need for targeted training and awareness initiatives in these areas.

4.1.2 Critical Barriers to AI Adoption (RQ2)

Table 5: Top Barriers to AI Implementation

Barrier	Percentage Rating as Critical/Significant
Lack of trained staff in AI	18 (72%)
Resistance to change	15 (60%)
Poor internet connectivity	13 (52%)
Unreliable power supply	13 (52%)
Lack of funding	12 (48%)

The data in Table 5 reveal that the most critical impediment to AI implementation across all types of institutions is a lack of trained staff in AI, cited by 18 (72%) of the 25 respondents; followed closely by resistance to change 15 (60%). Furthermore, over half of the respondents highlighted unreliable power supply and poor internet connectivity at 15 (64%) respectively as major obstacles. Notably, lack of funding, while still significant at 12 (48%), ranks lowest among the identified barriers, suggesting that financial resource concerns may be secondary to other barriers.

In Table 6 below, polytechnics reported the highest challenge, with 80% citing poor internet connectivity as the most severe barrier. Similarly, state universities struggle predominantly with unreliable power supply 72%, stressing infrastructural limitations in public institutions.

Table 6: Most Severe Barriers by Type of Institution

Institution	Most Severe Barrier	Percentage
Federal University	Lack of trained staff	60%
Private University	Lack of funding	75%
State University	Unreliable power supply	72%
Polytechnic	Poor internet connectivity	80%

In contrast, private universities primarily face financial constraints, with 75% identifying lack of funding as their key challenge, possibly a reflection of less access to public funding support. Meanwhile, federal universities are most affected by the shortage of trained personnel 60%, pointing to a skills gap despite their broader institutional reach. These institutional differences indicate that tailored interventions are necessary to address the unique challenges within each type of institution.

4.1.3 Skill Level and Training Required for AI Adoption in Academic Libraries (RQ3)

Table 7: Self-Reported Skill Levels

Skill Area	Percentage Rating as Skilled/Very Skilled
Basic computer literacy	85%
Data literacy & analysis	63%
AI tool evaluation	47%
Generative AI applications	42%
Machine learning basics	28%

Table 6 shows that while basic computer literacy is nearly universal at 85%, proficiency drops notably as the skills become more specialised. Data literacy and analysis rank second (63%), suggesting a moderate level of competency in handling information. However, fewer respondents feel confident in skills directly related to artificial intelligence, with only 47% and 42% rating themselves as skilled or very skilled in AI tool evaluation and generative AI applications respectively. The strongest decline is seen in machine learning basics, with just 28% reporting confidence, indicating a significant gap in advanced technical knowledge necessary for effective AI integration in library and information services.

Table 8: Most Requested Training Areas

Training Need	Percentage Selecting as Top 3 Need
Introduction to AI in libraries	89%
Data analytics for decision-making	76%
AI-powered cataloguing	71%
Chatbot implementation	65%

The overwhelming majority of respondents (89%) as shown in Table 8 identified "Introduction to AI in libraries" as one of their top three training needs, reflecting a widespread interest in building basic AI literacy. This is closely followed by training in "data analytics for decision-making" (76%); and AI-powered cataloguing (71%) and chatbot implementation (65%), suggesting that professionals are eager to adopt and utilise AI tools that enhance operational efficiency and user engagement.

4.1.4 Inclusive AI Design for Library and Information Services in Academic Libraries (RQ4)

Table 9: Priority Features for Inclusive AI in Academic Libraries

Feature	Percentage Rating as Very/Extremely Important
Accessibility features	82%
Multilingual support	68%
Low-bandwidth functionality	65%
Screen reader compatibility	63%

Data in Table 9 reveal that accessibility features emerged as the highest-rated priority (82%) in ensuring inclusive design in AI tools for library and information services. Multilingual support (68%), low-bandwidth functionality (65%), and screen reader compatibility (63%) were also regarded as essential, indicating the need for AI systems to cater to diverse linguistic backgrounds, infrastructural limitations, and usability by individuals with visual impairments. These findings highlight a commitment among librarian and information professionals to ensuring AI implementations prioritise inclusivity and digital equity, especially for users with special needs.

Table 10: Preferred Training Formats

Format	Percentage Preference
In-person workshops	65%
Online courses	25%
Self-paced modules	7%
Mentorship programs	3%

Table 9 data reveal that in-person workshops are the most preferred training format among respondents, with 65% favouring this hands-on, interactive approach. Online courses follow at a distant 25%, reflecting some openness to virtual learning, though not as strongly endorsed. Self-paced modules (7%) and mentorship programmes (3%) received significantly lower preference, suggesting that participants prefer structured and communal learning experiences to independent or one-on-one alternatives. These insights indicate a general leaning towards face-to-face, guided training environments for skill development in AI applications.

4.2 Qualitative Results

4.2.1 AI Awareness among Librarians and Information Professionals in Academic Libraries

The respondents interviewed demonstrated awareness and a clear understanding of AI as a tool for enhancing library efficiency rather than replacing human expertise. One described AI as "a speeding up of services using technology," while another stated that, "*AI has come to stay... it's just for librarians now to adapt and use it side by side with their skills*." This perspective reflects growing awareness among academic librarians of the need to integrate AI meaningfully into professional routines. Likewise, AI is gradually being incorporated into library operations, especially in technical services and bibliographic search. One of the respondents reported using ChatGPT to support cataloguing and resource selection, stating that "*We query ChatGPT to provide us with the classification scheme... but we still do checks using the Library of Congress catalogue*"; while another librarian referenced AI tools for literature searches, although institutional-level integration remains limited: "*We probably may not have started using AI as extensively as some other institutions*."

4.2.2 Barriers to AI Adoption in Academic Libraries

The librarians identified a skills gap among staff and infrastructure challenges as major barriers to AI adoption in academic libraries. One librarian stressed the need for more expertise among librarians to avoid policy violations, noting that "*If you don't know the right way to use AI tools, you run will foul of policy issues.*" Another respondent observed that due to limited institutional sponsorship, many librarians had not received recent training: "*Many only have first degrees and haven't been trained in years.*" Also, one participant argued that infrastructural deficit undermines the desire to adopt AI for library and information services, arguing that "*Policies aren't the problem—funding and internet are…MTN connectivity works everywhere except the library*."

4.2.3 Skills and Required Training

The librarians agreed that up-skilling through training initiatives is required across institutions in Nigeria; although the approach varies depending on each institution's priorities regarding staff development. For example, some institutions place greater emphasis on academic or administrative staff training and allocate fewer resources to professional development for library personnel. As a result, librarians in such institutions are often left to seek learning opportunities independently. "*The school doesn't sponsor us for workshops... Librarians take it upon themselves to seek training*," one disclosed. Another librarian stated that while the skill gap and inadequate funding to support staff training persist, they

have decided to have an in-house bi-weekly "*up-skill hour*" to ensure staff are abreast of library trends and skilled in using AI for library services. Additionally, respondents emphasised the need for training for librarians, and specifically noted the necessity to enhance the analytical, search, and verification skills in the use of AI in academic libraries. As stated by the librarians, AI tools "can't replace critical thinking," and one emphatically said that: "*Even when AI returns results, I still do checks" because "the essence is to reduce stress, not replace our work*".

4.2.4 Inclusive AI Design and Services

The response from the librarians reveals that inclusivity remains a concern, especially in AI tool design. One librarian advocated for the acquisition of assistive technologies, the employment of staff trained in special education, and called for local language support and the development of inclusive collections, stating: "*Libraries must include users usually neglected, elderly patrons or those with health challenges.*" However, another librarian criticised AI's limited accessibility, arguing that "*AI tools are not inclusive enough... They should cater to the visually or hearing impaired.*"

5. Discussion of Findings

The results indicate a moderate to high level of awareness of AI applications among librarians, with 73% of respondents reporting being either moderately or extremely familiar with AI tools. Federal universities recorded the highest familiarity levels, while colleges of education and polytechnics lagged significantly. This trend is consistent with the study of Adeleke & Olorunsola (2021) which suggests that institutional type and access to technological resources could influence AI awareness. Meanwhile, the higher familiarity among federal institutions may be attributed to relatively better funding, access to training, and exposure to research-driven environments compared to other types of institution. In terms of specific AI tools, chatbots and AI-powered search engines were the most familiar technologies among respondents, aligning with Jebet and Gichugu (2025) who noted that these tools are among the most adopted AI applications in library settings due to their direct utility in streamlining reference processes and enhancing user services. However, the declination in familiarity with more complex tools such as machine learning and predictive analytics reflect gaps in advanced AI knowledge.

Qualitative responses further validated these trends. Librarians demonstrated conceptual awareness of AI's role in enhancing, rather than replacing, professional functions. The statement that "AI has come to stay... it's just for librarians now to adapt and use it side by side with their skills" echoes the view of Buhalis *et al.* (2022) that AI is a complement rather than a replacement for human expertise. However, the limited institutional-level AI implementation noted by participants underscores the need to fill current gap between awareness and actual adoption, which is in congruence with the study of Nwosu *et al.* (2023).

5.2 Barriers to AI Adoption

The most critical barrier identified was the lack of trained staff in AI, followed by resistance to change, poor internet connectivity, unreliable power supply, and lack of funding. This hierarchy of challenges resonates with the findings of Adeyemi and Adetoro (2022), who observed that infrastructural and human capital deficits remain the most pressing impediments to digital transformation in Nigerian libraries. Notably, while funding is often cited as a primary challenge in existing literature, this study found it to be comparatively less severe than technical and skills-related barriers—suggesting that even where limited funds exist, the greater challenge may lie in optimally deploying those resources for training and systems development.

Institution-specific barriers also reflected this complexity. Federal universities primarily struggled with human resource gaps, whereas private institutions were more constrained by funding. State universities and polytechnics reported infrastructural limitations such as power and connectivity as their most severe obstacles. These findings lend credence to Olanrewaju and Ajayi's (2021) argument that library innovation strategies should be context-sensitive and reflect local institutional realities. As one interviewee noted, "Policies aren't the problem—funding and internet are," highlighting how systemic issues outside of the library's control can hinder even well-intentioned innovation efforts.

5.3 Skill Levels and Training Needs

The study found high basic computer literacy among respondents but declining competence in AI-specific skills such as AI tool evaluation and machine learning basics. These findings echo those Nwosu *et al.* (2023), who argued that the limited capacity of staff to engage with emerging technologies can lead to digital exclusion within academic libraries. While librarians appear to possess foundational ICT skills, they remain underprepared for the demands of AI-driven environments, a gap which underscores the need for ongoing professional development. The most requested training areas—"Introduction to AI in libraries" and "Data analytics for decision-making"—further support this observation. These priorities reflect librarians' awareness of the relevance of AI and their willingness to build capacity in this domain. Interview narratives reinforced this enthusiasm but also highlighted institutional neglect in supporting library staff development. For instance, a respondent lamented: "The school doesn't sponsor us for workshops... Librarians take it upon themselves to seek training." This shows that professional development opportunities for librarians are often inconsistently provided and rely heavily on personal initiative. Moreover, the preference for in-person workshops suggests a strong inclination toward collaborative, guided learning environments, indicating that practical, workshop-based training yielded more effective learning outcomes among librarians than online or self-paced methods.

5.4 Inclusivity in AI Design

Inclusivity was recognised as a significant consideration for AI tool design in academic libraries. Accessibility features, multilingual support, and low-bandwidth functionality were rated highly, suggesting that librarians are attuned to the diverse needs of their user populations. This is congruent with global best practices as outlined by IFLA (2019), which emphasises inclusivity and accessibility as core principles in the digital transformation of library services. The qualitative findings enriched this perspective, with respondents advocating for tools that support local languages, users with visual impairments, and elderly patrons. However, criticism was also levelled at current AI tools for not being adequately inclusive, echoing the caution that most AI platforms are still designed without the needs of the Global South in mind. One respondent's statement that "AI tools are not inclusive enough... They should cater to the visually or hearing impaired" is a stark reminder of the digital divide and the necessity for culturally and infrastructurally appropriate AI systems.

Summarily, while awareness and enthusiasm for AI are steadily growing among academic librarians and information professionals, infrastructural deficits, skill gaps, and the need for more inclusive AI designs remain significant barriers that must be addressed through targeted policy interventions and sustained professional development initiatives.

Table 10: Triangulation Matrix

Theme	Quantitative Findings	Qualitative Findings	Convergence/Divergence
Awareness of AI among librarians	73% of respondents reported being extremely, very, or moderately familiar with AI; federal universities showed the highest awareness (38%).	Librarians described AI as a tool to "speed up services" and viewed it as complementary to human expertise. Some noted limited institutional-level AI use.	High individual awareness but limited institutional adoption highlighted in both datasets.
Barriers to AI adoption	Top barriers identified: unreliable power supply (68%), poor internet connectivity (62%), lack of trained staff (55%), and funding issues (53%).	Interviewees emphasised poor infrastructure (e.g., internet issues inside libraries), lack of training, and funding limitations. Ethical concerns about	Both datasets pointed to infrastructural and skill-related barriers rather than resistance to change.
		untrained AI use were raised.	
Skill levels and training needs	High basic computer literacy (85%), lower proficiency in AI-specific skills (e.g., AI tool evaluation 47%, generative AI use 42%). Training needs prioritised: introduction to AI (89%) and data analytics (76%).	Librarians noted that institutional support for training is often absent. Personal responsibility and in-house initiatives like "up-skill hour" were mentioned. Emphasis was placed on using AI to support, not replace critical thinking.	Quantitative skill gaps matched qualitative emphasis on lack of structured training opportunities; and a need for adaptive strategies emerged.
Priorities for inclusive AI design	Key features needed: accessibility (82%), multilingual support (68%), low-bandwidth functionality (65%).	Librarians advocated for assistive technologies, support for disabilities, and more inclusive AI systems. Criticism of current AI tools' lack of inclusivity was expressed.	Strong alignment on the necessity for inclusive and accessible AI tools.

6. Conclusion

This study has provided insights into the current situation of AI adoption in academic libraries in Nigeria, revealing progress and extant challenges. While awareness of AI applications is relatively high among librarians, particularly in federal and private universities, significant disparities exist across other types of institution, with polytechnics and colleges of education lagging behind. The integration of AI into library and information services, such as cataloguing and resource selection, demonstrates its evolving potential to enhance efficiency. However, infrastructural deficits, including unreliable power supply and poor internet connectivity, remain critical barriers, exacerbated by a lack of trained staff and institutional funding. These findings underline the need for a coordinated approach to ensure AI revolution is accompanied by adequate evolution across academic libraries.

7. Recommendations

To address these challenges, the following recommendations are proposed:

1. Targeted Infrastructure Investment: Government and institutional stakeholders should prioritise improving power and internet connectivity, particularly in state-owned institutions, where infrastructural gaps are most severe. Public-private partnerships could be explored to subsidise costs and ensure sustainable solutions.

2. Structured Training Programmes: Librarians and information professionals require systematic training initiatives tailored to meet their varying skill levels; from introductory AI literacy to advanced areas predictive analytics and like machine learning. Given the strong preference for in-person workshops (65%), institutions should allocate budgets for regular, hands-on training sessions, complemented by sponsored capacity building initiatives and accredited online courses. Additionally, institutions should integrate AI competency into staff Key Performance Indicators (KPIs) and provide special funding for professional development. Success stories, such as the peer-led "up-skill hours", could be scaled into formal Continuing Professional Development (CPD) programmes.

3. Policy Frameworks for Inclusive AI: National and institutional AI policies must incorporate inclusive design features, such as screen reader compatibility and multilingual support, to ensure AI tools cater to marginalised patrons. In developing AI policies, librarians and information professionals should be involved to ensure the peculiarities of their services are considered in the policy formulation and implementation. Likewise, librarians should collaborate with rights organisations to audit and improve the accessibility of existing systems, especially for clientele with special needs.

5. Research and Localised Solutions: Further studies should explore context-specific AI applications for different types of libraries in Nigeria, such as low-bandwidth tools for regions with poor connectivity and librarians' pragmatic adaptations of blending AI innovations with established expertise. This will provide better insights into how libraries harness technology to advance access to knowledge while preserving the irreplaceable human touch as the heart of librarianship.

References

Adekanye, E. A. (2024). Artificial intelligence utilization and library service quality in University of Lagos Main Library: A linear regression modelling. *Journal of Management and Social Science Research*, 5(3), 37 – 50. http://doi.org/10.47524/jmssr.v5i3.38

Adeleke, D. S., & Olorunsola, R. (2021). Digital transformation in Nigerian academic libraries: Challenges and prospects. *Library Hi Tech News*, 38(4), 12-18.

Adeyemi, B. M., & Adetoro, N. (2022). Policy gaps in AI adoption for Nigerian libraries. *Journal of Librarianship and Information Science*, 54(2), 210-225.

Balnaves, E. (2024). Open source as a gateway to artificial intelligence. *South African Journal of Libraries and Information Science*, *90*(2), 1-7. https://hdl.handle.net/10520/ejc-liasa_v90_n2_a1

Brokensha, S., Kotzé, E., & Senekal, B. (2023). Machine learning for document classification in an archive of the National Afrikaans Literary Museum and Research Centre. *Journal of the South African Society of Archivists*, *56*, 134-147. https://dx.doi.org/10.4314/jsasa.v56i1.10

Buhalis, D., Leung, D., & Lin, M. (2022). Industry 5.0 and the human in the loop of smart tourism. *Journal of Smart Tourism*, 1(1), 1-12.

Cox, A. (2024). Developing a library strategic response to Artificial Intelligence. *eLucidate*, *16*(4). https://doi.org/10.15131/shef.data.24631293.v1

Cox, A. M. (2023). AI and the future of libraries: A systematic literature review. *Journal of Documentation*, 79(1), 45-67.

Deng, L. (2022). Artificial intelligence in libraries: Applications and ethical considerations. *Library Trends*, 70(3), 345-362.

Eke, H. N. (2023). The digital divide and AI readiness in African libraries. *International Journal of Information Management*, 68, 102487.

George, A. S., & George, A. H. (2020). Industrial revolution 5.0: the transformation of the modern manufacturing process to enable man and machine to work hand in hand. *Journal of Seybold Report*, *1533*(9211), 1525-68128.

International Federation of Library Associations and Institutions (IFLA) (2020). IFLA Trend Report Update 2019. *IFLA*. https://repository.ifla.org/handle/20.500.14598/3507

IFLA. (2024). Information Access: the Internet and AI. *International Federation of Library Associations*. https://www.ifla.org/news/information-access-the-internet-and-ai/

Jansen, B. J., Salminen, J., & Guan, K. (2020). Data-driven personalisation in digital libraries. *Information Processing & Management*, 57(6), 102277.

Jebet, T., & Gichugu, M. (2025). Adoption and use of artificial intelligence tools in service delivery in selected academic libraries in Kenya. International Academic Journal of Information Sciences and Project Management, 3(7), 287-301. https://iajournals.org/articles/iajispm_v3_i7_287_301.pdf

Mitric, J., Radulovic, I., Popovic, T., Scekic, Z., & Tinaj, S. (2024). AI and Computer Vision in Cultural Heritage Preservation. *28th International Conference on Information Technology (IT)*, Zabljak, Montenegro, 2024, pp. 1-4. https://doi.org/10.1109/IT61232.2024.10475738.

Mourtzis, D. (2021). Towards the 5th industrial revolution: A literature review and a framework for process optimization based on big data analytics and semantics. *Journal of Machine Engineering*, *21*(3). https://doi.org/10.36897/jme/141834

Nahavandi, S. (2019). Industry 5.0—A human-centric solution. *Sustainability*, 11(16), 4371. https://doi.org/10.3390/su11164371

NCAIR (2024). National Artificial Intelligence Strategy. *NCAIR/NITDA*. Available at: https://ncair.nitda.gov.ng/wp-content/uploads/2024/08/National-AI-Strategy_01082024-copy.pdf

Noack, P. (2020). The Fifth Industrial Revolution: Where Mind Meets Machine. *The National*. Available online: https://www.thenationalnews.com/opinion/comment/the-fifth-industrial-revolution-where-mind-meets-machine-1.1061280 (accessed on 16 March 2025).

Noble, S. M., Mende, M., Grewal, D., & Parasuraman, A. (2022). The Fifth Industrial Revolution: How harmonious human–machine collaboration is triggering a retail and service [r]evolution. *Journal of Retailing*, *98*(2), 199-208. https://doi.org/10.1016/j.jretai.2022.04.003

Nwosu, J. C., Ezejiofor, R. A., & Ugwu, C. I. (2023). Digital skills gap among Nigerian librarians: Implications for AI adoption. *African Journal of Library and Information Science*, 33(1), 55-70.

Olanrewaju, F. T., & Ajayi, S. O. (2021). Infrastructure deficits and technological exclusion in Nigerian libraries. *Library Management*, 42(6/7), 401-415.

Oyediran-Tidings, S. O., Nkiko, C., & Ekere, J. N. (2022). Bridging the digital divide in Nigerian academic libraries. *Journal of Academic Librarianship*, 48(3), 102543.

Özdemir, V., & Hekim, N. (2018). Birth of industry 5.0: Making sense of big data with artificial intelligence. *OMICS: A Journal of Integrative Biology*, 22(1), 65-76. https://doi.org/10.1089/omi.2017.0194

Patel, R., & Kumar, S. (2023). Multilingual voice assistants for low-resource settings: The IIT Delhi model. *Journal of Accessibility and Design for All*, 13(1), 1-18.

Pathak, P., Pal, P. R., Shrivastava, M., & Ora, P. (2019). Fifth revolution: Applied AI & human intelligence with cyber physical systems. *International Journal of Engineering and Advanced Technology*, *8*(3), 23-27. https://www.researchgate.net/profile/Parashu-Pal/publication/331966435

Shijia, O. (2021). The Fifth Industrial Revolution Will Be More People-Centered with Focus on Value-Added. *China Daily Global*. Available online: http://epaper.chinadaily.com.cn/a/202105/21/WS60a6f527a31099a234356428.html (accessed on 19 March 2025).

UNILAG (2020). University of Lagos Receives Donation of Robots from Platform Capital. *UNILAG*. https://unilag.edu.ng/university-of-lagos-receives-donation-of-robots-from-platform-capital/

Yang, W., Fu, R., Amin, M. B., & Kang, B. (2025). Impact and influence of modern AI in metadata management. *arXiv preprint arXiv:2501.16605*. https://arxiv.org/abs/2501.16605

Ziatdinov, R., Atteraya, M. S., & Nabiyev, R. (2024). The Fifth Industrial Revolution as a Transformative Step towards Society 5.0. *Societies*, 14, 19. https://doi.org/10.3390/soc14020019

Acknowledgement

The authors would like to acknowledge and thank Dr. Adetoun Adebisi Oyelude [FNLA, CLN], the University Librarian of Olusegun Agagu University of Science and Technology (OAUSTECH); Professor Helen Emasealu, the University Librarian of the University of Port Harcourt (UNIPORT); and Mr. Olabisi Olatunji (CLN), the Head of Technical Services, Nile University of Nigeria, for their invaluable insights that enriched this research output. Thank you all!

A Study on Perception and Implementation of Persistent Identifiers in Nigerian Universities

Salihu T. Salihu (CLN)
Federal University Dutsin-Ma, Katsina State
tsalihu.salihu@gmail.com

Fatimah Jibril Abduldayan (PhD, CLN)
University Librarian,
Nigeria Maritime University, Okerenkoko, Delta State
datarootng@gmail.com

&

Matthew Simon Otache
Department of Library and Information Science
University of Calabar, Cross River State.

Abstract

Persistent identifiers (PIDs) have transformed the global scholarly publishing landscape by ensuring permanent access to online information resources. This study investigated Nigerian academics perception of PIDs, its impact on the Nigerian scholarly community, and challenges encountered in its implementation in Nigerian universities. The study employed a quantitative research approach. Data were elicited from 236 Nigerian lecturers in public and private universities, using an online questionnaire. Convenience sampling technique was used in selecting the respondents for the study and the collected data were analysed using descriptive statistics such as frequency, percentage, and mean. Kruskal-Wallis H and Mann-Whitney U inferential statistics were used to test the hypotheses at 0.05 level of significance. The study revealed that Nigerian university lecturers had positive perception of persistent identifiers and their perception on the PIDs used by researchers (i.e. ORCID) was found to be higher than those used for research output and research institutions. The respondents reported that persistent identifiers have helped in improving the visibility and accessibility of their research output and their global recognition. Even though the findings shows that robust ICT infrastructure exist to support PID implementation in Nigerian universities, costly maintenance and inadequate funding were seen as threats to the sustainability of PID initiatives. A statistically significant difference was found in the perception of PIDs among academic staff based on their academic qualifications ($H = 25.412$; $p = 0.000$). A statistically significant difference was also found in the impact of PIDs among them based on their academic qualifications ($H = 34.498$; $p = 0.000$) and institutional affiliation ($H = 19.978$; $p = 0.001$). The study recommended that National University Commission should mandate the adoption of PIDs and organize a PID literacy training and capacity building workshop to speed up PID adoption in Nigerian universities.

Keywords: *Awareness; Open Science; Persistent Identifiers; Research Output; Visibility.*

Introduction

Human beings face various problems throughout their lives. The complexity of these problems often requires a systematic approach to proffering solutions. Jain (2023) referred to the systematic approach employed in unravelling these complexities as research. Research is the conscious effort made towards finding solutions to problems encountered by people in different spheres of human endeavours be it business, education, sports, health, and governance. It is a process that requires an individual to collect and analyse data in a bid to provide a well-documented steps and tailored response to problems begging for solutions (World Health Organization, n.d.). Abduldayan (2021) referred to the product of research as research output.

Belcher and Halliwell (2021) defined research output as "the actual knowledge, innovations, and services produced by research as well as the media that communicate knowledge and innovation". They are the evidence of the research activity and they contain solutions to real world problems. —Naidoo (2011) specifically referred to research output as 'a measure of evaluation'. This is because they constitute the metrics used in rating the productivity and impact of researchers and research institutions. The former being the research productivity of academic staff and researchers while the latter being the impact on the research/academic community and other stakeholders such as policy makers and persons that are directly or indirectly impacted by the research output. Without access to output of the research, the mysteries and complexities that come with human co-existence may not be intelligently unravelled. Also, the benefits that accrue from the conduct of the research will not be enjoyed "(Sukoco et al., 2023). Hence, the need for research visibility and accessibility.

Research visibility prequels accessibility because access to and retrieval of research findings is possible only when it is searchable and retrievable online. "–Abrahams et al. (2010) described visibility as the discoverability and traceability of research outputs for the development of new knowledge or policies.

Accessibility on the other hand entails retrievability of research outputs. Research visibility and accessibility therefore entails making the output of research visible, searchable, discoverable, and retrievable for potential users' within and outside the research/academic community. Hitherto to the use of technology for electronic publishing, research outputs were disseminated only in print format via journal platforms. Access was therefore restricted by geographical boundaries since information seekers would have to commute down to libraries housing the research outputs to gain access. Alternatively, information seekers could also purchase this information resources thereby eliminating the geographic barriers but invoking the cost barrier initially shouldered by libraries. The coming of electronic publishing eliminated the geographical boundaries since information seekers could access the output of research at their comfort zones. However, the problem of cost still persisted since access to research articles was not without payment of subscription fees (Uzun et al., 2024). As a result, open access publishing platforms came along to eliminate the cost barriers for both researchers and users.

Open access publishing is a publication model that ensures research findings are accessed by information users at zero cost. The open access publishing model sometimes places the publication cost on the researcher in the guise of gold open access, other times splits the publication cost between the researcher and user in the guise of hybrid open access, and sometimes frees the researcher and user of any financial responsibility in the guise of diamond open access (Upadhyaya et al., 2024; Uzun et al., 2024). Additionally, the use of institutional and digital repositories by universities, research institutions, and organizations helped in eliminating all cost barriers for information users (Kodua-Ntim & Fombad, 2020). This tremendously improved the visibility, accessibility, and impact of research output and that of the entities involved in their production (Tapfuma & Hoskins, 2021).

Despite the introduction of electronic publishing and open access technology in the dissemination of research findings, the visibility, access, and impact of research outputs still remain a challenge due to the ephemeral nature and duplicity of uniform resource locators used by some publishing platforms (Askitas, 2010; Van de Sompel et al., 2014). Several authors reported that the decay of URLs ranks high among the factors that hinder visibility and access to research findings """(Hennessey & Ge, 2013; Isfandyari-Moghaddam et al., 2010; Isfandyari-Moghaddam & Saberi, 2011; Watwood, 2016). The problem of a single research output having multiple URLs (Isfandyari-Moghaddam & Saberi, 2011) also weighs down on its impact (Askitas, 2010). Howell and Burtis (2023) observed a decline in URL decay of selected journals within the last decade even though they affirmed that the problem persists. The use of persistent identifiers and the formulation of policies that encourage their adoption serve as a remedy for decaying URLs and decreasing impact of research outputs (Askitas, 2010; Howell & Burtis, 2023; Madden et al., 2020).

Madden et al. (2020) defined persistent identifiers as "long-lasting references to digital objects of various types". PIDs confer permanent and unique digital identity to all entities in the research ecosystem. They are the mechanisms that facilitate enduring referral to an online research entity such as a researcher, his research output, organization, and funder. The traceability of citations, and consistent and unambiguous exchange of scholarly information across scholarly platforms are the key functions of persistent identifiers (Rueda et al., 2017). These PIDs include handles, digital object identifiers, archival resource keys, open researcher and contributor ID, grant ID, research activity identifiers, and research organization ID (Jefferies, n.d.; The ARK Alliance, 2023).

Preliminary analysis of data available on the research organization registry have shown widespread adoption of ROR ID among research institutions in the global north. However, Nigeria which happens to be in the global south has only 7 out of the 272 Nigerian universities with digital identities on the registry (National Universities Commission, 2024; Research Organization Registry, 2025). Similarly, data available on the Registry of Open Access Repositories shows that all 18 Nigerian universities on the registry are yet to provide digital object identifiers for research objects in their repositories while universities in the global north have long integrated PID services with their repositories (*Registry of Open Access Repositories*, 2010). The factors hindering the adoption of PIDs is not far-fetched. The implementation cost is too expensive for institutions in the global south to bear and the funds available to support these institutions is limited (Oaiya, 2025). This has the potential to hinder visibility and accessibility of Nigerian scholarly outputs. Despite the low PID adoption indices deduced from data available online, literature in the field has shown a dearth of empirical studies on PIDs adoption in the Nigerian parlance. ""Macgregor et al. (2023) reported that the perception of users provides insights into factors responsible for PIDs adoption and their implementation by relevant stakeholders. Against this backdrop, this study investigated academic staff perception of PIDs in Nigerian universities, the impact PIDs have on the academic community, and challenges encountered during its implementation.

The study showcases the significance of PID implementation to stakeholders such as National Universities Commission, Tertiary Education Trust Fund, universities, repository managers, and academic staff. National Universities Commission would be able to leverage on the metrics provided through PIDs for evidence-based ranking of academic institutions in Nigeria. The findings from this research would help TETFund craft ways to improve grant monitoring. Information pertaining to academic staff research publication and impact would be easily verified by universities during promotion exercise. Repository managers would become acquainted with sustainable and affordable PID implementation practices which will help in overcoming present challenges and improving the visibility, accessibility, and impact of institutional research output. Lastly, academic staff would be well informed about the benefits offered by PIDs. This will help in speeding up the adoption rate of PIDs and enhance the global visibility, accessibility, and impact of Nigerian research entities.

Research Questions

The following research questions were formulated to guide the study:

1. What are the perceptions of academic staff in Nigerian universities regarding persistent identifiers?
2. What impact do persistent identifiers have on the visibility and accessibility of scholarly outputs of academic staff in Nigerian universities?
3. What are the main infrastructural, financial, and technical challenges faced by repository managers in the implementation of PIDs?

Hypothesis

$\mathbf{H}_{01}$ There is no significant difference in the perception of academic staff regarding PIDs across federal, state, and private universities in Nigeria

$\mathbf{H}_{02}$ There is no significant difference in the perception of academic staff on PIDs based on their academic qualifications.

$\mathbf{H}_{03}$ There is no significant difference in the impact of PIDs on what? among academic staff across federal, state, and private universities.

Or

PIDs has no significant impact on the visibility and accessibility of scholarly outputs of academic staff in Nigerian universities

$\mathbf{H}_{04}$ There is no significant difference in the impact of PIDs among academic staff based on their academic qualification.

Literature Review

The emergence of persistent identifiers hinged majorly on the high obsolescence rate of uniform resource locators and its attendant hinderance on research visibility and accessibility (Wagner et al., 2009). The last decade of the 20th century and the beginning of the new millennium witnessed a shift from the failed URL system to Handle system and Archival Resource Keys. Created in 1994 by the Corporation for National Research Initiatives in United States of America, the handle system provided digital identity for online resources with its most important qualities being uniqueness and persistence overtime (Arms & Ely, 1995). In 1995, a team from CNRI spearheaded by David Ely, successfully piloted its implementation in Library of Congress (Arms & Ely, 1995). The handle system paved way for the development and use of digital object identifiers (Arms, 2012; DOI Foundation, 2023). The introduction of Archival Resource Keys in 2001 was also a significant milestone that impacted the scholarly publishing landscape (The ARK Alliance, 2023). The impact of ARKs surpassed the boundaries of long-term access, making it unique among other PIDs. ARKs prioritized enduring service devoid of the associated costs of minting to its user community (Kunze & Bermès, 2024). These developments heralded the beginning of enduring visibility and accessibility of scholarly research outputs.

Few studies have been carried out to understand how persistent identifiers are changing the scholarly communication landscape. ""Macgregor et al. (2023) studied "User perceptions and understanding of PIDs in support of open scholarly infrastructure". The study participants were mainly scholars actively engaged in research activities. However, scholars with open research experience were excluded to understand the level of PID literacy among those that are not predisposed to them. The findings revealed that researchers in the study had a positive perception of PIDs despite the relatively poor understanding recorded. The reason for this positive perception is not farfetched. —Meadows et al. (2019) reported that persistent identifiers provide a single data pool for grant institutions to access information about authors that will be sufficient to make informed decisions. The authors posited that the use of persistent identifiers saves both researchers and grant bodies from unnecessary paperwork and bureaucracy involved in the grant application process. Mejias and Mostafa (2023) in a study titled "Enhancing the impact of your research with persistent identifiers" described the impact of persistent identifiers on entities in the research ecosystem. The study identified enhanced discoverability, collaboration, data management, impact monitoring, attribution, and preservation as the deliverables offered by persistent identifiers. Therefore, the creation, usage and maintenance of PIDs require a well-defined management plan that will ensure that the scholarly community continues to enjoy the benefits it offers.

Several organizations exist that are responsible for PIDs as they go through each phase in the PID life cycle. These organizations are referred to as PID service infrastructure providers or registration agencies ————————(Kraft et al., 2017; Schnieders et al., 2022). The prominent ones include Datacite, Crossref, ARK Alliance, and ORCID ""(DOI Foundation, 2022; Kraft et al., 2017; Lehmann-Haupt, 2022; The ARK Alliance, 2023). Datacite and Crossref are "global non-profit organizations that provide, DOIs and other services critical to research communications making all kinds of research objects, easy access to find, assess, and reuse" (DOI Foundation, 2022). Both Datacite and Crossref along with California Digital Library are the service providers for Research Organization ID (Research Organization Registry, 2025). Incidentally, the California Digital Library is also a founding member of the ARK Alliance, a community of individuals and institutions committed to providing ARKs services (The ARK Alliance, 2023). These organizations have contributed immensely to the global growth and adoption of persistent identifiers. Reports show that there are about 257 million DOIs and over 8.2 billion ARKs currently in existence (The

ARK Alliance, 2023). ORCID on the other hand has 9.2 million active researchers, 5,904 active integrated systems, and 1,447 organizational members in 250 countries while ROR has over 110,000 registered organizations (ORCID, 2025; Research Organization Registry, 2025). These achievements are not without challenges such as cost barriers, infrastructure issues, and dominance of entities from the global north (Oaiya, 2025). Even though some registration agencies provide take off funds, it mostly lasts for a year and this leaves research entities with the burden of sustainability and continuity –(Confederation of Open Access Repositories, 2023; Tembo, 2025).

From the literature reviewed, it is evident that there is generally a paucity of literature on PIDs both in the global north and global south. While few empirical studies have been carried out in the global north on PIDs, the availability of PID related empirical studies, particularly in Nigeria is lacking. The current study contributes to the body of knowledge on PID discourse globally and closes the gap observed in Nigerian.

Methodology

A descriptive survey research design was adopted in the study. The population of the study comprised 73,443 academic staff across federal, states, and private universities in Nigeria (National Universities Commission, 2019). The appropriate sample size for the study was 272 deducing from the sample size table of Saunders *et al.* (2009). Despite the population being determinate, convenient sampling technique was used to select 236 academic staff who voluntarily participated in the study. Owing to the geographical spread of the study population, an online questionnaire was created using Microsoft Forms. The questionnaire was structured into four sections as follow:

Section A: Background Information

Section B: Academic Staff's Perception of Persistent Identifiers

Section C: Impact of persistent identifiers on Nigerian universities' academic staff and their publications

Section D: Challenges encountered in the Implementation of Persistent Identifiers

Variables in sections B – D were ordinal variables measured on a 5-point Likert scale of strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1).

The questionnaire was subjected to face and content validity before the link of the final version was shared on social media platforms belonging to Nigerian universities' academic staff to elicit their responses. A letter of informed consent was included in the introductory letter and all respondents consented to participating in the study.

Cronbach Alpha was used to test the reliability of the instrument, and all the scales had their coefficient values above 0.7 except for financial challenge which had below 0.7. The result indicated the item responsible for a drop in the coefficient value and after deleting the item, the coefficient value for the financial challenge scale rose to .879. The summary of the reliability test in Table 1 below shows that the overall coefficient value for all the scales is .958.

Table 1: Summary of the Reliability Statistics

Variable	Cronbach's Alpha based on Standardized Items	Number of Items
Academics Perception of PIDs	.912	5
Impact of PIDs	.928	6
Infrastructural Challenges	.956	5
Technical Challenges	.969	5
Financial challenges after item deletion	.879	3
Overall Scale	.958	24

The data collection commenced on the 17th of December 2024 and ended on the 2nd of February 2025 making a total of 48 days. The questionnaire yielded a response rate of 87% with 236 responses. The Statistical Package for Social Science (SPSS) version 27 was used for the data analysis. Frequency, percentage, and arithmetic mean were used for the descriptive analysis. The midpoint for the responses was arrived at by calculating the mean of the five scales as follows, ((5+4+3+2+1) /5) = 3. The criterion mean was deduced as follows:

Strongly Disagree 1.00 – 1.99

Disagree 2.00 – 2.99

Neutral 3.00 – 3.99

Agree 4.00 – 4.49

Strongly Agree 4.50 – 5.00

Items with values between 1.00 – 2.99 were interpreted to mean negative perception or impact while those between 3.00 – 5.00 were interpreted as positive perception or impact.

Kruskal -Wallis H and Mann-Whitney U inferential statistics were used to test the hypothesis at 0.05 level of significance. These tests are non-parametric in nature and allow researchers to navigate the challenges of running numerous tests to meet certain assumptions. Specifically, the tests do not require the data to be normally distributed making it suitable for the present study (McKight & Najab, 2010).

Results

This section presents the results from the data analysis carried out in the study.

Demographic Characteristics of Respondents

The results in Table 2 revealed that majority of the respondents were males (130, 55.1%). Most of the respondents (82, 34.7%) were between the age group of 31-40 years. Many of the study respondents were from the North Central geo-political zone (60, 25.4%) with North East (14, 5.9%) having the least representation. More than half of the respondents worked in Federal Universities (128, 54.2%) with those from State (56, 23.7%) and Private (52, 22.1%) universities having almost equal representation. The result also shows that majority of the respondents (200, 84.8%) possessed postgraduate qualifications with 122 (51.7%) having master's degrees and 78 (33.1%) having Doctorate degrees. The result further revealed that an ample number of respondents belonged to the middle cadre- Lecturer II/ Librarian II (56, 23.7%) and Lecturer I/ Librarian I (44, 18.6%). Additionally, a greater number of the respondents were from the Library and Information Science Profession (118, 50%). The results also show that most of the respondents (184, 78%) were experienced in scholarly communication, open science, and use of repository technology.

Table 2: Demographic Characteristics of Respondents

Gender	**Frequency**	**Percentage**
Male	130	55.1%
Female	106	44.9%
Total	**236**	**100**
Age	**Frequency**	**Percentage**
21 – 30 years	38	16.1%
31 – 40 years	82	34.7%
41 – 50 years	68	28.8%
51 – 60 years	48	20.3%
Total	**236**	**100**
Geo-political Zone	**Frequency**	**Percentage**
North East	14	5.9%
North Central	60	25.4%
North West	50	21.2%
South East	30	12.7%
South South	38	16.1%
South West	44	18.6%
Total	**236**	**100**
Institution Type	**Frequency**	**Percentage**
Federal University	128	54.2%
State University	56	23.7%
Private University	52	22.0%
Total	**236**	**100**
Academic Rank	**Frequency**	**Percentage**
Professor/University Librarian	10	4.2%
Associate Professor/Reader/Deputy University Librarian	20	8.5%
Senior Lecturer/Senior Librarian	44	18.6%
Lecturer I/Librarian I	44	18.6%
Lecturer II/Librarian II	56	23.7%
Assistant Lecturer/Assistant Librarian	34	14.$%
Graduate Assistant/Assistant Librarian	28	11.9%
Total	**236**	**100**

Faculty/Discipline	Frequency	Percentage
University Library/LIS Department	118	50.0%
Faculty of Agriculture	2	0.8%
Faculty of Arts and Humanities	4	1.7%
Faculty of Engineering/Environment	10	4.2%
Faculty of Education	22	9.3%
Faculty of Law	4	1.7%
Faculty of Life Sciences	16	6.8%
Faculty of Medical/Pharmaceutical Health Sciences	42	17.8%
Faculty of Physical Sciences	4	1.7%
Faculty of Social Management Sciences	14	5.9%
Total	**236**	**100**
Scholarly Communication, Open Science, Repository Technology	**Frequency**	**Percentage**
Yes	184	78.0%
May be	22	9.3%
No	30	12.7%
Total	**236**	**100**

Academic Staff's Perception of Persistent Identifiers

Table 3: Academic Staff's Perception of Persistent Identifiers

Items	SA	A	N	D	SD	Mean	Std. Dev
Persistent identifiers such as ORCID, Scopus ID, and Researcher ID can be used to create a unique identity for myself in the academic and research community	98 (41.5%)	100 (42.4%)	26 (11.0%)	4 (1.7%)	8 (3.4%)	4.17	.934
Persistent identifiers such as ORCID, Scopus ID, and Researcher ID can be used to uniquely identify authors and co-authors in the academic and research community	94 (39.8%)	112 (47.5%)	22 (9.3%)	0 (0%)	8 (3.4%)	4.20	.871
Persistent identifiers such as DOI can be used to reference a research article in a publishing platform	82 (34.7%)	112 (47.5%)	24 (10.2%)	8 (3.4%)	10 (4.2%)	4.05	.984

Persistent identifiers such as DOI and handles can be used to reference research articles, thesis, and dissertations in a digital repository	72 (30.5%)	124 (52.5%)	26 (11.0%)	4 (1.7%)	10 (4.2%)	4.03	.931
Persistent identifiers such as ROR can be used to uniquely identify my research institution and other research institutions in the academic and research community	58 (24.6%)	108 (45.8%)	60 (25.4%)	6 (2.5%)	4 (1.7%)	3.89	.863
Weighted Mean = 4.07; Std. Dev = 0.917							

Results from Table 3 show that majority of respondents (100, 42.4%) in the study agreed that persistent identifiers such as ORCID, Scopus ID, and Researcher ID can be used to create a unique identity for authors in the academic and research community. The result further reveals that a greater number of respondents (112, 47.5%) agreed that these persistent identifiers can be used to accurately attribute ownership of scholarly works to authors and co-authors. In the same vein, 112 (47.5%) respondents agreed to the use of DOIs and ARKs for referring to research articles in publishing platforms. 124 (52.5%) further indicated that persistent identifiers such as DOIs, Handles, and ARKs can be used to reference research articles, thesis, and dissertations in a digital repository. The result on the use of ROR for uniquely identifying researchers' institutions was also perceived positively by majority of the respondents (108, 45.8%). Deducing from the overall mean for Nigerian academic staff's' perception of PID (x = 4.07), the researchers infer that Nigerian academic staff generally have a positive perception towards PID.

Impact of persistent identifiers on Nigerian academic staff and their publications

Table 4: Impact of persistent identifiers

Items	SA	A	N	D	SD	Mean	Std. Dev
PIDs have helped in increasing my global visibility as a researcher	74 (31.4%)	116 (49.2%)	46 (19.5%)	0 (0%)	0 (0%)	4.12	.705
PIDs have helped in increasing the visibility of my research output	72 (30.5%)	116 (49.2%)	40 (16.9%)	6 (2.5%)	2 (0.8%)	4.06	.807
PIDs have helped in increasing the discoverability of my research output	74 (31.4%)	96 (40.7%)	56 (23.7%)	4 (1.7%)	6 (2.5%)	3.97	.922

My research output enjoys global accessibility due to PIDs	80 (33.9%)	84 (35.6%)	58 (24.6%)	6 (2.5%)	8 (3.4%)	3.95	.975
PIDs have enabled other researchers to accurately cite my work	76 (32.2%)	96 (40.7%)	52 (22.0%)	6 (2.5%)	6 (2.5%)	3.97	.936
I have witnessed an increase in my citations since I started using PIDs (ORCID, Scopus ID, Researcher ID)	76 (32.2%)	82 (34.7%)	66 (28.0%)	10 (4.2%)	2 (0.8%)	3.93	.920
Weighted Mean = 4.00; Std. Dev = 0.8775							

Table 4 reveals that majority of the respondents (116, 49.2%) agree that persistent identifiers increase their global visibility as researchers and that of their research output respectively. Furthermore, majority of the respondents indicated that persistent identifiers has helped in increasing the discoverability (96, 40.7%) and accessibility (84, 35.6%) of their research outputs. Additionally, 90 (40.7%) respondents indicated that persistent identifiers have made it easy for their works to be accurately cited with 82 (34.7%) respondents agreeing to witnessing a significant increase in the citations due to their adoption of ORCID, Scopus ID, and Researcher ID. The overall mean of x = 4.00 shows that Nigerian universities academic staff acknowledge the positive impact of persistent identifiers on research entities in the scholarly community.

Challenges Encountered in the Implementation of Persistent Identifiers

Table 5: Challenges Encountered in the Implementation of Persistent Identifiers

Items	**Yes**			**No**	
Are you a repository manager in your university?	50 (21.2%)			186 (78.8%)	
Do you have an ORCID profile?	32 (64%)			18 (36%)	
Does your institution have a ROR ID?	24 (48%)			26 (52%)	
Have you implemented PIDs (Handle, DOI, ARK, etc) in your university?	28 (56%)			22 (44%)	
What are the financial challenges encountered in the implementation of PIDs (Handle, DOI, ARK, etc) in your university?	**SA**	**A**	**N**	**D**	**SD**
The cost of minting and maintaining PID is unbearable	4 (14.3%)	12 (42.9%)	10 (35.7%)	0 (0%)	2 (7.1%)

Allocating sufficient funds for PID related activities is quite a challenge	8 (28.6%)	12 (42.9%)	6 (21.4%)	0 (0%)	2 (7.1%)
Securing grants and funding from PID minting agencies is quite a challenge	0 (0%)	16 (57.1%)	8 (28.6%)	0 (0%)	4 (14.3%)
What are the infrastructural challenges encountered in the implementation of PIDs (Handle, DOI, ARK, etc) in your university?	**SA**	**A**	**N**	**D**	**SD**
My university has robust ICT infrastructure to support PID implementation	4 (14.3%)	14 (50%)	6 (21.4%)	2 (7.1%)	2 (7.1%)
My university has dedicated storage and back up space to support PID implementation	4 (14.3%)	14 (50%)	6 (21.4%)	2 (7.1%)	2 (7.1%)
Network connectivity and sufficient bandwidth for PID implementation is available in my university	8 (28.6%)	14 (50%)	4 (14.3%)	0 (0%)	2 (7.1%)
Adequate physical and virtual security measures have been taken to safeguard all ICT components used for PID implementation purposes	4 (14.3%)	16 (57.1%)	6 (21.4%)	0 (0%)	0 (0%)
There is adequate power supply to support the implementation of PIDs in my university	4 (14.3%)	16 (57.1%)	6 (21.4%)	0 (0%)	0 (0%)

What are the technical challenges encountered in the implementation of PIDs (Handle, DOI, ARK, etc) in your university?	**SA**	**A**	**N**	**D**	**SD**
My university has technical staff with requisite skills to support PID implementation	6 (21.4%)	12 (42.9%)	8 (28.6%)	0 (0%)	0 (0%)
Integrating PIDs with institutional repositories is quite challenging	4 (14.3%)	16 (57.1%)	8 (28.6%)	0 (0%)	0 (0%)
Assigning PIDs to digital objects in the repository is quite challenging	2 (7.1%)	18 (64.3%)	8 (28.6%)	17 (10%)	2 (1%)
Managing PIDs metadata is quite challenging	2 (7.1%)	18 (64.3%)	6 (21.4%)	2 (7.1%)	0 (0%)
Resolving broken PIDs with the service providing and ensuring continuous functionality is quite challenging	4 (14.3%)	18 (64.3%)	6 (21.4%)	17 (10%)	2 (1%)

Table 5 depicts the number of repository managers that participated in the study, their usage of ORCID and ROR ID, and challenges repository managers encountered in the implementation of persistent identifiers in their institutions. 50 (21.2%) respondents identified as repository managers in their institutions and 32 (64%) out of the 50 agreed to having an ORCID profile. Furthermore, 24 (48%) repository managers indicated that their institutions possess ROR ID and 28 (56%) indicated that persistent identifiers have been institutionalized in their universities. A total of 12(42.9%) repository managers indicated that the cost of minting and maintaining persistent identifiers and insufficient funds are major stumbling blocks in the implementation process. Additionally, 16 (57.1%) repository managers indicated that securing funds for facilitating PID projects is quite a challenge.

Majority of the repository managers (14, 50%) agreed to having robust ICT infrastructure, dedicated storage, and adequate bandwidth to support PID implementation in their institutions. The results further revealed that the physical and virtual safety of ICT infrastructure is guaranteed, and provisions have been made for sufficient power supply to support PID implementation in majority of the institutions (16, 57%).

Most of the repository managers (12, 42.9%) agreed to having staff with requisite skills to support PID implementation. However, most of the repository managers (16, 57.1%) indicated that integrating PIDs with institutional repositories is quite a challenge with 18 (64.3%) repository managers stating that they find it difficult to assign PIDs to digital objects. In the same vein, 18 (64.3%) repository managers indicated their helplessness in managing PIDs metadata and resolving issues surrounding broken PIDs. This shows a gap in the requisite skills possessed by repository managers, contradicting respondents claims to having the technical staff that can manage the implementation process. Additionally, the number of repository managers without ORCID profile (18, 36%) further echoes this skill gap and amplifies it beyond technicality.

Hypothesis Testing

The result of the hypothesis tested in this study is presented as follows:

$H_0$1 There is no significant difference in the PIDs' perception of academic staff across federal, states, and private universities.

Table 6 presents the result of the analysis carried out to find out the difference in academic staff perception of PIDs across federal, states, and private universities. The Kruskal-Wallis H test shows that there is no significant difference in academic staff perception of PIDs across the various types of universities in Nigeria (H = 5.864; df = 2; p value > .000). Therefore, the null hypothesis which states that there is no significant difference in the PIDs perception of academic staff across federal, states, and private universities is not rejected.

Table 6: Kruskal-Wallis H Test for Institution Type and Perception of PIDs

Kruskal-Wallis H Statistic	df	P value	Interpretation
5.864	2	.053	Null hypothesis not rejected

$H_0$2 There is no significant difference in the PIDs' perception of academic staff based on their academic qualifications.

Table 7 presents the result of the hypothesis test carried out to ascertain the difference in the PIDS' perception of academic staff based on their academic qualifications. The result showed a statistically significant difference in PIDS' perception based on the academic qualifications of academics (H = 25.412; df = 2; p < 0.000). A post-hoc comparison of each of the groups was carried out using the Mann-Whitney U test. The result in Table 7 shows that the PIDS' perception of academic staff with PhD qualification was statistically significantly higher than those with Bachelors (U = 648; p value < .005) and Masters (U = 3904; p < 0.05). Additionally, academic staff with Masters were also found to have a statistically significant higher PIDS perception than those with Bachelors (U = 1230; p < .05).

Table 7: Kruskal-Wallis H and Mann-Whitney U Test for Academic Qualification and Perception

Kruskal-Wallis H Statistic	df	P value	Interpretation

25.412	2	.000			Null hypothesis is rejected			
Post-Hoc Comparison								
Comparison	**Grp 1**	**Median**	**Grp 2**	**Median**	**Test Statistic**	**Z value**	**P value**	**Interpretation**
Bachelors Vs Masters	36	19	122	20	1230.000	-4.048	.000	Null hypothesis rejected
Bachelors Vs Doctorate	36	19	78	22	648.000	-4.666	.000	Null hypothesis rejected
Masters Vs Doctorate	122	20	78	22	3904.000	-2.169	.030	Null hypothesis rejected

$H_0$3 There is no significant difference in the impact of PIDs among academic staff across federal, states, and private universities.

The result in Table 8 is the outcome of the hypothesis test carried out to ascertain the difference in the impact of PIDs among academic staff in federal, states, and private universities. The result shows a statistically significant difference in the impact of PID among academics based on their institutional affiliation ($H = 19.978$; $df = 2$; $p < 0.05$). A post-hoc comparison of each of the groups was carried out using the Mann-Whitney U test. The result in Table 8 shows a statistically significant higher difference in the impact of PIDs among academic staff in federal universities compared to those in private universities ($U = 2102$; $p < 0.05$). Similarly, a statistically significant higher difference was observed in the impact of PIDs among academic staff in state universities compared to those in private universities ($U = 820$; $p < 0.05$). However, a statistically significant difference in the impact of PIDs was not found between academic staff in federal universities and those in state universities respectively.

Table 8: Kruskal-Wallis H and Mann-Whitney U Test for Institution Type and Impact of PIDs

Kruskal-Wallis H Statistic	**df**	**P value**			**Interpretation**			
19.978	2	<.001			Null hypothesis is rejected			
Post-Hoc Comparison								
Comparison	**Grp 1**	**Median**	**Grp 2**	**Median**	**U Statistic**	**Z value**	**P value**	**Interpretation**
Federal Vs State	36	20.5	122	24	3168.000	-1.267	.205	Null hypothesis not rejected
Federal Vs Private	36	20.5	78	27	2102.000	-3.896	<.001	Null hypothesis rejected
State Vs Private	122	24	78	27	820.000	-3.943	<.001	Null hypothesis rejected

$H_0$4 There is no significant difference in the impact of PIDs among academic staff based on their academic qualification.

The result in Table 9 presents the outcome of the hypothesis test carried out to find out the difference in the impact of PIDs among academic staff with varying academic qualifications. The result showed a statistically significant difference in the impact of PIDs among academic staff based on their academic qualifications ($H = 34.498$; $df = 2$; $p < 0.05$). A post-hoc comparison of each of the groups was carried out using the Mann-Whitney U test. The result in Table 8 shows a statistically significantly higher difference in the impact of PIDs among academic staff with a doctorate degree compared to those with a Bachelors ($U = 522$; $p < 0.05$) and master's degree ($U = 3322$; $p < 0.05$). Similarly, a statistically significantly higher difference was observed in the impact of PIDs among academic staff with master's degree compared to those with Bachelor's degree ($U = 1314$; $p < 0.05$).

Table 9: Kruskal-Wallis H and Mann-Whitney U Test for Academic Qualification and Impact of PIDs

Kruskal-Wallis H Statistic	df	P value	Interpretation
34.438	2	<.001	Null hypothesis rejected

Post-Hoc Comparison

Comparison	Grp 1	Median	Grp 2	Median	U Statistic	Z value	P value	Interpretation
Bachelors Vs Masters	36	20.5	122	24	1314.000	-3.694	<.001	Null hypothesis rejected
Bachelors Vs Doctorate	36	20.5	78	27	522.000	-5.424	<.001	Null hypothesis rejected
Masters Vs Doctorate	122	24	78	27	3322.000	-3.636	<.001	Null hypothesis rejected

Discussion of Findings

The goal of every research is to have a unique identity that distinguishes from other research in the academic and research community. Commonality of names is a norm in our clime, especially in the northern and southwestern part of the country. This could lead to inaccurate attribution of scholarly work and impersonation. Similarly, the provision of multiple access to scholarly work through different platforms sometimes makes it difficult to attribute all citation instances to the article. Most importantly, the absence of persistent identifiers and prevalence of URLs due to clog in the PID implementation wheel can thwart the visibility and accessibility of research entities. All these can contribute to inaccurate ranking of research institutions based on the impact of their researchers and research output. Persistent identifiers such as ORCID, Scopus ID, Researcher ID, DOIs, ARKs, and ROR help to resolve these problems and ensure proper attribution, visibility, accessibility, and citation at all levels. This highlights the reason for positive perception of persistent identifiers observed in this study. Even though the general perception of persistent identifiers appears to be positive, Nigerian academic staff's perception of the use of ORCID, Scopus ID, and Researcher ID were found to be the highest, followed by DOIs, Handles, and ARKs, and then ROR. This finding corroborates that of ""Macgregor et al. (2023) which reported that researchers in their study have positive perception towards persistent identifiers even though a thorough understanding of their purpose was lacking.

The impact of research in the scholarly community is tied to the visibility and accessibility of research outputs. Visibility and accessibility often translate to impact because these research entities are easily discoverable and open to global usage. Thus, academic staff attestation to the fact that they enjoy increased visibility, discoverability, and accessibility due to persistent identifiers is because these identifiers have given them global recognition and acknowledgement. Their research outputs have also been synthesized to produce novel research outcomes and to influence policies at different levels of governance. According to the findings, the impact derived by academic staff is in the global visibility they and their research outputs received. Contrary to the findings of ""Macgregor et al. (2023), academic staff understudied clearly understand the purpose of persistent identifiers and its attendant impact on research entities in the scholarly community and beyond. The assertion by (Mejias & Mostafa, 2023) that persistent identifiers enhances discoverability, attribution, and preservation supports the findings of this study.

Despite these positive results on perception and impact of persistent identifiers, repository managers still face enormous challenges in institutionalizing them. Some repository managers were found not to have ORCID and some of the institutions have no ROR ID. These categories of persistent identifiers are free of cost and the inability of repository managers to use them speak volumes of their competence and commitment to the PID initiative. Even though repository managers acknowledged the presence of robust ICT infrastructure to support PID implementation, –(Tembo, 2025) reported scarcity and obsolescence of ICT resources and infrastructure as a challenge in contrast with the findings of this study. The hurdles presented such as costly maintenance and inadequate funding were reported as threats to the sustainability of the PID initiatives in line with the study of Tembo (2025) where lack of enduring source of funding stood as a stumbling block. PID related tasks such as creation and management of PIDs were also viewed as major stumbling blocks to PID implementation, indicating a gap in repository managers' technical skills. This could be as a result of poor PID literacy and lack of interest in PID initiatives which necessitates training and capacity building for repository managers to better equip them with the requisite skill and knowledge needed to manage the PID implementation process ""(Macgregor et al., 2023).

Further analysis revealed that academic staff in federal, states, and private universities all have a positive perception of PIDs with no statistically significant difference observed in their perception. However, the PID perception of academic staff with doctorate degrees were found to be statistically significantly higher than those with master's degree and bachelor's degree. In the same vein, the PID perception of academic staff with master's degrees was found to be statistically significantly higher than those with bachelor's degrees. The findings also revealed that academic staff in federal and states universities had a statistically significantly higher positive outlook towards the impact of PIDs than those in private universities.

Conclusion

Conclusively, this study highlights individual efforts made by Nigerian university academic staff and repository managers in leveraging persistent identifiers to impact the academic and research community globally. The perception and impact scores received by persistent identifiers across different demography represented in this study give credence to the fact. Nigerian university academic staff, irrespective of gender, age, institution geo-location, institution type, educational status, rank, discipline, and open access experience have seen the value in persistent identifiers and are adopting them for different purposes. Nigerian university academic staff perception of ORCID and DOI were found to be higher than ROR. This is because the referencing scope in terms of pointing to several research articles via a single ORCID is higher than a DOI pointing to a maximum of five ORCIDs depending on the number of authors. Nigerian university academic staff acknowledge the impact of PIDs in increasing their global visibility. It further shows their commitment to the conduct of impactful research and contribution to the global knowledge economy.

Furthermore, some repository managers are lagging in the implementation of PIDs, especially ORCID and ROR ID that are available at zero cost. Repository managers need to acquire a unique digital identity for themselves and their institutions. Additionally, repository managers and research institutions need to explore flexible PID business models that can be adopted in the institutionalization of PIDs in Nigeria. This can be achieved through creation of a consortia by research institutions in Africa to defray the associated costs of implementation or adoption of Archival Resource Keys which are viable alternatives (LIBSENSE, 2023). This will help them overcome cost barriers and ensure sustainability of PID implementation in academic institutions.

Even though Nigerian academics were generally found to have a statistically significant positive perception of PIDs across the various institutions, a statistically significant difference was observed in PID perception among those with lower qualification. The findings on impact of PIDs also show that Nigerian academics in government owned universities had a statistically significant higher PID impact than those in private owned institutions. Similarly, the PID impact score of academics yet to earn a postgraduate degree was also statistically significantly lower than those with postgraduate degrees. Deducing from the findings, the study therefore recommends that National University Commission should mandate the adoption of PIDs and organize PID literacy training and capacity building workshop for all academic staff in government and private owned Nigerian universities. The workshop will help to improve PID literacy among Nigerian academics and build the technical skills of repository managers. Academics with bachelor's degree should be mentored by senior colleagues and they should be made to understand the importance of PIDs and the positive impact it has on their global reputation. TETFUND should mandate the use of persistent identifiers in grant applications and research output submission at the end of the grant. Universities should also include academic staff possession of persistent identifier as a promotion requirement because of its potential to increase the visibility of both the university and the researcher. Lastly, ARKs should be adopted as a cost -free and sustainable PID alternative for universities.

The paucity of empirical literature on PIDs perception, impact, and implementation were limitations that were reflected in the structure of the literature review and a barrier to adequately supporting the findings of the study. While this study is limited to universities, future studies should focus us on other higher institutions such as polytechnics and colleges of education in Nigeria. The adoption and impact of PIDs on academic journals published in Nigerian higher institutions should also be studied.

References

Abduldayan, F. J. (2021). Computer-Based Data Management Model for Chemistry Research ins Federal Universities of Technology in Nigeria. http://repository.futminna.edu.ng:8080/jspui/bitstream/123456789/14358/1/PhD%20ABDULDAYAN%20Fatimah%20Jibril.pdf

Abrahams, L., Burke, M., & Mouton, J. (2010). Research Productivity-Visibility-Accessibility and Scholarly Communication in Southern African Universities. *African Journal of Information and Communication*, 20–36.

Arms, W., & Ely, D. (1995, June 23). *The Handle System*. https://www.cnri.net/cstr/handle-overview.html

Arms, W. Y. (2012). The 1990s: The formative years of digital libraries. *Library Hi Tech*, *30*(4), 579–591. https://doi.org/10.1108/07378831211285068

Askitas, N. (2010). *What Makes Persistent Identifiers Persistent*. https://doi.org/10.2139/ssrn.1639996

Belcher, B., & Halliwell, J. (2021). Conceptualizing the elements of research impact: Towards semantic standards. *Humanities and Social Sciences Communications*, *8*(1), 1–6. https://doi.org/10.1057/s41599-021-00854-2

Confederation of Open Access Repositories. (2023, September 28). *Persistent Identifiers: Addressing the challenges of global adoption*. COAR. https://coar-repositories.org/news-updates/persistent-identifiers-addressing-the-challenges-of-global-adoption/

DOI Foundation. (2022). *Existing Registration Agencies*. https://www.doi.org/the-community/existing-registration-agencies/

DOI Foundation. (2023). *DOI Handbook*. https://www.doi.org/doi-handbook/DOI_Handbook_Final.pdf

Hennessey, J., & Ge, X. (2013). A cross disciplinary study of link decay and the effectiveness of mitigation techniques. *BMC Bioinformatics*, *14*. https://doi.org/10.1186/1471-2105-14-S14-S5

Howell, S., & Burtis, A. (2023). The continued problem of URL decay: An updated analysis of health care management journal citations. *Journal of the Medical Library Association*, *110*, 463–470. https://doi.org/10.5195/jmla.2022.1456

Isfandyari-Moghaddam, A., & Saberi, M. (2011). The Life and Death of URLs: The Case of Journal of the Medical Library Association. *Library Philosophy and Practice*, *2011*.

Isfandyari-Moghaddam, A., Saberi, M., & Esmaeel, S. (2010). Availability and Half-life of Web References Cited in Information Research Journal: A Citation Study. *International Journal of Information Science and Management*, *8*.

Jain, N. (2023, July 25). What is Research? Definition, Types, Methods and Process. *IdeaScale*. https://ideascale.com/blog/what-is-research/

Jefferies, N. (n.d.). *Introduction to Persistent Identifiers*. https://www.bodleian.ox.ac.uk/sites/default/files/bodreader/documents/media/iskills-oa-introduction-persistent-identifiers.pdf

Kodua-Ntim, K., & Fombad, M. C. (2020). Strategies for the use of open access institutional repositories at universities in Ghana. *Library Management*, *41*(6/7), 515–530. https://doi.org/10.1108/LM-02-2020-0023

Kraft, A., Dreyer, B., Löwe, P., & Ziedorn, F. (2017). 14 Years of PID Services at the German National Library of Science and Technology (TIB): Connected Frameworks, Research Data and Lessons Learned from a National Research Library Perspective. *Data Science Journal*, *16*(0). https://doi.org/10.5334/dsj-2017-036

Kunze, J. A., & Bermès, E. (2024). *The ARK Identifier Scheme* (Internet Draft draft-kunze-ark-40). Internet Engineering Task Force. https://datatracker.ietf.org/doc/draft-kunze-ark-01

Lehmann-Haupt, J. (2022). *ORCID's First Decade: From Startup to Sustainability*. ORCID. https://info.orcid.org/orcid-first-decade-history/

LIBSENSE. (2023). *Roadmap for Implementing PIDs in Africa*. https://doi.org/10.5281/zenodo.7970386

Macgregor, G., Lancho-Barrantes, B. S., & Pennington, D. R. (2023). *Measuring the Concept of PID Literacy: User Perceptions and Understanding of PIDs in Support of Open Scholarly Infrastructure*. *7*(1). https://doi.org/10.1515/opis-2022-0142

Madden, F., van Horik, R., van de Sandt, S., Lavasa, A., & Cousijn, H. (2020). *Guides to Choosing Persistent Identifiers—Version 3* (Version 3). Zenodo. https://doi.org/10.5281/ZENODO.3862655

McKight, P. E., & Najab, J. (2010). *Kruskal-Wallis Test*. https://doi.org/10.1002/9780470479216.corpsy0491

Meadows, A., Haak, L., & Brown, J. (2019). Persistent identifiers: The building blocks of the research information infrastructure. *Insights: The UKSG Journal*, *32*(1). https://doi.org/10.1629/uksg.457

Mejias, G., & Mostafa, M. (2023). *Enhance the Impact of your Research with Persistent Identifiers*. https://www.authoraid.info/en/news/details/1891/

Naidoo, N. (2011). What is research? A conceptual understanding. *Journal of Emergency Medicine*, *1*. https://doi.org/10.1016/j.afjem.2011.05.011

National Universities Commission. (2019). *Nigerian Universities system statistical digest*. https://nigeriareposit.nln.gov.ng/handle/20.500.14186/727

National Universities Commission. (2024). *National Universities Commission Monday Bulletin* (p. 28). https://www.nuc.edu.ng/wp-content/uploads/2024/02/26th-February-2024_compressed.pdf

Oaiya, O. (2025). *Bridging the Scholarly Divide: A Sustainable and Inclusive Approach to*

Persistent Identifiers in Nigeria. Eko-Konnect 2025 User Conference, Lagos. https://2025.eko-konnect.org.ng/download/bridging-the-scholarly-divide-a-sustainable-and-inclusive-approach-to-persistent-identifiers-in-nigeria/

ORCID. (2025, February 8). *ORCID Statistics*. ORCID. https://info.orcid.org/resources/orcid-statistics/

Research Organization Registry. (2025). *Research Organization Registry (ROR)*. Research Organization Registry (ROR). https://ror.org/

Rueda, L., Fenner, M., & Cruse, P. (2017). DataCite: Lessons Learned on Persistent Identifiers for Research Data. *International Journal of Digital Curation*, *11*(2), 39–47. https://doi.org/10.2218/ijdc.v11i2.421

Schnieders, K., Mierz, S., Boccalini, S., Meyer zu Westerhausen, W., Hauschke, C., Hagemann-Wilholt, S., & Schulze, S. (2022). ORCID coverage in research institutions—Readiness for partially automated research reporting. *Frontiers in Research Metrics and Analytics*, *7*, 1010504. https://doi.org/10.3389/frma.2022.1010504

Sukoco, B., Putra, R., Muqaffi, H., Lutfian, M., & Wicaksono, H. (2023). Comparative Study of ASEAN Research Productivity. *SAGE Open*, *13*. https://doi.org/10.1177/21582440221145157

Tapfuma, M., & Hoskins, R. (2021). *Challenges for Establishment of Institutional Repositories: The Case of Zimbabwe's University Libraries* (pp. 139–159). https://doi.org/10.4018/978-1-7998-5018-2.ch008

Tembo, L. (2025). *The Nigerian ORCID Consortium – Benefits and Challenges*. Eko-Konnect 2025 User Conference, Lagos. https://2025.eko-konnect.org.ng/download/the-nigerian-orcid-consortium-benefits-and-challenges/

The ARK Alliance. (2023, August 23). *ARK Alliance*. ARK Alliance. https://arks.org/

Upadhyaya, A., Mukherjee, A., Tripathi, V., & Jeet, P. (2024). *Open Access and Licensing: Charting a Path to Global Knowledge Sharing*. *5*, 1–6.

Uzun, H., Akca, G., Sönmez, B., Orman, E., Kaçan, Y., & Dil, E. (2024). REVIEW Open Access The evolving landscape of publishing in human reproduction: An analysis of scientometric data, open-access publishing, and article processing charges. *Middle East Fertility Society Journal*, *29*. https://doi.org/10.1186/s43043-024-00198-2

Van de Sompel, H., Sanderson, R., Shankar, H., & Klein, M. (2014). Persistent Identifiers for Scholarly Assets and the Web: The Need for an Unambiguous Mapping. *International Journal of Digital Curation*, *9*(1), 331–342. https://doi.org/10.2218/ijdc.v9i1.320

Wagner, C., Gebremichael, M. D., Taylor, M. K., & Soltys, M. J. (2009). Disappearing act: Decay of uniform resource locators in health care management journals. *Journal of the Medical Library Association : JMLA*, *97*(2), 122. https://doi.org/10.3163/1536-5050.97.2.009

Watwood, C. (2016). Mapping the literature of pediatric nursing: Update and implications for library services. *Journal of the Medical Library Association : JMLA*, *104*, 278–283. https://doi.org/10.3163/1536-5050.104.4.005

World Health Organization. (n.d.). *Research*. Retrieved 13 November 2024, from https://www.who.int/health-topics/research

Academic Libraries as Dynamic Partners and Knowledge Hubs for Research Productivity and Professional Development for Academics

By

ABDULLAHI OLAYINKA ISIAKA
Kwara State Polytechnic, Ilorin, Nigeria
Email: abdulyinka.isiaka@gmail.com
Phone: 08067956408

BENJAMIN ADEBISI BAMIDELE
Kwara State College of Health Technology, Offa, Kwara State.
Email: benbammy0706@gmail.com
Phone: 08032528552

ADELANI ROTIMI IBITOYE
Igbajo Polytechnic, Igbajo, Osun State.
Email: paibitoye2012@gmail.com
Phone: 07032986849

ABDULLAHI ADEBOLA YUSUF
Al-Hikmah University, Ilorin, Nigeria
Email: aayusuf@alhikmah.edu.ng
Phone: 08033533385

Abstract

Academic libraries have long been regarded as repositories of knowledge, but their roles are rapidly evolving to meet the growing demands of research productivity and professional development among academics. This paper explores how libraries are transforming into dynamic partners and knowledge hubs to facilitate access to resources, tools, and services that enhance research output and academic growth among academics. This study adopted a survey design approach. The population of this study is all the 86 academic librarians from the nine university libraries in Kwara State. Total enumeration sampling technique was used and data were collected via questionnaire from the respondents. Data collected were analysed and presented with frequency counts, simple percentage and tables. Findings revealed that academic libraries play significance roles as dynamic partners in supporting research activities and professional development such as supporting multidisciplinary research; mentorship and consultation services; facilitating research collaboration among academics; engaging with global networks for shared resources; and training and capacity building for academics. Findings further revealed the invaluable roles of academic libraries as knowledge hubs in supporting research activities and professional development such as supporting scholarly publishing; enhanced access to research resources; promoting lifelong learning among academics; bibliometric analysis services; open-access initiative programs; and research data management and curation. Lastly, findings identified the innovative technologies academic libraries adopted to align their services with the changing needs of researchers and academics such as open-access academic databases; enhanced digital repositories; and cloud computing services. This study concluded that the roles of academic libraries as dynamic partners and knowledge hubs are paramount to research productivity and professional development of academics in Kwara State. This study recommended that academic libraries need to do more on building institutional partnerships by collaborating with academic departments, research centers, and external organizations to develop shared resources and programs that benefit researchers.

Keywords: *Academics; Academic Libraries; Dynamic Partners; Knowledge Hubs; Professional Development; Research Productivity.*

Introduction

The role of academic libraries has undergone a profound transformation over the past few decades, driven by advancements in information technology, changes in research practices, and the increasing emphasis on knowledge-driven economies. Dempsey (2015) states that the future of libraries is not just about managing collections but also about facilitating knowledge creation and collaboration among researchers. In the past, libraries primarily served as repositories for books and printed materials, providing academics and students with access to physical resources for research and learning. However, the digital revolution has drastically altered how information is created, shared, and accessed, pushing libraries to adopt new technologies and innovative services to meet the needs of modern researchers and educators. Nwalo (2014) states that academic libraries have evolved into knowledge hubs that provide access to digital resources, offer research support services, and contribute to the overall academic development of institutions. Academic libraries are now envisioned as dynamic partners and knowledge hubs, facilitating research productivity and fostering professional development, particularly within among academics. This paradigm shift underscores the evolving demands of the academia, where access to diverse and robust information resources, coupled with tailored services, is essential for advancing research endeavors and development.

Academic libraries have always played a central role in supporting research, learning and teaching of their parent institutions. They provide access to vast collections of books, journals, and electronic resources essential for scholarly inquiry. Vinopal and McCormick (2013) states that the developments in digital media, network technologies, research workflows, scholarly communication and funding policies are challenging academic libraries to respond with a wider array of services and facilities for researchers. However, the increasing complexity of academic research, coupled with the exponential growth of information sources, has created new demands for tailored services that enhance research productivity. Tenopir et al. (2017) indicate that library involvement in academic research enhances the quality of outputs by providing researchers with the necessary tools, resources, and expertise. This shift has highlighted the importance of academic libraries as active dynamic partners and knowledge hubs in the research process, offering specialized support, such as data management, bibliometric analysis, and access to open-access platforms. Gibbons (2016) states that academic libraries support researchers through services like data management, citation tracking, and bibliometrics, which contribute to effective research workflows. This partnership also extends to interdisciplinary research, where academic libraries provide platforms for knowledge sharing across diverse academic fields.

The professional development of academics is closely tied to their ability to effectively engage with emerging technologies and information sources. Academic libraries offer training programs, workshops, and tools to improve digital literacy and equip researchers with the skills needed to thrive in a knowledge-intensive world. Brown and King (2018) states that professional development programs facilitated by libraries contribute significantly to improving academic staff's research output, teaching quality, and technological competence. Through such initiatives, libraries are positioning themselves not just as service providers but as strategic partners in academic growth. Jaguszewski and Williams (2013) states that academic libraries support for research has emerged as a strategic issue and generated studies investigating service developments, new roles, skills requirements. Libraries, in this regard, play a pivotal role in fostering digital literacy and supporting researchers in navigating the complexities of digital tools. Sulaiman et al. (2019) emphasizes the need for library services to include digital literacy training, equipping academics with the skills needed to effectively use digital databases, research management tools, and collaborative platforms.

Despite growing recognition and relevance of academic libraries as dynamic partners and knowledge hubs for academics, they continue to face significant challenges in fulfilling their expanded roles in supporting scholarly endeavors. Rapid technological changes, budgetary constraints, and shifting user expectations demand continuous innovation and adaptability are among the challenges. Coates (2017) identified financial constraints, inadequate infrastructure, and a lack of sufficient digital tools hinder the ability of libraries to meet the demands of modern academic research. Moreover, as libraries strive to become dynamic partners, there is often a disconnect between library services and academic needs, which can lead to underutilization of library resources. Diep (2011) states that librarians are mainly contacted for lending materials and basic information queries. The author further states that some librarians have attempted to engage with academics in teaching information literacy, the lack of collaboration between academics and librarians has been reported as one of the main obstacles limiting the success of these ventures. Shen (2012) states that academics and librarians are still mostly working separately due to differences in their goals, nature of work, expertise and status.

In this evolving environment, academic libraries are uniquely positioned to serve as dynamic partners and knowledge hubs. However, many academic libraries struggle to fully adapt to these changing demands, which can undermine their ability to effectively support research productivity and professional development among academics. It is to this end, that this study situates itself to explore how academic libraries can further transform into dynamic partners and knowledge hubs. The study aims to illuminate strategies that can enhance the effectiveness and sustainability of libraries in academic institutions by exploring the intersection of library services, academic productivity, and professional development.

Research Questions

i. What are the contributions of academic libraries as dynamic partners in supporting research activities and professional development?
ii. What are the current roles of academic libraries as knowledge hubs in supporting research activities and professional development?
iii. What are the innovative technologies adopted by academic libraries to align their services with the changing needs of researchers and academics?

Literature Review *(Empirical Review)*

Roy and Habib (2024) conducted a study on "Fostering effective collaboration between library and information science academics and practitioners in Bangladesh: Insights, challenges and recommendations". They utilized a qualitative approach to gather data through semi-structured, unstructured, and focus group interviews with renowned Bangladeshi academics and experienced library practitioners. The study identifies the strengths, weaknesses, barriers and opportunities in relation to effective collaboration between library and information science academics and practitioners. Additionally, the study proposed viable solutions and outlines the potential for academic and professional success

through collaboration. The authors states that effective collaboration between library and information science academics and practitioners is vital for the professional growth and success of individuals working in the field. As it will facilitate the exchange of knowledge, skills and innovative practices, which, in turn, enhance the quality of library services. It will also allow for the integration of theoretical knowledge with practical experience, resulting in more effective and efficient library operations. The study has broader implications for the global library and information science community, adding a valuable perspective from a developing nation. The results highlight the significance of mindset and attitude in influencing collaborative efforts, urging academics and practitioners to adopt an open-minded approach without ego-related conflicts.

Cox (2023) carried a study titled "The Position and Prospects of Academic Libraries: Weaknesses, Threats and Proposed Strategic Directions". The purpose of the study is to guide strategy development, decision making and advancement of positioning by identifying and analyzing the key strengths, weaknesses, opportunities and threats impacting academic libraries. The study is unique in applying SWOT analysis to academic libraries collectively. The study focuses on weaknesses and threats. Weaknesses are identified as conservatism, stakeholder misperceptions, economics and diversity. Declining position, identity blurring, competition and uncertainty constitute the key threats. The examination of these factors is followed by a discussion of the whole analysis and a proposed framework for future strategy development and positioning, based on ten strategic directions emerging from the analysis. These are: active positioning; knowing the territory; being politically attuned; prioritizing outward engagement; maximizing social capital; communicating value and identity; embracing uncertainty; addressing diversity deficits; leveraging change in scholarly communications; and maintaining long-term perspective. The study concluded that academic library is an established presence, a democratic place on campus, usually liked, trusted, respected for its compatible values and strong service ethic, and viewed as a decent citizen of the institution with an outlook oriented towards support, collaboration and the public good. It has reinvented itself to deliver a more versatile value proposition and enjoys new opportunities in a transformed environment for learning, research and scholarly communications.

Pham and Tanner (2014) conducted a literature review study titled "collaboration between academics and librarians: A literature review and framework for analysis". The authors examined recent literature for a review of the concepts of collaboration in library and information science and related disciplines and developed a conceptual framework for application in academic contexts globally. They used an investigation of literature exploring the multifaceted meanings and dimensions of collaboration and subsequent development of a framework for analysis. To exemplify the use of the framework in analysing collaboration between academics and librarians, and to demonstrate the impact of context on collaboration, they explore the situation and educational contexts in two national settings: one a developed country (Australia) and the other a developing country (Vietnam). They found out that contextual factors have a substantial impact on the nature of collaboration between academics and librarians. The collaboration framework developed in their study applied to academic settings in the two countries, Vietnam and Australia, and dimensions of collaboration are compared and contrasted in the two countries. Insights and implications were drawn concerning the distinctive features of effective collaboration as well as the achievements and challenges of such collaborative partnerships. Their study is literature-based article reports on the first part of a larger research project. They provide insights into the current condition and challenges in developing collaboration between academics and librarians. Their proposed framework is beneficial to academics, librarians and universities interested in addressing the issues of this partnership in various academic contexts.

Revez (2018) conducted a study on "Opening the Heart of Science: A Review of the Changing Roles of Research Libraries". The purpose of the review is to highlight the challenging issues stemming from the relationship between research and libraries. The study performed a broad literature analysis that focused on the intersection of three different perspectives: the future of research libraries; the emerging new roles; and the ongoing openness of science. The study states that libraries are still at the heart of science but challenged by several stakeholders within the complexity of present science production and communication. The study highlighted research support services, research data management, or research information management as the emerging roles, among others, sustaining an open path where libraries thrive to be more collaborative while looking forward to establishing new partnerships. Literature from the research shows that research libraries are trying to find a place that is not necessarily new, but which is now in an environment with new features. The study concluded that libraries are and have been responsible for a very important part of the archive of science. This role makes them essential elements for the transition from the "old" processes of science production and dissemination to an environment deeply marked by digital technologies, globalization and the importance of networks.

Pinfield, Cox and Rutter (2017) wrote a report for Society of College, National and University Libraries (SCONUL) titled "Mapping the Future of Academic Libraries". The report states that academic libraries currently operate within and contribute to a rapidly changing environment. Being aware of what is changing and ensuring that libraries can continue to play a useful role in higher education (HE) is a profound ongoing challenge. The report is aimed at helping in addressing that challenge. It considers library futures over the next decade, a formidable but important undertaking. They based their analysis on a mixed-methods research project involving a review of the literature, in-depth interviews with a range of

stakeholders both within and beyond the library community, and a survey of library staff. They reported their findings as well as providing reflection on their implications for libraries and their future. They concluded the report by the statement "Rather than an end-point in itself, this report is part of a much wider ongoing discussion about the future of academic libraries". The report further states that at such, it is appropriate to summarise it in the form of fourteen paradoxes with which libraries are currently living and about which there is considerable ongoing debate in terms of their resolutions: (1) Participants identified a wide range of potentially transformative trends for libraries, but there was no consensus about which trends were most important. (2) Some key nexuses of change can be identified, but the end game for each remains unclear. (3) Despite the recognition of potentials for change, images of the library of the future seemed rather similar to what exists now. (4) Despite many trends being recognised, some key transformational forces, such as Artificial Intelligence, were not widely understood. (5) Library spaces are seen as unique and valuable, but library digital spaces are far from compelling. (6) Libraries see themselves as good at collaboration but are often too insular. (7) Libraries see themselves as forward-looking but often fail to engage in truly innovative thinking and risk-taking. (8) There was agreement that alignment to the institution was essential, but we suggest there are three radically different styles of alignment. (9) Library participants were optimistic about the future of libraries, but non-library participants were less so. (10) The need for change is widely recognised but so is the existence of resistance to change. (11) Libraries have to respond to the immediate needs of users but have a growing challenge of preserving born-digital objects. (12) There is a need both to collaborate and to compete with other departments and organisations. (13) Collaboration is increasingly necessary for delivery of library services but can contribute to the erosion of the library's identity. (14) There is wide support for some mantras about the value of libraries, but in reality, these need to be questioned.

Corall and Jolly (2019) carried out a study titled "Innovations in Learning and Teaching in Academic Libraries: Alignment, Collaboration, and the Social Turn". Their study provides evidence of a shift in the type and focus of innovation implemented by academic libraries in the direction suggested by Rowley (2011) and Walter and Lankes (2015), which is consistent with a more general trend towards the practice of social innovation, particularly in public services (Harris & Albury, 2009). They embodied the range of theory and variety of evidence-based practices and illustrate as well as Lankes's (2011) contention that "The mission of librarians is to improve society through facilitating knowledge creation in their communities" and that librarians and libraries are key partners in the learning experiences of students. The study has provided new insights into the developing roles of librarians and the integration of their practice into the learning and teaching enterprise of higher education institutions. They were motivated by gaps in the literature as well as our personal interests in tracking innovations in learning and teaching in academic libraries, we decided to put together our own collection of innovative developments in library contributions to the educational mission of their institution. They were interested in discovering both what innovations librarians were implementing and evaluating, and how they were conceiving and approaching their projects; e.g., which activities and/or audiences are the focus for their innovations? Are their innovations primarily technological/technical, managerial/administrative, collaborative/inter-organisational, or another type of innovation?

Corrall (2014) carried out an exploratory study titled "Designing Libraries for Research Collaboration in the Network World: An Exploratory Study". The study states that advances in technology and changes in higher education and research are forcing libraries to rethink the services they offer to researchers and how they are presented. The study further states that librarians are moving into "higher end support" and adopting new service models based on "deep collaboration" with academic partners. The internal arrangements that form the design of an organization can determine whether it achieves its mission under particular conditions. The study explores how libraries in 24 leading UK research universities are organizing resources and services to support the research enterprise. They used qualitative data collected from institutional websites and other public domain sources and the data were analysed using matrix techniques. The results of their findings show a trend away from integrated library and computing service organizations; variety in institutional reporting lines, but predominantly in large professional service groups; consistency in internal library groupings, but variation in portfolio and job titles; expansion of specialist positions, with new functional roles complementing traditional subject liaisons; and dedicated spaces, working groups, and integrated websites promoting boundary-spanning activities. The findings confirm and extend prior work and are being used to design a large-scale international survey.

Method

The study adopted the descriptive survey design to collect opinions, feelings and beliefs of the respondents on the topic understudy. The study's population is 86 academic librarians in all the nine (9) university libraries in Kwara State, Nigeria. A total enumeration technique was adopted due to small size of the population and in order to give equal opportunity of participation in the study. A self-constructed questionnaire titled ***"Exploring the Roles of Academic Libraries as Dynamic Partners and Knowledge Hubs for Research Productivity and Professional Development among Academics"*** was prepared with online survey (Google Form). The questionnaire was sent to the respondents by sharing the link to WhatsApp platforms of all the participating university libraries through the help of a staff from each of the university library. Only 62 (72%) questionnaire were filled by the respondents after being left active for a

period of 30 days. Data collected were analyzed with the use of Statistical Package for the Social Sciences (SPSS) with the use of frequency counts, simple percentages and tables for interpretation.

Analyses of Results

Table 1: The Roles of Academic Libraries as Dynamic Partners in Supporting Research Activities and Professional Development.

Statements	SA	A	D	SD
Building Institutional Partnerships	16(25.8%)	29(46.7%)	12(19.3%)	5(8.0%)
Mentorship and Consultation Services	35(56.4%)	21(33.8%)	4(6.4%)	2(3.2%)
Training and Capacity Building for academics	25(40.3%)	22(35.4%)	10(16.1%)	5(8.0%)
Engaging with Global Networks for shared resources	28(45.1%)	21(33.8%)	9(14.5%)	4(6.4%)
Supporting Multidisciplinary Research	42(67.7%)	15(24.1%)	3(4.8%)	2(3.2%)
Facilitating Research Collaboration among academics	29(46.7%)	26(41.9%)	6(9.6%)	1(1.6%)

Study's Data, 2025

Table 2 reveals the roles of academic libraries as dynamic partners in supporting research activities and professional development. Respondents strongly agreed to Supporting Multidisciplinary Research 42(67.7%), Mentorship and Consultation Services 35(56.4%), Facilitating Research Collaboration among academics 29(46.7%), Engaging with Global Networks for shared resources 28(45.1%), Training and Capacity Building for academics 25(40.3%). However, 21(33.8%) of the respondents only agreed to Building Institutional Partnerships. This indicates that academic libraries play significance roles as dynamic partners in supporting research activities and professional development for the academics.

Table 2: The Roles of Academic Libraries as Knowledge Hubs in Supporting Research Activities and Professional Development.

Statements	SA	A	D	SD
Enhanced Access to Research Resources	37(59.6%)	19(30.6%)	5(8.0%)	1(1.6%)
Research Data Management and Curation	28(45.1%)	19(30.6%)	9(14.5%)	6(9.6%)
Digital Tools and Technologies for Research	25(40.3%)	25(40.3%)	8(12.9%)	4(6.4%)
Supporting Scholarly Publishing	39(62.9%)	20(32.2%)	2(3.2%)	1(1.6%)
Promoting Lifelong Learning among academics	32(51.6%)	25(40.3%)	3(4.8%)	2(3.2%)
Open-Access Initiative Programs	29(46.7%)	26(41.9%)	6(9.6%)	1(1.6%)
Bibliometric Analysis Services	30(48.3%)	26(41.9%)	5(8.0%)	1(1.6%)

Source: Study's Data, 2025

Table 3 reveals the roles of academic libraries as knowledge hubs in supporting research activities and professional development. Respondents strongly agreed to Supporting Scholarly Publishing 39(62.9%), Enhanced Access to Research Resources 37(59.6%), Promoting Lifelong Learning among academics 32(51.6%), Bibliometric Analysis Services 30(48.3%), Open-Access Initiative Programs 29(46.7%), Research Data Management and Curation 28(45.1%). However, 25(40.3%) of the respondents respectively strongly agreed and agreed to Digital Tools and Technologies for Research. This indicates that academic libraries play invaluable roles as knowledge hubs in supporting research activities and professional development.

Table 4: The Innovative Technologies Adopted by Academic Libraries to Align their Services with the Changing Needs of Researchers and Academics.

Statements	SA	A	D	SD
Artificial Intelligence and Machine Learning	12(19.3%)	16(25.8%)	22(35.4%)	12(19.3%)
Virtual and Augmented Reality	11(17.7%)	13(20.9%)	16(25.8%)	22(35.4%)
Enhanced Digital Repositories	30(48.3%)	20(32.2%)	8(12.9%)	4(6.4%)
Cloud Computing Services	27(43.5%)	20(32.2%)	10(16.1%)	5(8.0%)
Blockchain for Academic Integrity	12(19.3%)	18(29.0%)	18(29.0%)	14(22.5%)
Open-Access Academic Databases	38(61.2%)	22(35.4%)	2(3.2%)	0(0.0%)
Electronic Document Delivery Services	13(20.9%)	17(27.4%)	19(30.6%)	13(20.9%)

Study's Data, 2025

Table 4 reveals the innovative technologies academic libraries adopted to align their services with the changing needs of researchers and academics. Respondents strongly agreed to Open-Access Academic Databases 38(61.2%), Enhanced Digital Repositories 30(48.3%), Cloud Computing Services 27(43.5%). This implies that academic libraries adopted innovative technologies to align their services with the changing needs of researchers and academics. However, some respondents strongly disagreed to Virtual and Augmented Reality 22(35.4%), Blockchain for Academic Integrity 14(22.5%) and Electronic Document Delivery Services 13(20.9%).

Discussion of Findings

The findings of this study have revealed that academic libraries play significant roles as dynamic partners in supporting research activities and professional development. Such roles include *Supporting Multidisciplinary Research.* This is in line with a statement of Nwalo (2014), that academic libraries have evolved into knowledge hubs that provide access to digital resources, offer research support services, and contribute to the overall academic development of institutions. Another role is *Mentorship and Consultation Services,* which is supported by the statement of Tenopir et al. (2017), that library involvement in academic research enhances the quality of outputs by providing researchers with the necessary tools, resources, and expertise. *Facilitating Research Collaboration among academics,* is another role and it is in line with the statement of Dempsey (2015), that the future of libraries is not just about managing collections but also about facilitating knowledge creation and collaboration among researchers. Similarly, Roy and Habib (2024) states that effective collaboration between library and information science academics and practitioners is vital for the professional growth and success of individuals working in the field. The findings of the study by Roy and Habib (2024) highlighted the significance of mindset and attitude in influencing collaborative efforts, urging academics and practitioners to adopt an open-minded approach without ego-related conflicts.

Another role academic library plays is *Engaging with Global Networks for shared resources,* but it contradicted the findings of Vinopal and McCormick (2013), that the developments in digital media, network technologies, research workflows, scholarly communication and funding policies are challenging academic libraries to respond with a wider array of services and facilities for researchers. Similarly, Rowlands et al. (2018) states that libraries are evolving to become knowledge brokers, facilitating partnerships between researchers, students, faculty, and external organizations. Also, *Training and Capacity Building for academics*, as affirmed by the findings of Brown and King (2018), that professional development programs facilitated by libraries contribute significantly to improving academic staff's research output, teaching quality, and technological competence. Similarly, Allen (2017) found out that researchers who actively engaged with library services, including consultation and training, produced higher-quality research outputs. Also, Hensley and Brown (2019) demonstrated that libraries that foster collaborative environments and provide mentorship programs to researchers positively impact the professional development of academics, helping them to improve their research skills and academic.

Furthermore, findings of this study have also revealed the invaluable roles of academic libraries as knowledge hubs in supporting research activities and professional development. Such roles include *Supporting Scholarly Publishing*. This is affirmed by findings of Roy and Habib (2024), that effective collaboration between library and information science academics and practitioners will facilitate the exchange of knowledge, skills and innovative practices, which, in turn, enhance the quality of library services. Further revealed that it will also allow for the integration of theoretical knowledge with practical experience, resulting in more effective and efficient library. However, it is contradicted by the findings of Shen (2012), that academics and librarians are still mostly working separately due to differences in their

goals, nature of work, expertise and status. Another role is *Enhanced Access to Research Resources*, as it is in line with the study of Cox (2023), that academic library is an established presence, a democratic place on campus, usually liked, trusted, respected for its compatible values and strong service ethic, and viewed as a decent citizen of the institution with an outlook oriented towards support, collaboration and the public good. However, Coates (2017) identified financial constraints, inadequate infrastructure, and a lack of sufficient digital tools hinder the ability of libraries to meet the demands of modern academic research. *Promoting Lifelong Learning among academics*, is another role as it is supported by Sulaiman et al. (2019), they emphasize the need for library services to include digital literacy training, equipping academics with the skills needed to effectively use digital databases, research management tools, and collaborative platforms.

Another invaluable role of academic libraries as knowledge hubs in supporting research activities and professional development is *Bibliometric Analysis Services,* as it is in line with the stamen of Gibbons (2016), that academic libraries support researchers through services like data management, citation tracking, and bibliometrics, which contribute to effective research workflows. *Open-Access Initiative Programs,* is another role as it is supported by Corrall (2014) that librarians are moving into "higher end support" and adopting new service models based on "deep collaboration" with academic partners. Also, Jaguszewski and Williams (2013), that academic libraries support for research has emerged as a strategic issue and generated studies investigating service developments, new roles, skills requirements. *Research Data Management and Curation,* is also another role. It is affirmed by the study of Revez (2018), which highlighted research support services, research data management, or research information management as the emerging roles, among others, sustaining an open path where libraries thrive to be more collaborative while looking forward to establishing new partnerships. Similarly, Heidorn (2018) states that libraries are providing services such as data curation, repository management, and assisting with data sharing in compliance with ethical standards and institutional.

Finally, the findings of this study identified the innovative technologies academic libraries adopted to align their services with the changing needs of researchers and academics. Such innovative technologies include *Open-Access Academic Databases.* This is in line with the study of Cox (2023), which focused on weaknesses and threats as factors hindering academic libraries position and prospects. The examination of these factors is followed by a discussion of the whole analysis and a proposed framework for future strategy development and positioning, based on ten strategic directions emerging from the analysis. These are: active positioning; knowing the territory; being politically attuned; prioritizing outward engagement; maximizing social capital; value and identity; embracing uncertainty; addressing diversity deficits; leveraging change in scholarly communications; and maintaining long-term perspective. Another innovative technology is *Enhanced Digital Repositories,* as it is supported by the study of Harnad (2020), that libraries have been at the forefront of developing institutional repositories where research data can be stored, shared, and reused, further advancing the open-access movement. Also, Corrall (2014) states that advances in technology and changes in higher education and research are forcing libraries to rethink the services they offer to researchers and how they are presented. *Cloud Computing Services*, is another innovative technology as it is supported by the findings of Corrall (2014), the findings showed a trend away from integrated library and computing service organizations; variety in institutional reporting lines, but predominantly in large professional service groups; consistency in internal library groupings, but variation in portfolio and job titles; expansion of specialist positions, with new functional roles complementing traditional subject liaisons; and dedicated spaces, working groups, and integrated websites promoting boundary-spanning activities.

Conclusion

The present and future of academic libraries lies in their ability to adapt, innovate, and collaborate as dynamic partners and knowledge hubs to support research productivity and professional development of academics. They can empower academics to excel in their research work and contribute meaningfully to academic society. Through continuous evolution and adoption of emerging technologies, academic libraries will remain indispensable pillars of research excellence and professional advancement. This study underscores the paramount roles of academic libraries as dynamic partners in support research productivity and professional development of academics in Kwara State. Academic libraries support multidisciplinary research and facilitate research collaboration among academics by playing a crucial role in fostering interdisciplinary collaborations, curating resources and creating platforms for diverse academic interactions. They also provide mentorship and consultation services by employing research consultants and subject librarians who provide personalized mentorship to academics. These services range from literature searches to grant proposal development. They engage with global networks for shared resources by participating in consortia to foster global knowledge-sharing networks and enable academics to access resources and expertise beyond institutional boundaries. They also offer training and capacity building for academics by organizing tailored workshops on information literacy, digital proficiency, research methodologies, and academic writing. These programs empower academics to enhance their research skills and professional capabilities.

This study further underscores invaluable roles of academic libraries as knowledge hubs in support research productivity and professional development of academics in Kwara State. Academic libraries supporting scholarly publishing by providing guidance on publishing strategies, including selecting

appropriate journals, understanding copyright, and navigating peer review processes. They enhance access to research resources by investing in digital resources, such as e-journals, databases, and institutional repositories to provide academics with seamless access to cutting-edge knowledge. They also promote lifelong learning among academics by curating relevant resources, offering learning opportunities, and adapting to emerging trends in education and research. They provide open-access initiative and inter-library loan programs to further enhance the accessibility of research materials. They also offer research data management and curation by providing data storage, preservation, and sharing platforms to academics comply with data management policies and maximize the impact of their work. Finally, this study underscores innovative technologies academic libraries adopted to align their services with the changing needs of researchers and academics. Academic libraries offer open-access to academic databases; enhanced digital repositories; and cloud computing services by providing cloud-based platforms to enable secure, scalable, and accessible repositories for storing research outputs, theses, and dissertations.

However, based on the findings, this study hereby provides the following recommendations: **(i)** Academic libraires needs to do more on building institutional partnerships by collaborating with academic departments, research centers, and external organizations to develop shared resources and programs that benefit researchers. **(ii)** Academic libraries should adopt more digital tools and technologies for research such as citation managers, plagiarism detection software, and research analytics platforms. These tools streamline the research process, ensuring accuracy, efficiency, and visibility of research outputs. **(iii)** Academic libraries should adopt artificial intelligence and machine learning for personalized recommendations and advanced search tools that will enhance research process and user experience. **(iv)** Academic libraries should also provide virtual and augmented reality to facilitate innovative teaching, learning, and research practices. **(v)** Academic libraries should integrate blockchain for academic integrity to address issues of academic integrity, authorship verification, and research transparency. **(vi)** Academic libraries can make use of electronic document delivery services for academics to fast-track research process.

References

Allen, D. (2017). The impact of library services on academic performance and research productivity: A case study of researchers in a university setting. *Journal of Academic Librarianship, 43*(5), 267-274.

Brown, J. & King, C. (2018). Professional development through library training: A case study in academic faculty development. *Journal of Education and Library Services, 45*(2), 112- 118.

Coates, E. (2017). Challenges in academic libraries: Managing limited resources in an era of technological change. *Journal of Library Administration, 57*(6), 617-632.

Corrall, S. (2014). Designing libraries for research collaboration in the network world: An exploratory study. *Liber Quarterly, 24*(1), 17–48.

Corrall, S. & Jolly, L. (2019). Innovations in learning and teaching in academic libraries: Alignment, collaboration, and the social turn. *New Review of Academic Librarianship, 25*(2-4), 113-128. https://doi.org/10.1080/13614533.2019.1697099

Cox, J. (2023). The position and prospects of academic libraries: Weaknesses, threats and proposed strategic directions, *New Review of Academic Librarianship,* 29(3), 263-287. https://doi.org/10.1080/13614533.2023.2238691

Dempsey, L. (2015). The future of libraries: Building partnerships for knowledge creation and dissemination. *Library Trends, 64*(2), 274-290.

Diep, K. C. (2011). A conceptual framework for best practices in information literacy instruction based on stakeholders' perceptions: A case study of four Vietnamese academic libraries. PhD Thesis, University of Hawaii at Manoa, Honolulu, HI. http://search.proquest.com/docview/892022682?accountid12528

Gibbons, S. (2016). Library as research partner: Enhancing productivity and fostering collaboration. *College & Research Libraries, 77*(5), 663-675.

Harnad, S. (2020). The open data movement: Implications for academic libraries and research dissemination. *Journal of Open Science, 8*(3), 95-102.

Harris, M. & Albury, D. (2009). The innovation imperative: Why radical innovation is needed to reinvent public services for the recession and beyond. London: NESTA. https://media.nesta.org.uk/documents/the_innovation_imperative.pdf.

Heidorn, P. B. (2018). Research data management: Libraries' role in supporting data curation and sharing. *Information Services and Use, 38*(3), 235-249.

Hensley, M. & Brown, R. (2019). The role of libraries in supporting academic careers and professional development. *Journal of Library Administration, 59*(5), 581-599.

Jaguszewski, J. M. & Williams, K. (2013). New roles for new times: Transforming liaison roles in research libraries. Washington, DC: Association of Research Libraries. http://www.arl.org/storage/documents/publications/NRNT-Liaison-Roles-final.pdf.

Lankes, R. D. (2011). The atlas of new librarianship. Cambridge, MA: MIT Press.

https://davidlankes.org/new-librarianship/the-atlas-of-new-librarianship-online/

Nwalo, K. (2014). The role of academic libraries in promoting research and scholarly communication in Africa. *African Journal of Library, Archives and Information Science, 24*(2), 103-115.

Pham, H. T. & Tanner, K. (2014). Collaboration between academics and librarians: A literature review and framework for analysis. *Library Review, 63*(1/2), 15-45. https://doi.org/10.1108/LR-06-2013-0064

Pinfield, S.; Cox, A. M.; Rutter, S. (2017). Mapping the future of academic libraries: A report for SCONUL. Society of College, National & University Libraries: London, UK.

Revez, J. (2018). Opening the heart of science: A Review of the changing roles of Research libraries. *MDPI Publications,* 6(9). https://doi.org/10.3390/publications6010009

Rowlands, I., Nicholas, D., Russell, B., Canty, N. & Watkinson, A. (2018). The evolving role of academic libraries in supporting collaborative research. *Journal of Librarianship and Information Science, 50*(4), 316–328. https://doi.org/10.1177/0961000616663643

Rowley, J. (2011). Should your library have an innovation strategy? *Library Management, 32*(4/5), 251–265. https://doi.org/10.1108/01435121111132251

Roy, P. & Habib, M. A. (2024). Fostering effective collaboration between library and information science academics and practitioners in Bangladesh: Insights, challenges and recommendations. *IFLA Journal. 50*(3), 574–590. https://doi.org/10.1177/03400352241236737

Shen, L. (2012). Improving the effectiveness of librarian-faculty collaboration. *Collaborative Librarianship, 4*(1), 14-22.

Sulaiman, S., Halim, A. H. A. & Ghazali, N. (2019). Digital literacy training for academic staff: A vital service provided by libraries. *Library and Information Science Research, 41*(2), 146–159. https://doi.org/10.1016/j.lisr.2019.04.002

Tenopir, C., Birch, B. & Allard, S. (2017). Academic libraries as research partners: Their role in supporting faculty productivity. *Information Processing & Management, 53*(3), 558–568. https://doi.org/10.1016/j.ipm.2016.11.005

Vinopal, J. & McCormick, M. (2013). Supporting digital scholarship in research libraries: Scalability and sustainability. *Journal of Library Administration, 53*(1), 27–42. https://archive.nyu.edu/bitstream/2451/31698/2/Vinopal_McCormick_Final.pdf.

Walter, S. & Lankes, R. D. (2015). The innovation agenda. *College & Research Libraries, 76*(7), 854–858. https://doi.org/DOI:10.5860/crl.76.7.854

Access and Utilization of Information and Communication Technology (ICT) Facilities for Academic Performance of Undergraduate Students in Private University Libraries in Abuja, Nigeria

By
AJI, KINGSLEY OLAWALE
Federal Capital Territory
College of Education, Zuba
College Library Service
Whatsapp Line: 09013480277
Kingsola4u2003@gmail.com

Abstract

The study investigated access and utilization of Information and Communication Technology (ICT) facilities for academic performance of undergraduate students in private University libraries in Federal Capital Territory, Abuja, Nigeria. It sought to establish the relationship between ICT facilities and students' academic performance particularly looking at the accessibility and utilisation of ICT facilities in private university libraries in FCT, Abuja. The study was guided by three research questions. Survey research design was used for the study. Population comprised of all the 3,376 undergraduate students in private Universities in Abuja. Nigeria. Proportionate and stratified random sampling technique was used and Cohen, Manion and Morrison (2007) table for selecting a sample size of 364 undergraduate students. A self designed questionnaire was used for data collection. Findings show that out of 364 copies of the questionnaire administered, 351 were completed, returned and found usable showing a response rate of 96%. Data were analysed using descriptive and inferential statistics and results were presented in tables, frequency distribution, percentages, and mean score. Findings of the study showed that ICT facilities were highly accessible by undergraduate students in meeting their academic needs. The study also revealed that in private university libraries in Abuja, majority of undergraduate students agreed to the utilization of ICT facilities in libraries for: obtaining current information in their field of study, processing information, storing information, retrieving information, disseminating information among others. It was discovered that majority of the respondents positively agreed that ICT facilities aid their academic performance in the following areas: completing their project report, learning independently, typing of course work and assignment, applying what has been learnt in real world situation, improving their organizational skills, GPA have improved remarkably through the use of ICT facilities among others. The study recommended that: more financial support should be made available to provide the basic ICT infrastructural facilities, information literacy should be incorporated in school curriculum, expansion of the e-library unit for students to have access to ICT infrastructures, provision of internet services in the students hostel as well as classroom and among others.

Keywords: *Academic performance, Access,, information and Communication Technologies (ICT), private Universities, Abuja, utilization, Undergraduate students*

Introduction

Students Academic performance remains central in any institution of learning, as it measure the extent to which learning objective is achieved in the learner. This involves hard work and discipline on the path of students to achieve academic excellence, and this attitude tends to differentiate the achievers, who make rapid strides in their career from others. A wise man once said that "more devastating than the mismanagement of natural resources is the waste of *human* resources." Great people are never satisfied with mediocrity. They cannot take pleasure in an unfulfilled life. They are always on the lookout to see how they can become better and when they see human excellence or the opportunities for it, they get thrilled and look for ways to achieve it themselves. The only way mankind would achieve excellence in his career prospect is by commitment and dedication to work. Undergraduate students who are not left out in the quest for personal development always strive to perform excellently in their academic pursuit in universities. Academic performance according to Trowel in Odeh, Ogwuche & Ivagher (2015) is defined as "knowledge attaining ability or degree of competence in academic task usually measured by standardised tests and expressed in a grade or units based on students' performance". In the same vein, Rabiu (2016) defined academic performance as achievement acknowledged and skill possessed by an individual as a result of instructions. One of the major means of achieving academic performance by university students is through the use of ICT facilities , especially the ones available in university libraries for research, assignment, project and other academic task.

Information and communication Technology (ICT) has been identified as one of the key driving forces of change and innovation in the modern era. ICT has flooded every aspect of human life, including the field of education. ICT tools facilitate collaborative learning and knowledge sharing among students and lecturers, enabling them to exchange ideas and feedback in real-time (Gbadura, Sadiq & Abdu, 2023). The availability of Information and Communication Technologies (ICTs) Facilities in libraries have not only increased or broadened the impact of information resources at their door steps, but also placed more

emphasis on effective and efficient services. ICT application in libraries, commonly known as library automation, have indeed continue to ease and promote quick and timely access to and transfer of information resources that are found dispense round the globe. Adenuga (2012) asserted that ICT facilities and services available in libraries include computers, access to the internet ant it resources, Local Area Networks (LANs), Compact Disc- Read Only Memory (CD-ROM) databases, online databases, Online Public Access Catalogues (OPACs), photocopiers, Interlibrary lending and Document Delivery (ILL/DD) services, computer laboratories, scanners, printers, microfiche readers and telephones among others.

Access to Information and Communication Technology facilities significantly enhances students' academic performance by improving research capabilities, communication, and academic engagement. Jude & Dankara (2017) opined that the lack of access to ICT facilities, teacher educators faced challenges in utilizing modern teaching methods that rely on technology which are essential for enhancing students' engagement and academic performance. Accessibility to Information and communication Technology facilities has become a crucial determinant of academic performance in university education globally.

Universities and policy makers increasingly recognize and emphasize the importance of information and Communication Technology (ICT) in enhancing academic outcomes of undergraduate students in Nigeria. Okoro and Ekpo (2016) opined that institutions of higher learning provide computer and Information Technology as learning materials to gain knowledge and experience. Students now have more understanding during teaching process. The internet for instance provides a wide range of information and learning tools in educational lines. The objective of the exercise is to prepare students in solving problems. One method is by using multimedia activities. Besides learning, the instructor can attract the students' interest in learning process and they understand more if they learn by using something that will attract their interest. ICT plays some important roles in student academic performance by enabling them to associate between concrete, tangible fact from abstract ones, also help to promote the students retention and also facilitate the simulation and recovery phase. Okoro and Ekpo (2016) further stated that the computer tends to be an excellent tool for education. The idea is that students will be active participants rather than spectator in teaching and learning process.

As at 2024 there were 272 universities in Nigeria approved by the National University Commission (NUC) being owned by federal and state governments as well as private organisations. Regardless of their ownership, the objectives of establishing them are not far from teaching, learning and community services. Libraries established within these universities support the objectives by providing information resources to support teaching, learning, research and community services. In FCT Abuja, there are six (6) universities in the territory with two Federal and four Private universities. These universities are University of Abuja, National Open University of Nigeria, African University of Science and Technology, Abuja, Veritas University, Baze University and Nile University, Abuja. The universities identified had successfully implemented ICT in their library operation.

Problem statement

Students' academic performance remains central in any institution of learning, as it measure the extent to which learning objective is achieved. ICTs provide opportunity for educational institutions and other agencies to harness and utilize technology to compliment and support the teaching and learning process. However, in spite of the enormous advocacy of ICT aided teaching and learning, investment and donation of ICT equipment to universities in Nigeria, universities still face the challenge of how to transform students learning process to provide functional and effective information using ICTs in this dynamic, information-rich, and continuously changing environment. Undergraduate students in private universities in Abuja find it difficult to access and use ICT facilities to achieve their information needs so as to pursue academic and research activities. The cause of concern is that unless this problem is addressed, investment in the deployment of ICTs in universities in Nigeria is going to be a waste and improvement in the quality of teaching and learning is going to be sluggish. This may make universities fail to achieve its mission and to produce graduates who are ready for the world of work which is increasingly reliant on ICT aided generation and dissemination of knowledge. In view of this problem, there is need to examine the impact of Information and Communication Technology (ICT) facilities access and use on academic performance of undergraduate students in private university libraries in Federal Capital Territory Abuja, which will aim at bridging the gap on accessibility and use of Information and Communication Technology (ICT) facilities for academic performance of undergraduate students in university libraries FCT, Nigeria.

Objectives of the Study

The study examined the impact of Information and Communication Technology (ICT) facilities access and use on academic performance of undergraduate students in private university libraries in Federal Capital Territory Abuja, Nigeria. However the specific objectives are to;

1. Determine the level of accessibility of ICT facilities by undergraduate students in the selected private university libraries in FCT Abuja, Nigeria;
2. Determine the utilization of ICT facilities by undergraduate students in the selected private university libraries in FCT Abuja, Nigeria;
3. Determine the influence of the ICT facilities on undergraduate students academic performance in the selected private university libraries in FCT Abuja, Nigeria;

Literature Review

The influence of Information and Communication Technology (ICT) on students' academic performance and national development cannot be overemphasized, and this has motivated academic libraries to establish electronic library (e-library) where patrons can readily access information from the internet. Opportunities of this nature are bound in universities and other higher institutions of learning in Nigeria in consonance with the goals of tertiary education which among others include: to acquire both physical and intellectual skills which will enable individuals to be self-reliance and useful members of the society (Igba, 2018).

Abdullahi and Haruna (2008) carried out a study on the utilisation of Information and Communication Technology (ICT) for information service delivery in university libraries in Adamawa state. It is a survey design. The sample population was 578 respondents in 3 universities in Adamawa State. 517 duly completed questionnaires were retrieved and used for data analysis. The findings of the study revealed that, university libraries in Adamawa State with high level of computer utilisation are efficient in the delivery of information service. Findings also revealed that there is significant difference among university libraries in Adamawa State in the levels of CD-ROM utilisation and information service delivery. The statistically significant difference between University libraries in CD-ROM utilization to high and low level could be interpreted as the utilisation of CD-ROM is higher in ABTI American University Library followed by Adamawa State University Library and then Federal University of Technology Yola, which indicate that university libraries that have high usage of CD-ROM tend to render more efficient information service. The utilisation of internet significantly differed in University libraries in Adamawa State and information service delivery. The pattern of response could be interpreted this way, that utilisation of internet for information service delivery is higher in ABTI American University, followed by Adamawa State University and Federal University of Technology Yola, which means the University with Higher responses on internet utilisation, enjoys qualitative information service delivery. Findings show that there is significant difference among University libraries in Adamawa State in utilisation of e-mail and information service delivery. The paper revealed that ABTI American University of Nigeria library indicate a high response on the utilisation of e-mail as respondents seems to achieve a 100% information service delivery via e-mail utilization. The findings also revealed that majority of the respondents were of the view that they had speedy access to information resources in the University libraries. Findings from the study also indicate that majority of the respondents were of the view that ICT training and development programme sponsored by the University libraries was mainly through orientation/induction course. However as revealed from the study, the problems associated with ICT utilisation in University libraries in Adamawa State are frequent power failure and lack of alternative power source. The paper recommends that adequate ICT facilities be provided in all the sections/units of the university libraries, alternative power source be provided in the libraries and the library staff should be exposed to ICT training and retraining to enhance acquisition of basic ICT skills. This will, to a large extent, improve the quality of information service delivery in libraries.

In a related study conducted by Yisadoko, Aji & Martin(2023) on the influence of Information and Communication Technology (ICT) on Post Graduate students' research activities in five Federal University Libraries in North Central, Nigeria. The objectives of the study were to find out the research activities of postgraduates' student, availability of ICT facilities, influence of ICT on research activities and challenges in the utilisation of ICT facilities. Four research questions were formulated to guide the study. Two null hypotheses were tested at 0.05 level of significance using PPMC. Descriptive survey design was employed for the study and sample size of 311 postgraduate students, five (5) Heads of ICT unit in the university libraries were used, stratified proportionate sampling technique was used to select sample. The instruments used for data collection were structured questionnaire and observation checklist. A total of 311 copies of questionnaire were distributed to the respondents out of which 287 copies were dully filled and returned representing 93% response rate. Descriptive statistics was used to analyse the data. The findings revealed that ICT facilities are available for research at different levels in the federal university libraries under study. It also shows that ICT facilities influence research activities in finding and communicating information quickly and easily. The study identifies insufficient ICT facilities, irregular power supply, poor Internet connectivity as the challenges for effective utilisation of ICT facilities for research. The study recommends provision of sufficient computers with Internet connectivity, improvement in ICT infrastructure in university libraries, provision of adequate electricity with alternative sources of power.

Isah (2016) investigated the effect of access and utilisation of electronic resources on academic performance of postgraduate students in universities in North central Nigeria. Five objectives of the study guided the researcher and corresponding five research questions. Relevant literatures were reviewed in relation to the objectives of the study. The study adopted descriptive survey research design and was guided by five research questions. Questionnaire was used as the primary instrument for data collection. The total population for the study is 9085 postgraduate students and sample size of 357 post graduate students were used for the study and a response rate of 77% was obtained for data analysis. Findings of the study revealed that electronic books and electronic databases are the most available electronic resources. Although the utilisation of these resources is low and access and use of e-resources has improved the academic productivity of post graduate students in universities in north central Nigeria. The study recommended increased investment in ICT facilities at the surveyed universities to promote increase access and use of electronic resources by post graduate students in North central Nigerian Universities.

Methodology

Descriptive survey research design was adopted for the study. The target population for the study constitutes of 3,376 undergraduate students across the three selected private universities in Abuja. A sample size of 364 undergraduate students was drawn out of the total population of 3,376 undergraduate students using proportionate stratified random sampling technique. This involves arranging the population according to strata or layers. These strata within the proposed study were the various faculties across the three selected private universities in Abuja. Using a sample size of 364 respondents is in line with Cohen, Manion and Morrison (2007) which stipulated that in a population size of 5,000 respondents, a sample size of 364 with confidence level of 95% is adequate. However the researcher decided to select 364 undergraduate students from a population of 3,376 which is not up to 5,000.

Self designed questionnaire was used for data collection. Descriptive and inferential statistic using frequency count, percentages and mean score were used for data analysis. . A benchmark of 2.50 mean score was considered as accepted, while below 2,50 was rejected

Result and Discussion

Data were analyzed with the use of descriptive statistics using frequency count, simple percentages, and mean score

Table 1: Level of Accessibility to ICT facilities by undergraduate students in selected private university libraries in FCT-Abuja

S/N	Undergraduate students level of access to ICT facilities in university libraries	Very High(VH)	High(H)	Low(L)	Very Low(VL)	□	Decision
1	ICT facilities are accessible in the university library for student research	65(18.5%)	138(39.3%)	114(32.5%)	34(9.7%)	2.67	Accepted
2	Undergraduate students access ICT facilities in the library frequently for assignment	39(11.1%)	117(33.3%)	145(41.3%)	50(14.2%)	2.41	Rejected
3	Access tools are adequate for accessing ICT resources in library in preparation for examination	66(18.8%)	131(37.3%)	118(33.6%)	36(10.3%)	2.65	Accepted
4	Undergraduate students access ICT facilities to meet their academic needs	87(24.8%)	142(40.5%)	98(27.9%)	24(6.8%)	2.83	Accepted
5	Basic ICT skills are used to access ICT facilities to enhance academic achievement	70(19.9%)	128(36.5%)	114(32.5%)	39(11.1%)	2.65	Accepted

Table 1 showed the level of accessibility of ICT facilities by undergraduate students in private universities in FCT Abuja. On accessibility of ICT facilities in library for research, the table revealed that majority of the respondents indicated that the level of access to ICT facilities in library is high with a mean score of (x=2.67). On the frequency of access to ICT facilities in library by undergraduate students for assignment, majority of the respondents indicated that the frequency of access to ICT facilities in library is low with a mean score of (x=2.41). On the adequacy of access tools for accessing ICT resources in library in preparation for examination majority of the respondents indicated that the level of adequacy of access tools for accessing ICT resources is high with a mean score of (x=2.65). On accessing ICT facilities by undergraduate students in library to meet their academic needs most of the respondents indicated that the level of access to ICT facilities in meeting their academic needs is high with a mean score and of (x=2.83). Majority of the respondents also indicated that the level of ICT literacy skills for accessing ICT facilities in library to enhance academic achievement is high with a mean score of (x=2.65).

Table 5: Utilization of ICT Facilities by Undergraduate Students in selected private university libraries in FCT-Abuja, Nigeria

Key: FX- weight, STD-Standard Deviation **X-** Mean, SA-Strongly Agreed, A-Agreed, D-Disagreed, SD-Strongly Disagreed

Table 2 revealed the reasons for the utilization of ICT facilities by undergraduate students in private university libraries in FCT, Abuja. Out of the eleven items provided for undergraduate

S/N	utilization of ICT facilities by Undergraduate students	SA 4	A 3	D 2	SD 1	$\bar{X}$	Decision
1	Obtaining current information in their field of study to enhance research productivity	153(43.6%)	140(39.9%)	31(8.8%)	27(7.7%)	3.19	Accepted
2	Processing information to enhance high CGPA	109(31.1%)	197(56.1%)	40(11.4%)	5(1.4%)	3.17	Accepted
3	Storing information for study	104(29.6%)	179(51.0%)	66(18.8%)	2(0.6%)	3.09	Accepted
4	Retrieving information for research	110(31.3%)	157(44.7%)	72(20.5%)	12(3.4%)	3.30	Accepted
5	Disseminating information for continuous assessment	119(33.9%)	140(39.9%)	73(20.8%)	19(5.4%)	3.02	Accepted
6	Online registration of courses	191(54.4%)	139(39.6%)	13(3.7%)	8(2.3%)	3.46	Accepted
7	Compilation and completion of assignment	151(43.0%)	143(40.7%)	27(7.7%)	30(8.5%)	3.18	Accepted
8	Test and examination	64(18.2%)	132(37.6%)	91(25.9%)	64(18.2%)	2.56	Accepted
9	For entertainment and relaxation	87(24.8%)	126(35.9%)	78(22.2%)	60(17.1%)	2.68	Accepted
10	Online business transaction	86(24.5%)	123(35.0%)	78(22.2%)	64(18.2%)	2.66	Accepted
11	Project work/Research compilation	175(49.9%)	137(39.0%)	30(8.5%)	9(2.6%)	3.36	Accepted

students to indicate their reasons for the utilization of ICT facilities in private university libraries. All of the items yielded a high mean score values above 2.50 on a 4-point Likert Scale. These items include item 1: Obtaining current information in their field of study to enhance research productivity(X=3.19); item 2: Processing information to enhance high CGPA(X=3.17); item 3 Storing information for study (X=3.09); item 4: Retrieving information for research(X=3.30);item 5: Disseminating information for continuous assessment(X=3.02); item 6:Online registration of courses(X=3.46); item 7: Compilation and completion of assignment(X=3.18); item 8: Test and examination(X=2.56); item 9: For entertainment and relaxation(X=2.68); item 10: Online business transaction (X=2.66); item 11: Project work/Research compilation (X=3.36). This reveals that majority of the respondents agreed to the utilization of ICT facilities in private university libraries in FCT, Abuja for academic purposes.

Table 3: Impact of the use of ICT facilities on undergraduate students' Academic performance in selected private university libraries in FCT Abuja, Nigeria

S/N	Impact of ICT on undergraduate students Academic Performance	SA	A	D	SD	$\bar{X}$	Decision
1	I use the computer to complete my projects, reports	82(23.4%)	168(47.9%)	61(17.7%)	40(11.4%)	2.83	Accepted
2	ICT allows me to learn independently	104(29.6%)	142(40.5%)	82(23.4%)	23(6.6%)	2.93	Accepted
3	I use the computers to type course work and assignments	86(24.5%)	158(45.0%)	64(18.2%)	43(12.3%)	2.82	Accepted
4	I CT helps me apply what have been learnt to the real world situation	100(28.5%)	141(40.2%)	86(24.5%)	24(6.8%)	2.90	Accepted
5	ICT improves my organizational skills	112(31.9%)	122(34.8%)	70(19.9%)	47(13.4%)	2.85	Accepted

6	ICT makes me develop interest in the learning content	86(24.5%)	168(47.9%)	72(20.5%)	25(7.1%)	2.90	Accepted
7	My GPA has been on the decline	62(17.7%)	66(18.8%)	93(26.5%)	130(37.0%)	2.17	Rejected
8	I use the internet to collaborate with others/team	90(25.6%)	108(30.8%)	113(32.2%)	40(11.4%)	2.71	Accepted
9	My GPA has improved remarkably	106(30.2%)	148(42.2%)	48(13.7%)	48(14.0%)	2.89	Accepted

Table 3 revealed the academic performance of undergraduate students through the use of ICT facilities in private university libraries in FCT-Abuja**.** On computer usage majority of the respondents (71.4%) positively agreed that they use computer to complete their project report with a mean score of (x=2.83). On independent learning majority of the respondents (70.0%) positively agreed that ICT allows them to learn independently with a mean score of (x=2.93). On typing of course work and assignment majority of the respondents (69.4%) positively agreed that they use the computer to type their course work and assignments with a mean score of (x=2.82). On application of learning to real world situation majority of the respondents (68.8%) strongly agreed and agreed that I CT helps them apply what have been learnt to the real world situation with a mean score of (x=2.90). On organizational skills majority of the respondents (66.8%) positively agreed with a mean score of (x=2.85). On interest in learning most of the respondents (72.3%) positively agreed and that ICT makes them develop interest in learning with a mean score of (x=2.90). On decline of GPA majority of the respondents (63.5%) disagreed that their GPA has been on the decline through the use of ICT facilities with a mean score of (x=2.17). On collaborating with others majority of the respondents (56.3%) positively agreed they use the internet to collaborate with others with a mean score of (x=2.71). On improvement of GPA through the use of ICT facilities majority of the respondents (72.3%) positively agreed that their GPA has improved remarkably through the use of ICT facilities with a mean score of (x=2.89).

Discussion of findings

This study examined the impact of ICT facilities access and use on the academic performance of undergraduate students' in private University libraries in FCT Abuja. In response to research question one, the study revealed a high level of accessibility to ICT facilities in libraries by undergraduate students in meeting their academic needs (see Table 1). This is supported by Moahi(2009) who found that ICTs have allowed information to be effectively managed and harnessed in universities and this has obviously led to enhanced access to information.

In response to research question two, The majority of undergraduate students in private university libraries in FCT, Abuja as revealed from Table 2 agreed to the utilization of ICT facilities for: obtaining current information in their field of study, processing information, storing information, retrieving information, disseminating information, online registration, assignment, test and examination, online business transaction and research work. From the findings of this study it shows that undergraduate students utilised ICT facilities in meeting their academic needs. The general high utilization of ICT facilities could be as a result of students being aware of ICT infrastructures in university libraries and also having the requisite skills to access and use them. The above findings also support the findings Oguike and Aji (2017) who discovered that library patrons and academic staff utilize ICT facilities for: acquiring information, processing information, storing information, disseminating information, entertainment and relaxation among others. In addition Mahmood (2009) discovered that students used the computer for the following: social media, collaborating with others, assignment, relaxation, entertainment among others. Mahmood's work also showed that students used computers more for word processing, presentations, statistical analysis, and emails.

Response to research question three on the influence of the use of ICT on undergraduate students academic performance revealed that a reasonable number of respondents positively agreed that ICT facilities aid their academic performance in the following areas: completing their project report, learning independently, typing of course work and assignment, applying what has been learnt in real world situation, improving their organization skills as well as corroborating with others. A good number of respondents also indicated that their Cumulative Grade Point Average (CGPA) have improved remarkably through the use of ICT facilities. This is in agreement with the findings of Khan and Sirajudin (2015) who found that many students considered ICT tools very helpful in that it help them to do assignment and also help to reduce social disparities between students, since they work in team inorder to achieve a given task. The author also revealed from findings that students are more eager to learn due to the presence of ICT facilities.

Summary of major findings

Emanating from the research findings are the following;

1. The study revealed that in private universities in Abuja, Majority of the respondents indicated a high level of access to ICT facilities in university libraries

2. The study also revealed that in private universities in Abuja, majority of undergraduate students agreed to the utilization of ICT facilities in libraries for: obtaining current information in their field of study, processing information, storing information, retrieving information, disseminating information, online registration, assignment, test and examination, online business transaction and research work
3. The study further revealed that majority of the respondents positively agreed that ICT facilities aid their academic performance in the following areas: completing their project report, learning independently, typing of course work and assignment, applying what has been learnt in real world situation, improving their organizational skills as well as collaborating with others. Majority of the respondents also positively disagreed that their GPA has been on the decline through the use of ICT facilities. They positively agreed that their GPA have improved remarkably through the use of ICT facilities.

Conclusion

This study explored the impact of Information and Communication Technology (ICT) facilities access and use on the academic performance of undergraduate students in private university libraries in Abuja. The following conclusions were drawn based on the findings of this study: Private universities in FCT, Abuja have acquired and subscribed to various ICT infrastructures and electronic resources respectively. Undergraduate students in private universities in FCT Abuja accessed ICT facilities in the library frequently to meet their academic needs. Undergraduate students also believed that ICT facilities aid their academic performance in the following areas: completing their project report, learning independently, typing of course work and assignment, applying what has been learnt in real world situation, improving their organizational skills as well as collaborating with others.

Although most of the undergraduate students in private universities in FCT Abuja have realize the impact of Information and Communication Technology (ICT) facilities on academic performance as majority of the students positively agreed that their Grade Point Average (GPA) have improved remarkably through the use of ICT facilities. However some students are still having difficulties in effective usage of ICT facilities and this is due to insufficient knowledge on available ICT infrastructures and electronic resources as well as low ICT literacy skills. Also electricity interruption, inadequate space in the e-library hinders access and utilization of ICT facilities by undergraduate students.

Recommendations

Based on the findings of the study, the following recommendations are proffered:

1. There should be expansion of space in the e-library for students who want to connect to the internet with their personal computer so as to provide more connection points and also, provision of internet connectivity in the hostels can be provided for more accessibility. In the same view, management of private universities in FCT- Abuja are encouraged to provide internet services in the students' hostels and classrooms since learning is a continuous process. This if carried out will also assist in reducing students' population in e-library.
2. Information literacy and ICT skills in searching and retrieving electronic information resources should be incorporated in the school curriculum and intensified. This will empower undergraduate students with the skills needed in the utilization of ICT facilities for academic purpose
3. Awareness campaign to give orientation to students on the benefit of ICT on their academic performance should be carried out through seminars, lectures and symposia.

References

Abdullahi Z.M. &Haruna I.(2008). Utilization of Information and Communication Technologyfor information service delivery in University Libraries in Adamawa State.*AnInternational Journal of Information and Communication Technology(ICT),* 5(2),24-30.

Cohen L., Manion M., and Morrison(2007). Research Methods in Education. Abingdon, Oxon: Routledge, 6th edition

Isah, A.Y. (2016). Effects of Access and Utilisation of Electronic Resources on Academic Performance of Post graduate Students in selected Universities in North central Nigeria. A thesis submitted in partial fulfilment of the requirements for the award of master of Library and Information Technology, Department of Library and information Technology, FutMinna.

Jude, H.O., & Dankaro, A.A. (2017). ICT Resource Utilization, Availability and Accessibility by Teacher Educators for Instructional Development in college of education Katsina-Ala. *New Media and Mass communication Journal*

Khan M.S., Khan I. and Siraju-Din(2015). The Impacts of ICT on the Students' Performance: AReview of Access to Information. *Research on Humanities and Social Sciences*, 5(1), 85-97.

Mahmood, K. (2009). Gender, subject and degree differences in university students' access,

Useand attitudes toward information and communication technology (ICT).*International Journal of Education and Development using Information and CommunicationTechnology (IJEDICT), 5*(3), 206-216. Retrieved from http://ijedict.dec.uwi.edu//viewarticle.php?id=704

Moahi, K.K. 2009. ICT and Health Information in Botswana: Towards the Millennium DevelopmentGoals. *Information Development* 25 (3): 198-206.

NUC (2024). National Universities Commission Monday: A publication of the Office of the Executive Secretary. *Bulletin*, 26th February, 2024 , 19 (09)

Odeh, R.C, Oguche, O.A &Ivagher, E.D.(2015). Influence of School Environment on AcademicAchievement of Students in Secondary Schools in Zone "A" Senatorial District of Benue State, Nigeria.*International Journal of Recent Scientific Research* 6(7), 4914-4922.

Oguike, M. and Aji, K. (2017). Information and Communication Technology (ICT) FacilitiesUtilization in selected Colleges of Education Libraries in Nigeria.*Librarianship in Africa(JLIS),* 9(1&2), 42-59.

Okoro, C.O. and Ekpo E.E.(2016).Effects of Information and Communication Technology in academic achievement of students in christian Religious Studies in Cross rivers state. *International Journal of Interdisciplinary Research Method,* 3 (2), 14-24

Rabiu, H., Mohammed, A.I., Umaru, Y. & Ahmed, H.T. (2016). Impact of Mobile Phone Usage on Academic Performance Among secondary School students, Taraba State, Nigeria, *European Scientific Journal* 12(1)

Yisadoko, S. Aji, K.O & Martin, D..(2023). Influence of Information and Communication Technology on Postgraduate Students Research activities in Federal University Libraries in Northern Nigeria. *Lafia Journal of Library and Information Science,* 4(1),123-139

Adoption and Use of Emerging Technologies for Reference Services in Academic Libraries of Private Universities in Edo State, Nigeria

By

Efosa Egharevba (CLN)
egharevba.efosa@iuokada.edu.ng // 07033861451, https://orcid.org/0000-0002-3236-6731

Bonnie Obeka Obande (CLN)
bonnie.obande@iuokada.edu.ng // 07038769657, https://orcid.org/0009-0001-3068-3055

Vincent Osamuyimen Ekhaguosa (CLN)
vekhaguosa@iuokada.edu.ng // 07030122622

Musa Bilal Ado (CLN)
bilal.musa@iuokada.edu.ng // 07032313742

Abstract

The study examines the adoption of emerging technologies in academic reference services in academic libraries in Private Universities in Edo State, Nigeria. Three research questions guided the study and one hypothesis guided the study. Descriptive research design was used. The population of the study which is 4,224 is made up of all the registered library users with the private university in Edo State, Nigeria for 2023/24 academic session. A sample size of 365 library users was obtained using Taro Yamene was used for the research. The instrument used for data collection was a structured questionnaire titled "Questionnaire on Impact of Emerging Technologies on the use of Reference Service in Academic Libraries in Private University in Edo State, Nigeria". ***.*** *It comprises of a 15 – item questionnaire divided into four clusters and each cluster contains relevant question items that addressed each of the three research questions. Data generated were analyzed using descriptive statistics of mean and standard deviation and shown on cone chart while the hypothesis was tested using linear regression with the aid of SPSS. The findings of the study established that the emerging technologies have significantly improved the efficiency, effectiveness and accessibility of reference services in academic libraries in Private Universities in Edo State, Nigeria; emerging technologies have reduced the need for physical visits to the library for reference service and have enabled librarians to provide more flexible and convenient services. Challenges associated with the adoption of emerging technologies in reference service in Private University in Edo State includes insufficient training and support for librarians, high cost of emerging technologies infrastructures and maintenance as well as technical issues and downturn. It was recommended that Librarians and library administrators should prioritize the development of emerging technologies infrastructures and the training of librarians in the use of emerging technologies to support reference services among others.*

Keywords*: Emerging Technologies, Reference Services, Academic Libraries, Private Universities and Library Services*

Introduction

The advent of emerging technologies has transformed the way libraries provide reference services to their users. Academic libraries, in particular, are leveraging technologies such as artificial intelligence, virtual reality, and social media to enhance the delivery of reference services (Adeyemi, 2022; Okello-Obura, 2021). The adoption of emerging technologies in academic libraries has the potential to improve the efficiency and effectiveness of reference services, enhance user experience, and increase access to information (Okonedo, 2020).

Omekwu and Ugwuanyi in Nwakaji (2020) defines academic library as "libraries established in Universities, Colleges of Education, Polytechnics and Monotechnics. Their collection is tailored towards achievement of the institution goals of teaching, learning and research. They serve the students, lecturers, administrative members of the academic community as well as others." They are central to learning, research, and have always depended on relevant new technologies, which on the other hand are driven by emerging trends in education and research. The major function of academic libraries is to provide resources to meet the needs of users. Their materials are diversified to support teaching and programmes that take place within them. Therefore, the academic library has to build a strong collection of information resources in physical and digital formats to cater for the knowledge requirements of students, faculty members and research scholars of the institution. To remain relevant, libraries must fulfill some set of roles for serving their parent institutions which includes the use of information and communication technology.

Libraries of all kind are integrating emerging technologies to enhance service delivery, improve access to information, and streamline operations. Emerging technologies have altered the way information is accessed and provided in academic libraries today and have also impacted the way that traditional library functions such as cataloguing and classification, collection development, management of resources and rendering of reference services are carried out. Emerging technologies have also had impact on the expectations of library users which cut across every strata of the society and have changed the way that

libraries now render their services. These assertions are supported by Owate & Iroeze (2023) who stated that emerging technologies play a very significant role in transforming the landscape of all types of libraries operated and the manner in which information professionals carry out their function, in the same vein Emumejakpor & Egharevba (2022) asserted that new and emerging technologies are now being used to perform the age long role of libraries which have been to acquire, organize, preserve and disseminate all forms of information resources to users within the shortest possible time. Obilade in Nwakaji (2020) view emerging technologies as electronic, non-electronic technologies and infrastructure systems used to create, store, manipulate, retrieve and communicate or disseminate information. It involves the use of computers and other electronic equipment to store and send information.

According to Imelda, B.E and Isu, M.I (2020), emerging technologies encompasses any new technological medium to record information which includes (Whether paper, pen, magnetic disk/ tape, optical disks – CD/ DVD, flash memory); and also technology for broadcasting information, any technology for communicating through voice and sound or images – microphone, camera, loudspeaker, telephone, to cellular phones, computers, software, peripherals, mobile devices, tablets, podcast, internet, scanners, printers, LCDs, ubiquitous computing, World Wide Web, connections to the Internet that are intended to fulfill information processing and communications functions and a host of yet to be developed technologies. There are some key emerging technologies used in libraries which includes Artificial Intelligence (AI) and Machine Learning (ML), Internet of Things (IoT), Blockchain Technology, Augmented Reality (AR) & Virtual Reality (VR), 5G and Advanced Networking, Robotics & Automation, Cloud Computing & Big Data Analytics, 3D Printing & Makerspaces, Digital Preservation Technologies and Smart Library Infrastructure. These technologies are helping libraries stay relevant in the digital age by providing innovative services and improving user experiences. Also it includes a number of technologies, such as mobile technology; email; two way instant messaging; chat rooms; blogs; personal web pages; video conferencing; satellite systems; online shopping rating systems; download of images, audio, video; and video games. Emerging technologies are mostly used in reference services.

Reference services in libraries, especially those of academic libraries are some of the most important services that are rendered in the library all over the world. The reference section of any type of library is extremely important in completing any library's mandate because the section helps users of the libraries to meet their information needs, especially current information for research and personal knowledge and information. The term reference service according to Kwanya, Stilwell and Underwood (2017) can be defined as a personalized service provided by librarians to help users find and evaluate information and to develop their information literacy skills. Katz in Nwakaji (2020) view reference services as the process of providing assistance to library users in finding information, answering questions and solving problems.

Reference services in academic libraries of private universities refer to the personalized support and guidance provided by librarians to students, faculty, and staff in locating, evaluating, and using information resources to support their research, teaching, and learning needs (Adeyemi, 2022; Okello-Obura, 2021). According to Saunders and Jordan (2019), reference services are essential in academic libraries as they provide users with expert guidance and support in navigating the complex information landscape.

In recent years, academic libraries have witnessed a significant shift from traditional print – based reference services to digital – based reference services, facilitated by the increasing availability of electronic resources, online database and digital libraries (Kaur and Rani, 2017; Singh and Kaur, 2015). This shift has enabled users to access reference services remotely, at any time, and from any location, thereby increasing the accessibility and convenience of reference services.

In addition, the impact of emerging technologies on the use of reference services in academic libraries is not without its challenges. The proliferation of digital resources has created new challenges for librarians, including the need to develop new skills to manage and provide access to digital resources, and the need to ensure that users have the necessary skills to effectively use digital resource Kwanya, T., Stilwell, C., & Underwood, P. 2017.; Manda & Nawe, 2017.

Despite these challenges, the benefits of emerging technologies on the use of reference services in academic libraries are undeniable. Emerging technologies has enabled librarians to provide more efficient and effective reference services, and has enabled users to access a wider range of resources and services (Adeyinka & Adeniran, 2016; Ojedokun & Bolarinwa, 2015). This study aims to investigate the impact of emerging technologies on the use of reference services in academic libraries, with a focus on how the adoption of emerging technologies have impacted the way reference services are provided, the benefits and challenges of emerging technologies on reference services in academic libraries in Private Universities in Edo State, Nigeria.

STATEMENT OF THE PROBLEM

The integration of emerging technologies in academic libraries has revolutionized reference services, but it also poses significant challenges. Despite the benefits, traditional reference services are being eroded, and librarians are struggling to adapt to the changing landscape (Adeyemi, 2022; Okello-Obura, 2021). This has created a gap between the services provided and users' needs. Furthermore, librarians' lack of skills and training in utilizing emerging technologies effectively (Okonedo, 2020; Baro, 2021) forces users to rely on potentially inaccurate or unreliable online resources.

This situation underscores the need to investigate the adoption and use of emerging technologies for reference services in academic libraries of private universities in Edo state on reference services in academic libraries and identify strategies to bridge the gap between librarians' services and users' needs.

OBJECTIVES OF THE STUDY

The main objective of this study is to examine adoption and use of emerging technologies for reference services in academic libraries of private universities in Edo state, Nigeria

The general objective has been fragmented into the following specific objectives for easy assessment, these are to;

i. examine how the adoption of emerging technologies on the use reference services provided by academic libraries of Private Universities in Edo State, Nigeria.
ii. ascertain the benefits of emerging technologies for reference services in academic libraries of Private Universities in Edo State, Nigeria.
iii. Identify the challenges associated with the adoption of emerging technologies for reference services provision in academic libraries of Private Universities in Edo State, Nigeria.

RESEARCH QUESTIONS

The following questions guided the study;

i. what extent do academic liberties of private universities in Edo State adopt emerging technologies for references services provided ?
ii. ii. what are the benefits of using emerging technologies in reference services in academic libraries of Private Universities in Edo State, Nigeria?
iii. What are the challenges associated with using emerging technologies in reference services in academic libraries in Private Universities in Edo State, Nigeria?

NULL HYPOTHESIS

Ho1:There is no significant correlation between the adoption of emerging technologies and the provision of reference services in academic libraries in Private Universities in Edo State, Nigeria.

LITERATURE REVIEW

It is pertinent to note that this study hinges on the Diffusion Innovation Theory. The Diffusion of Innovations Theory was developed by Everett Rogers in 1962. It is a theory that explains how new ideas, technologies, and practices spread and are adopted within a social system. The theory posits that the diffusion of an innovation is a process that involves several stages, including knowledge, persuasion, decision, implementation, and confirmation. Rogers defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003).

According to the Diffusion of Innovations Theory, there are five characteristics of an innovation that influence its adoption rate. These characteristics are relative advantage, compatibility, complexity, trialability, and observability. Relative advantage refers to the degree to which an innovation is perceived as better than the existing idea or practice. Compatibility refers to the degree to which an innovation is consistent with the existing values, needs, and practices of the adopter. Complexity refers to the degree to which an innovation is difficult to understand and use. Trialability refers to the degree to which an innovation can be experimented with before committing to its adoption. Observability refers to the degree to which the results of an innovation are visible to others.

The Diffusion of Innovations Theory also identifies five types of adopters, who are classified based on their willingness to adopt an innovation. These adopters are innovators, early adopters, early majority, late majority, and laggards. Innovators are the first to adopt an innovation and are typically venturesome and willing to take risks. Early adopters are the next to adopt an innovation and are typically respected and influential in their social systems. The early majority, late majority, and laggards adopt an innovation later and are typically more cautious and skeptical.

This theory is relevant to the present study because it provides useful framework for understanding the process of innovation adoption and diffusion. The theory highlights the importance of considering the characteristics of an innovation (emerging technologies in this case), as well as the characteristics of the adopters (librarian and library users), in order to promote the adoption of new ideas and technologies. By understanding the diffusion process, the academic library and library users can develop strategies to facilitate the adoption of innovations and to promote positive social change.

The advent of emerging technologies have revolutionized the way reference services are provided in academic libraries. Studies have shown that emerging technologies have improved the efficiency and effectiveness of reference services, enabling librarians to provide faster and more accurate responses to user queries (Kaur & Rani, 2017; Kwanya et al., 2017). The use of digital resources and online databases has also increased the accessibility of reference services, allowing users to access information remotely.

The adoption of emerging technologies have also led to changes in the role of librarians, who must now possess technical skills to effectively utilize digital resources and provide support to users (Bopp & Smith, 2011; Katz, 2002). Additionally, emerging technologies have enabled librarians to focus on more complex and high-value tasks, such as information literacy instruction and research support (Kwanya et al., 2017). However, some studies have also highlighted the challenges faced by librarians in adapting to the changing technology landscape, including the need for ongoing training and support.

Despite the benefits of emerging technologies, there are also concerns about the potential negative impacts on reference services. Some studies have highlighted the risk of information overload and the need for librarians to develop effective strategies for filtering and evaluating online information (Matesic, 2016; O'Connor, 2013). Additionally, there are concerns about the potential for emerging technologies to exacerbate existing inequalities in access to information, particularly for users who lack the necessary skills or technology to access digital resources..

The impact of emerging technologies on reference services have also been influenced by the development of new technologies and tools, such as social media and mobile devices. Studies have shown that these new technologies have the potential to enhance the delivery of reference services, but also require librarians to develop new skills and strategies for engagement and outreach (Kaur & Rani, 2017; Kwanya et al., 2017).

Emerging technologies have had a profound impact on the use of reference services in academic libraries. While there are challenges and concerns associated with the adoption of emerging technologies, the benefits of increased efficiency, accessibility, and effectiveness are clear. As emerging technologies continue to evolve and improve, it is likely that its impact on reference services will only continue to grow.

METHODOLOGY

This study adopted a descriptive survey research design to investigate the impact of emerging technologies on reference services in academic libraries in Private Universities in Edo State, Nigeria. The study focused on library users in four private universities: Igbinedion University, Benson Idahosa University, Wellspring University, and Samuel Adegboyega University. The population of the study consisted of 4,224 registered library users in the 2023/24 academic session. A sample size of 365 library users was determined using the Taro Yamane formula. A structured questionnaire, "adoption *of emerging technologies in academic reference services in academic libraries in Academic Libraries,"* was used for data collection. The 15-item questionnaire was divided into four clusters, each addressing a research question. The instrument was validated through expert opinion, and its reliability was established using Cronbach Alpha coefficient, yielding a reliability statistic of 0.85. Research questions were answered using mean and standard deviation, with results presented in charts. Linear regression analysis was used to test the formulated hypotheses, specifying the relationship between independent and dependent variables.

Functional Relationship

$Y = f(X)$

$y_1 = f(x_1)$ ……...….1

Regression Models

$y_1 = B + B_1x_1$----------Equation 1

These are the expectations on the subject of the existing effect of the dependent variable on independent variable. This refers to the way reference services are provided in line with the hypothesis formulated.

Table 1: Result for Linear Regression Model

S/N	Models	A Priori expectations	Sign
1	$y_1 = B + B_1x_1$	$\beta 1 > 0$, $p<0.05$: HO1 will be rejected	Positive
2	$y_2 = B + B_2x_2$	$\beta 2 < 0$, $p<0.05$: HO2 will be rejected	Negative

DATA ANALYSIS/RESULTS

This study has investigated the impact of emerging technologies on the use of reference service in academic libraries in Private Universities in Edo State, Nigeria.

Research Question 1: How has the adoption of emerging technologies impacted the way reference services are provided in academic libraries in Private Universities in Edo State, Nigeria?

Table 2: Mean ratings and standard deviation on how adoption of emerging technologies have impacted on the way reference services are provided.

S/No	Items	Mean	STD	Decision
1	Emerging technologies have increased the accessibility of reference services for users with disabilities.	3.89	0.35	Accepted
2	The adoption of emerging technologies has improved the speed and efficiency of reference services.	3.87	0.50	Accepted
3	Emerging technologies have changed the role of librarians in reference services, requiring more technical skills.	3.71	0.78	Accepted
4	The adoption of emerging technologies have improved the overall user experience of reference services.	3.63	0.84	Accepted
5	The use of digital resources and online databases have enhanced the quality of reference services.	3.59	0.66	Accepted
	Cluster Mean	**3.74**	**0.63**	**Accepted**

Source: Survey 2025

Figure 1: Cone Chart Showing Mean Ratings and Standard Deviation on how adoption of emerging technologies have impacted on the way reference services are provided

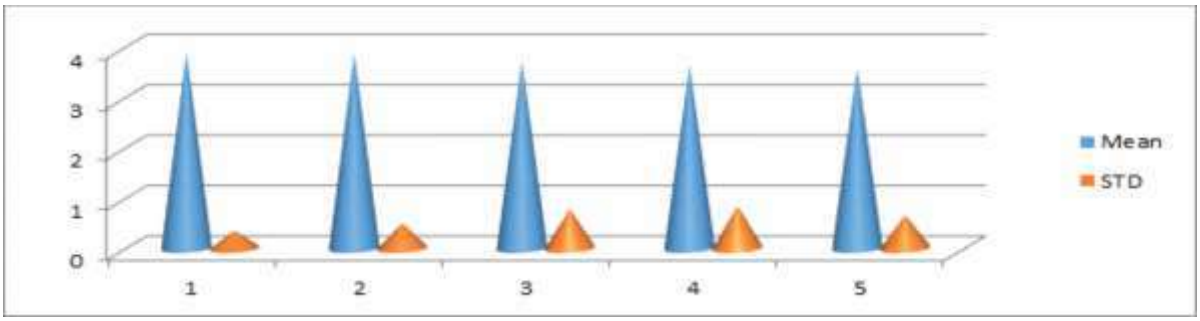


Table 2 and figure 1 shows how adoption of emerging technologies have impacted on the way reference services in Private Universities in Edo State, Nigeria are provided. As shown in this table, respondents' ranked emerging technologies have increased the accessibility of reference services for users with disabilities as the top most choice. The cluster mean and standard deviation are 3.74 and 0.63 respectively.

This finding is in line with consistent with Adeyemi (2022) that highlights the potential of emerging technologies to improve accessibility and inclusivity in libraries. Similarly, a study Okello-Obura (2021) also noted that emerging technologies can facilitate the provision of personalized and flexible library services that cater to the diverse needs of users.

Research Question 2: What are the benefits of using emerging technologies in reference services in academic libraries in Private Universities in Edo State, Nigeria?

Table 3: Mean ratings and standard deviation on benefits of using emerging technologies in reference services.

S/No	Items	Mean	STD	Decision
1	Emerging technologies have reduced the need for physical visits to the library for reference.	3.89	0.40	Accepted
2	Emerging technologies have improved the speed and efficiency of reference services.	3.84	0.37	Accepted
3	Emerging technologies have enabled librarians to provide more personalized and targeted reference services.	3.49	0.29	Accepted

4	The use of emerging technologies have improved the evaluation and assessment of reference services.	3.44	0.52	Accepted
5	Emerging technologies have enabled librarians to provide reference services.	3.10	0.36	Accepted
	Cluster Mean	**3.55**	**0.39**	**Accepted**

Source: Survey 2025

Cone Chart Showing Mean Ratings and Standard Deviation on benefits of using emerging technologies in reference services.

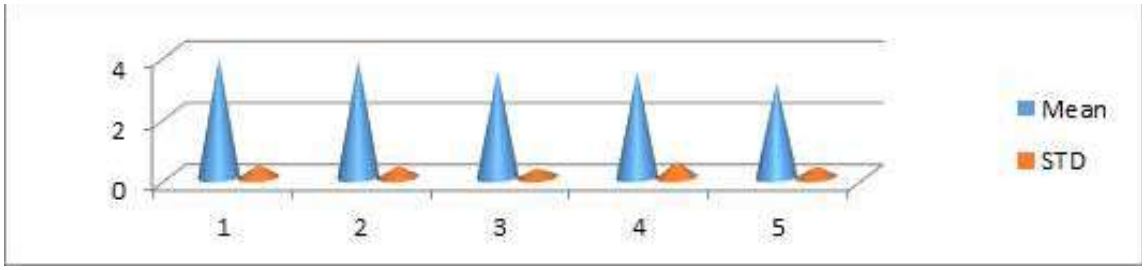


Table 3 and figure 2 shows the benefits of using emerging technologies in reference services in Private Universities in Edo State, Nigeria. As shown in this table, respondents' ranked emerging technologies have reduced the need for physical visits to the library for reference as the top most. The cluster mean and standard deviation are 3.55 and 0.39 respectively. This finding is consistent with previous research that highlights the potential of emerging technologies to enhance the convenience and accessibility of library services a study by Okonedo (2020) found that virtual reference services can reduce the need for physical visits to the library, thereby saving users' time and increasing their productivity.

Research Question 3: What are the challenges of using emerging technologies in reference services in academic libraries in Private Universities in Edo State, Nigeria?

Table 4: Mean ratings and standard deviation on challenges of using emerging technolgies in reference services.

S/No	Items	Mean	STD	Decision
1	Insufficient training and support for librarians.	3.68	0.56	Accepted
2	High cost of emerging technologies infrastructure and maintenance.	3.45	0.64	Accepted
3	Technical issues and downtime.	3.42	0.61	Accepted
4	Complexity of emerging technologies	3.30	0.52	Accepted
5	Rapid pace of technological change	3.21	0.65	Accepted
	Cluster Mean	**3.41**	**0.60**	**Accepted**

Source: Survey 2025

Cone Chart Showing Mean Ratings and Standard Deviation on challenges of using emerging technologies in reference services.

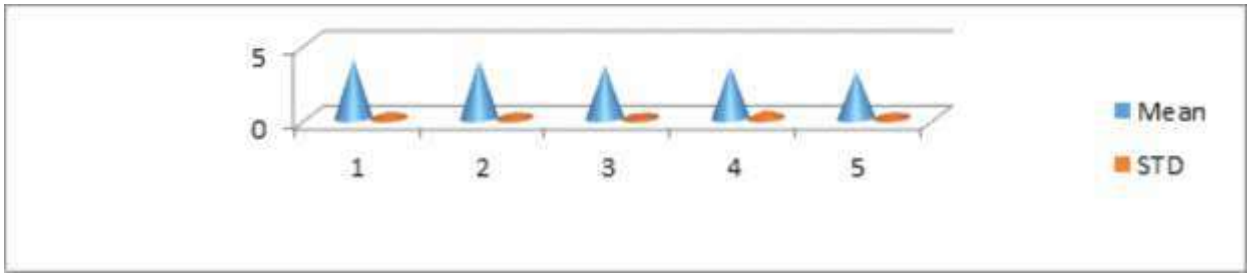


Table 4 and figure 3 shows the challenges of using emerging technologies in reference services in Private Universities in Edo State, Nigeria. As shown in this table, respondents' ranked insufficient training and support for librarians as the top most. The cluster mean and standard deviation are 3.41 and 0.60 respectively. A study by Ojedokun (2019) noted that inadequate training and support for librarians can lead to difficulties in adapting to new technologies, thereby affecting the quality of reference services. Adeyemi (2022) also emphasized the need for ongoing training and professional development for librarians to stay current with emerging technologies.

Test of Hypothesis

Research Hypothesis 1: Adoption of emerging technologies have no significant correlate on the way reference services are provided in academic libraries in Private Universities in Edo State, Nigeria.

Table 6: Simple regression analysis results on relationship between adoption of emerging technologies and the way reference services are provided in academic libraries in Private Universities in Edo State, Nigeria

Coefficients					
Model	Un standardized Coefficients		standardized Coefficients	T	Sig
	B	Std Error	Beta		
(Constant)	1.216	.293		-3.787	.000
User's Satisfaction	.571	.064	.756	20.244	.000
R= 0.756; R^2 = .57; $F_1$363 = 83.125					

R= 0.756; R^2 = .57; $F_1$363 = 83.125From the Table 6, the regression model equation using unstandardized coefficient is:

$Y = B + B_1x_1$

$Y = 1.216 + 0.756x_1$ ---------- Equation 1

Where: Y = Emerging Technologies

x_1 = Use of reference service

The result on the Table reveals that use of emerging technologies have positive and significant correlate on use of reference services in academic libraries in Private Univerities in Edo State, Nigeria $\beta = .756$, t statistic of 20.24 and computed p-value of 0.000 which is below the level of significance (0.05) adopted for this study. The Table shows that unit change in use of emerging technologies lead to an increase in use of reference services by Private Universities in Edo State by 0.756 units ($\beta = .756$). Moreover, the Table shows that use of emerging technologies 57.1% ($R_1 = 0.571$) variance on the use of reference service. Based on this result, the null hypothesis is rejected which affirms that adoption of emerging technologies have no significant correlate on the way reference services are provided in academic libraries in Private Universities in Edo State, Nigeria is hereby rejected.

DISCUSSION OF RESULTS/ FINDINGS

The result of the study reveals that the adoption of emerging technologies have significantly impacted the use of reference services in academic libraries in Private Universities in Edo State, Nigeria. The findings indicate that emerging technologies have increased the accessibility of reference services for users with disabilities, the adoption of emerging technologies have improved the speed and efficiency of reference services. This finding collaborates with that of Kaur & Rani (2017) who stated that emerging technologies have improved the efficiency and effectiveness of reference services.

The result show that emerging technologies have reduced the need for physical visits to the library for reference. This result suggests that emerging technologies have enabled librarians to provide more flexible and convenient services which is consistent with the findings of the previous study of Adebayo (2018).

However, the results also reveal some challenges associated with the adoption of emerging technologies in reference services. Most of the respondents reported that insufficient training and support for librarians, high cost of emerging technologies infrastructures and maintenance as well as technical issues and downturn were major challenges associated with the adoption of emerging technologies in reference services. This suggests that librarians and library administrators need to address these challenges in order to fully realize the benefits of emerging technologies in reference services.

In addition, the study reveals that adoption of emerging technologies have significant correlate on the way reference services are provided in academic libraries in Private Universities in Edo State, Nigeria.

CONCLUSSION

This study has investigated the impact of emerging technologies on the use of reference services in academic libraries in Private Universities in Edo State, Nigeria. The findings of the study reveal that

emerging technologies have significantly improved the efficiency, effectiveness and accessibility of reference services in academic libraries in Private Universities in Edo State, Nigeria.

The study found that emerging technologies have reduced the need for physical visits to the library for reference and has enabled librarians to provide more flexible and convenient services. However, the study also identified some challenges associated with the adoption of emerging technologies in reference service in Private University in Edo State which includes insufficient training and support for librarians, high cost of emerging technologies infrastructures and maintenance as well as technical issues and downturn.

IMPLICATIONS OF THE STUDY

The study's finding has implications for librarians, library administrators and policymakers seeking to improve the quality and accessibility of reference services in academic libraries.

RECOMMEDATIONS

Based on the findings of the study, the following recommendations are made;

1. Librarians and library administrators should prioritize the development of emerging technologies infrastructures and the training of librarians in the use of emerging technologies to support reference services.
2. Policymakers should provide support for the development of emerging technologies infrastructures in academic libraries.
3. Policymakers should promote the adoption of emerging technologies in reference services through policies and guidelines.

References

Adeyemi, O. A. (2022). Emerging technologies and reference services in academic libraries: A review. Journal of Library and Information Science, 19(1), 1-12.

Adeyinka, A.A and Adeniran, P.I (2016). The impact of information and communication technology on reference services in Nigeria university libraries. *Journal of Library and Information Science,* 8(1), 1 -9

Afolabi, M. O. (2020). Online reference services in academic libraries: A review. Journal of Library and Information Science, 17(1), 1-10.

Baro, E. E. (2021). Emerging technologies and library services: A study of university libraries in Nigeria. Library Philosophy and Practice, 1-15.

Bopp, R. E., & Smith, L. C. (2011). *Reference and information services: An introduction*. Santa Barbara, CA: Libraries Unlimited.

Bopp, R. E., & Smith, L. C. (2011). *Reference and information services: An introduction*. Santa Barbara, CA: Libraries Unlimited.

Emumejakpor, E. O. & Egharevba, E. (2022). Academic library services in the 21st century and National development in Nigeria. *Heartbeat Journal of Library and Information Science. Vol. 3, December, 2022.* 27 – 38.

Imelda, B.E and Isu, M.I (2020). Technologies for information management: Adoption and use in the 21st century. *Themes and trends in information science*, edited by Kingsley, N. I; Shaibu, A.S and Imelda, B.E. Zeh Communications Umuahia, pg 245 – 160

Katz, W. A. (2002). *Introduction to reference work*. New York: McGraw-Hill.

Kaur, K., & Rani, R. (2017). Impact of ICT on reference services in academic libraries. *Journal of Academic Librarianship,* 43(3), 257-264.

Kwanya, T., Stilwell, C., & Underwood, P. (2017). The impact of ICT on the role of librarians in academic libraries. *Journal of Librarianship and Information Science, 49(1), 1-11.*

Mande, P.A and Nawe, J (2017). The impact of ICT on reference services in Tanzanian university libraries. *Journal of Information Science,* 43(3), 257 – 265.

Matesic, M. A. (2016). Accessibility and usability of library databases. *Library Hi Tech,* 34(2), 278-291.

Nwakaji, E.B (2020). Availability and utilization of ICT in Benue State University, Makurdi. *Undergraduate project submitted to Faculty of Education, Benue State University, Makurdi.*

O'Connor, L. G. (2013). *Reference services for the digital age*. New York: Neal-Schuman Publishers.

Ojedokun, A. A. (2019). Librarians' skills and competencies in the digital age: A study of university libraries in Nigeria. Journal of Library and Information Science, 16(2), 1-12.

Okello-Obura, C. (2021). Impact of emerging technologies on reference services in academic libraries: A study of selected universities in Uganda. Library Philosophy and Practice, 1-20.

Owate, C. N. & Iroeze, P. C. (2023), Usage of emerging technologies in academic libraries for effective service delivery in public university institution in Rivers State, Nigeria. Library *Philosophy and Practice (e-journal). 7873.* Available at https://digitalcommons.unl.edu/libphilprac/7873

Saunders, L., & Jordan, J. (2019). Significantly different?: A comparison of reference services in academic libraries. Reference & User Services Quarterly, 58(3), 162-173.

An Empirical Analysis of Repackaging Library Services and Strategies in the 5th Industrial Revolution for Attracting and Retaining User Interest in Southeast Nigeria

Dr Adizetu A. Ali
Nnamdi Azikiwe Library
University of Nigeria Nsukka
adizetu.ali@unn.edu.ng

&

Tochukwu Victor Nwankwo
Nnamdi Azikiwe Library
University of Nigeria Nsukka
tochukwu.nwankwo@unn.edu.ng

Abstract

This study investigates how libraries in Southeast Nigeria are repackaging services to align with the demands of the Fifth Industrial Revolution (5IR), with an emphasis on human-centric, technology-driven service delivery. It seeks to explore user needs, assess current service conditions, evaluate existing repackaging strategies, and propose a strategic framework for enhancing information access, research productivity, and community development through digital integration. The study adopted a mixed-methods research design, combining quantitative surveys and qualitative interviews. Quantitative data were gathered from 164 librarians across five federal university libraries and 150 users from public and special libraries using structured questionnaires, validated by two lecturers from LIS department, University of Nigeria Nsukka. Qualitative insights were obtained through semi-structured interviews with six key informants: librarians, policymakers, and technology experts. Descriptive and inferential statistics were used for quantitative analysis, while thematic analysis was applied to qualitative data. The findings reveal a growing interest in digital, AI-driven, and personalized services among library users, with no significant gender-based differences in expectations. However, special library users demonstrated a stronger need for digital learning access compared to public library users. Major barriers to full 5IR integration include infrastructural deficits, inadequate funding, limited staff training, and weak policy support. Despite these challenges, emerging digital initiatives such as virtual training and online repositories have positively impacted user engagement. The study proposes a six-pillar strategic framework addressing policy alignment, infrastructure, human capital, academic integration, community outreach, and sustainability. The study was limited to federal university libraries and selected public and special libraries in Southeast Nigeria. Broader generalization may require wider geographic and institutional sampling. Further longitudinal studies are also needed to track long-term impacts of technology integration. The proposed framework provides actionable strategies for library administrators, policymakers, and stakeholders to drive digital transformation, enhance service relevance, and optimize resource use in line with 5IR demands. By promoting inclusive digital access, community engagement, and support for lifelong learning, the study emphasizes the role of libraries as critical agents of social development and digital equity in underserved regions.

Keywords: *Fifth Industrial Revolution (5IR); Library service repackaging; Digital transformation; Information access; Artificial Intelligence in libraries; Library users*

Introduction

The rise of the Fifth Industrial Revolution (5IR) represents a significant turning point in the evolution of information access, management, and dissemination. Unlike previous industrial revolutions that emphasized mechanization, automation, and efficiency, the 5IR prioritizes a human-centric approach that integrates advanced technologies like artificial intelligence, robotics, and the Internet of Things with ethical considerations and social well-being (Nwobu, Dumbiri, Ibia, & Oladokun, 2024). This paradigm shift demands a fundamental transformation in how libraries operate and engage with their users. As key agents of knowledge creation and dissemination, libraries are being challenged to move beyond their traditional roles into innovative domains where repackaging of services becomes critical. Ugwuogu (2015) underscores that academic and research libraries have transitioned from managing print resources to becoming dynamic digital hubs. In this new era, strategic adaptation, technological integration, and user-centered service delivery are not just desirable—they are imperative for libraries aiming to stay relevant.

In response to these dynamic demands, information repackaging has emerged as a strategic tool for attracting and retaining user interest. According to Onwuekwe and Onah (2024), both language and content repackaging play a pivotal role in enhancing service delivery. Their empirical work at the Donald Ekong Library revealed that translating information into local languages significantly improves access, especially in linguistically diverse regions like Southeast Nigeria. Content repackaging—reformatting information to match user preferences—further supports personalized engagement and improved user satisfaction. This aligns with the 5IR's emphasis on inclusivity and personalization, urging libraries to not only digitize services but also tailor them to the literacy levels, language needs, and accessibility challenges of their specific user populations. The library, thus, becomes a facilitator of equitable knowledge, using repackaging strategies to bridge information gaps.

However, despite the apparent value of repackaging services, there remain significant implementation gaps, especially in public and under-resourced libraries. Bello and Ojo (2018) report a troubling underutilization of repackaging formats and tools in Nigerian public libraries, with only a few formats like abstracts and reprints being actively used. The absence of critical formats such as braille, translations, and audiovisual materials hinders accessibility for users with diverse needs, including those with disabilities. This deficiency points to broader systemic issues, such as inadequate staffing, insufficient professional training, and a lack of investment in modern tools. The disparity between best practices and current realities underscores the urgent need for libraries to rethink their service models. Repackaging, in this context, becomes not only a service enhancement strategy but also a moral imperative to ensure equitable information access for all.

Moreover, the role of marketing in modern libraries cannot be overlooked. As Oyeniran and Olajide (2015) emphasize, most university libraries fail to effectively promote their diverse services, focusing largely on traditional reference offerings while neglecting to showcase innovative or user-tailored products. In an age where user attention is highly fragmented and competition for information sources is intense, marketing becomes a critical bridge between libraries and their communities. The integration of strategic communication, feedback mechanisms, and digital outreach helps libraries align their offerings with user expectations and technological trends. Marketing, therefore, works hand-in-hand with repackaging to not only improve visibility but also to reinforce user engagement, satisfaction, and retention in a highly competitive knowledge economy.

The Nigerian Content Development and Monitoring Board (NCDMB, 2024) provides an exemplary model of how strategic innovation, stakeholder engagement, and technological advancement can drive institutional transformation. While rooted in the oil and gas sector, the Board's emphasis on localized capacity-building, R&D investment, and inclusive outreach offers valuable insights for libraries seeking to navigate the 5IR. Just as NCDMB has leveraged partnerships and targeted initiatives to promote national development, libraries in Southeast Nigeria can reimagine their services by repackaging information to reflect user realities and regional dynamics. This study, therefore, aims to empirically analyze how academic and public libraries in Southeast Nigeria are adapting their service delivery strategies—particularly through repackaging—to attract and retain users in the transformative landscape of the 5IR. In doing so, it explores the intersection of technological innovation, user engagement, and strategic service delivery within a rapidly evolving information environment.

In fact, this study is both timely and necessary because librarianship and library services must remain relevant and valuable to these users at all cost. By examining how libraries in the region are responding to the demands of the 5IR through innovative repackaging strategies, the research seeks to uncover practical insights into improving user access, satisfaction, and engagement. It draws on empirical findings and theoretical perspectives to assess current practices, identify service gaps, and propose sustainable models for transforming library services. In doing so, the study not only contributes to the evolving discourse on information service delivery in Nigeria but also offers a roadmap for library innovation in the age of intelligent technology and human-centred knowledge systems.

Objectives of the Study

1. To investigate the current state of library services in Southeast Nigeria in the context of the 5th Industrial Revolution (5IR).
2. To explore the evolving needs and expectations of library users in the era of human-centric technological advancement.
3. To evaluate the effectiveness of existing repackaging strategies aimed at attracting and retaining user interest in libraries.
4. To propose a strategic framework for enhancing information access, research productivity, and community development through technology integration in libraries.

Literature Review

Current State of Library Services in Southeast Nigeria in the Context of the 5th Industrial Revolution (5IR)

The current state of library services in Southeast Nigeria reflects both commendable progress and persistent systemic challenges in adapting to the transformative demands of the Fifth Industrial Revolution (5IR). As Zondi et al. (2024) explain, artificial intelligence (AI) is revolutionizing academic libraries by enabling automation, intelligent recommendations, and personalized learning, offering a futuristic vision that remains elusive for many Nigerian libraries. While Southeast Nigerian university libraries have shifted from manual cataloguing to Online Public Access Catalogues (OPACs), the complete integration of AI systems is still largely aspirational (Ekwueme et al., 2024), highlighting a disconnect between awareness and implementation. Interviews with regional librarians echo these findings, indicating that while digital

platforms exist, advanced tools like AI, machine learning, and robotics remain inaccessible due to financial and infrastructural constraints (Hotsonyame, 2023). Further compounding these barriers, Gillespie et al. (2023) argue that strategic planning and sustained funding are crucial to enabling intelligent automation—resources that are currently inadequate in many Southeast Nigerian libraries.

Another key barrier to 5IR readiness in Southeast Nigeria is the limited application of social innovation strategies in public libraries, which are vital for fostering inclusive and human-centered services. According to Ajani, Tella, and Oladokun (2024), public libraries across Nigeria often contend with organizational inertia, lack of skilled personnel, and insufficient resources, all of which hinder adaptation to the socially driven priorities of the 5IR era. This sentiment is echoed by Adigun, Ajani, and Enakrire (2024), who argue that libraries must realign their missions toward digital inclusion and proactive community engagement to stay relevant in the evolving knowledge landscape. Green (2023) supports this view by highlighting that social innovation, if effectively implemented, has the power to transform libraries into critical hubs for lifelong learning, civic empowerment, and social justice. Unfortunately, many public libraries in Southeast Nigeria remain under-equipped and underutilized, necessitating urgent investment in culturally responsive programming, collaborative partnerships, and long-term sustainability frameworks (Gupta & Mangla, 2020).

Amid these systemic constraints, academic libraries in the region exhibit a more proactive stance toward the integration of 5IR technologies. For instance, at the National Open University of Nigeria, librarians have shown considerable awareness of emerging tools such as robotics, a development attributed to their professional training and exposure (Ekwueme et al., 2024), indicating that capacity-building can drive readiness. Similarly, Southeast Nigerian academic libraries are gradually adopting digital services, although these efforts are hampered by gaps in digital literacy and inconsistent institutional support (Valette et al., 2023). Byrkovych et al. (2023) emphasize that addressing the digital divide is essential for 5IR adoption, especially in low-resource environments where access and equity are persistent concerns. Additionally, Doğan and Niyet (2024) stress that innovation must be pursued in tandem with ethical design and user-centered values to maintain public trust and library integrity in an age of technological disruption.

It becomes evident that successful 5IR integration in Southeast Nigerian libraries will depend on a combination of technological readiness, institutional reform, and cultural adaptability. As Hotsonyame (2023) highlights, there is a strong awareness among library professionals of the potential of AI and related tools, yet limited access continues to stall practical implementation. Rodrigues and Mandrekar (2020) argue that the transformation of libraries in the digital age is not only about adopting new tools but also about redefining the librarian's role as an enabler of knowledge creation and innovation. This transformation demands sustained investment in ICT infrastructure, continuous professional development, and policy support that prioritizes inclusive innovation. Ultimately, embracing the 5IR in Southeast Nigerian libraries will require not just technological upgrades but a fundamental shift in mindset—one that embraces change, nurtures collaboration, and commits to lifelong learning.

Evolving Needs and Expectations of Library Users in the Era of Human-Centric Technological Advancement

In the era of human-centric technological advancement, the expectations of library users have significantly evolved, marked by a demand for faster, interactive, and decentralized access to information. Vasić (2014) explains that the rise of real-time internet access has transformed how users psychologically relate to information, expecting immediacy and interactivity rather than static systems. This requires libraries to adopt shared digital platforms like COBISS and BISIS to facilitate seamless access and integration across networks. Supporting this, Hassans (2025) argues that libraries must move from passive repositories to dynamic, community-driven digital environments that prioritize user inclusion, personalization, and responsiveness. Ekpolomo (2024) strengthens this view by noting the increasing demand among academic library users for immersive digital experiences and tailored services that actively contribute to their academic and personal development. These points collectively signal a critical transition in library services from one-size-fits-all models to adaptive, user-centered digital ecosystems that reflect the fast-paced realities of modern users.

Concurrently, the role of librarians has evolved beyond traditional boundaries to meet these changing user needs. Thiruppathi (2024) emphasizes that librarians must now serve as digital facilitators and educators, guiding users through increasingly complex information environments. This redefinition is necessitated by the proliferation of digital tools and the need for support in information navigation and digital literacy. Isiaka et al. (2024) highlight that in the context of the Fourth and emerging Fifth Industrial Revolutions, libraries must extend their roles to include inclusive digital training, particularly targeting underserved populations. Kraft-Terry and Brown (2023) illustrate how artificial intelligence allows librarians to provide personalized services, such as curating resources and recommending learning paths tailored to individual users' behaviors. Echoing this, Ekpolomo (2024) stresses that faculty and students now expect academic libraries to deliver sophisticated research support and user experience enhancements, similar to the personalized digital services they encounter in other online platforms.

Moreover, the shift in user expectations reflects broader societal transformations brought about by the 5th Industrial Revolution, where human empathy and ethical concerns are integrated with technological advancements. David-West (2021) articulates that library services today must prioritize accessibility, sustainability, and social responsibility as foundational principles. This evolution includes the adoption of immersive tools such as VR/AR, IoT, and blockchain technologies, which Azizi et al. (2020) and Tella and Ajani (2022) identify as critical to securing and enhancing digital learning environments. Zhang et al. (2020) further argue that these technologies are reshaping library spaces—both virtual and physical—into flexible, user-responsive environments that support diverse educational needs. Spotti and Windelband (2020) reinforce this by noting that such integration positions the library as an essential, innovative hub in a complex and socially aware knowledge ecosystem. These developments suggest that libraries must not only upgrade their technological capacity but also redefine their purpose in line with evolving human and societal values.

Finally, the cumulative evidence underscores that libraries must navigate a dual transformation—technological and philosophical—to remain relevant in this new era. The convergence of advanced technologies and user-centric values demands a fundamental shift in how libraries conceive of service delivery, community engagement, and institutional strategy. This includes aligning infrastructure with user behavior patterns, offering digital literacy programs, and embracing tools that enhance inclusivity and security. The scholarly consensus, as drawn from the cited works, indicates that libraries are no longer ancillary academic spaces but central actors in a digitally empowered, human-focused knowledge society. To thrive, they must cultivate agility, empathy, and innovation—reshaping themselves into participatory platforms that elevate user agency, enrich learning experiences, and uphold the ethical imperatives of the digital age.

Effectiveness of Existing Repackaging Strategies aimed at Attracting and Retaining User Interest in Libraries

The effectiveness of repackaging strategies in libraries lies in the transition from passive information provision to dynamic, user-centered services that align with contemporary information-seeking behavior. Ugwuogu (2015) emphasizes that modern academic and research libraries have expanded their functions beyond traditional services to include digital repositories, metadata creation, and virtual interactions, showing a necessary shift toward user-driven services. This transformation is especially critical in developing nations where libraries face the dual challenge of staying relevant and accessible amid rapid technological change. As such, repackaging is not merely a technical task but a strategic one, allowing libraries to convert dense or complex materials into simplified, engaging formats. Efemini (2023) supports this notion by identifying innovative repackaging formats such as video content, podcasts, and summarized texts, which not only capture users' attention but also cater to their preferred learning styles. Similarly, Uwandu and Osuji (2022) argue that interactive strategies like user orientation programs and face-to-face outreach are indispensable for making repackaged resources more visible and intuitive, aligning with Ugwuogu's (2015) call for libraries to prioritize user needs over institutional rigidity.

Nonetheless, the persistent underutilization of repackaged resources reveals gaps in implementation that hinder their intended impact. Uwakwe and Iwuchukwu (2023) point out that despite the availability of repackaged materials, many students continue to neglect library use due to entrenched poor reading habits, time constraints, and misconceptions about the library's relevance in a digital era. This suggests that simply providing repackaged content is insufficient without strategic user engagement and behavior modification. Although digital platforms like institutional websites and social media channels have been employed to raise awareness (Uwandu & Osuji, 2022), their influence is often diluted by infrastructural limitations and environments that do not encourage prolonged or meaningful interaction. Efemini (2023) cautions that repackaging must be supported by complementary strategies such as user training, targeted marketing, and the development of welcoming, functional library spaces that promote exploration. Ugwuogu (2015) reinforces the idea that the effectiveness of any repackaging effort depends on its alignment with users' cognitive preferences and real-world applications, advocating for a feedback-oriented approach that continuously refines content delivery.

In considering the long-term viability of repackaging strategies, it becomes clear that technological integration, institutional collaboration, and innovation are key pillars. Efemini (2023) notes that digitizing rare or context-specific materials and curating subject-focused guides significantly improve the relevance and accessibility of library resources, enhancing the academic experience. Uwandu and Osuji (2022) also highlight the importance of frequently updating content and maintaining quality standards as central to retaining user interest over time. Hybrid service models that combine physical and digital platforms—such as e-journals, CD-ROM databases, and interactive websites—reflect the evolving nature of repackaging strategies in response to user demand for flexibility and convenience. According to Ugwuogu (2015), the growing importance of information as an economic and intellectual asset necessitates that libraries adopt repackaging methods that showcase the value and applicability of their resources. Meanwhile, Uwakwe and Iwuchukwu (2023) argue for environmental upgrades and infrastructural investments that support these strategies, underscoring the fact that innovation in packaging must be matched by improvements in the user environment to foster sustainable engagement.

Overall, while repackaging has emerged as a promising approach for enhancing library engagement, its full effectiveness is contingent on systemic alignment across strategy, delivery, and environment. Efemini (2023) proposes that successful repackaging strategies are those embedded within a broader culture of innovation, user feedback, and contextual relevance, particularly in diverse and under-resourced educational settings. Uwandu and Osuji (2022) echo this view, suggesting that responsive and adaptable systems are better suited to meet shifting user expectations, especially in digital and blended learning contexts. The role of libraries as active agents in the academic ecosystem is reinforced by Ugwuogu (2015), who asserts that information must be packaged in ways that mirror its academic and practical value to ensure consistent use and trust. In this light, Uwakwe and Iwuchukwu (2023) emphasize the interplay between content and context, reminding us that without an enabling environment, even the most innovative repackaging strategies risk becoming underutilized resources. The synthesis of these perspectives points to the need for a holistic, user-centered framework that integrates content innovation, infrastructural support, and ongoing assessment to ensure repackaging efforts are both effective and sustainable.

Strategic Framework for Enhancing Information Access, Research Productivity, and Community Development through Technology Integration in Libraries

A strategic framework for enhancing information access, research productivity, and community development through technology integration in libraries must begin with a redefinition of the library's role to align with the demands of the digital age. Rafiq (2024) asserts that academic libraries should transition from being passive knowledge repositories to active agents of innovation by leveraging digital platforms, data analytics, and user-centered technologies to enrich education and research. This repositioning involves more than technology adoption—it requires a cultural shift towards proactive service delivery and inclusive access. Hazan and Ayub (2024) emphasize the practicality of this approach by documenting how digital catalog systems and virtual services in public libraries have simplified access and enhanced operational efficiency, particularly in resource-limited environments. Yet, Mubofu (2025) cautions that digital transformation is hindered by the digital literacy gap, stressing that without structured and ongoing training, the benefits of technology may remain underutilized. Nakaziba and Ngulube (2024) support this view by identifying professional development and institutional commitment as foundational to successful and sustained technology integration, suggesting that technological innovation in libraries must be strategically underpinned by human capital investment.

To bolster research productivity, libraries must embed technological integration into a strategic framework that emphasizes infrastructure readiness, cross-disciplinary collaboration, and policy reinforcement. Mubofu (2025) identifies systemic barriers—despite librarians' digital skills—as critical impediments, indicating that without conducive organizational and policy environments, technical capabilities alone cannot drive innovation. Addressing this calls for top-down support and a coherent strategy that bridges policy with practice. Rafiq (2024) further advocates for evidence-based service development, urging libraries to employ data and technology to meet evolving research needs and maintain their relevance within academic ecosystems. Nakaziba and Ngulube (2024) expand this argument by recommending an andragogical approach to training that ensures continuous learning aligns with institutional goals, thereby creating a sustainable model of digital transformation.

Meanwhile, Hazan and Ayub (2024) illustrate through empirical findings in Bone Regency that the effectiveness of digital infrastructure depends heavily on consistent investments and the cultivation of local capacity—making a strong case for libraries to develop context-sensitive strategies for research support. In promoting community development, libraries must extend their technological strategies to address social inclusion, lifelong learning, and public empowerment. Hazan and Ayub (2024) demonstrate that libraries equipped with digital tools have successfully extended their services to underserved rural populations, thereby transforming into platforms for social equity and civic education. However, as Mubofu (2025) indicates, these initiatives require institutional backing and librarian training to ensure outreach and impact, especially beyond academic users. Rafiq (2024) positions libraries as potential catalysts for community-driven innovation, where strategic digital engagement fosters creative spaces, digital citizenship, and local problem-solving. Nakaziba and Ngulube (2024) deepen this perspective by proposing a digital transformation model that includes both organizational and environmental readiness, ensuring that libraries are equipped to manage change across varying community contexts. Collectively, these insights affirm that community development through libraries is most impactful when technology strategies are holistically designed—balancing access, empowerment, and inclusion.

In conclusion, the reviewed literature underscores that a strategic framework for technology integration in libraries must be comprehensive, context-aware, and future-oriented. Rafiq (2024) calls for a shift in library identity towards digital leadership and user-centric innovation. Hazan and Ayub (2024) provide real-world evidence that digital transformation enhances both efficiency and outreach, especially when tailored to local needs. Mubofu (2025) reminds stakeholders that technological progress must be matched with skills development and institutional support to be meaningful. Finally, Nakaziba and Ngulube (2024) synthesize these arguments into a transformative model, advocating for ongoing professional learning and system-level change. Therefore, a strategic technology framework should not only digitize services but also recalibrate institutional structures and human capacities to realize the full potential of libraries in advancing education, research, and community well-being.

The literature review reveals that while libraries in Southeast Nigeria are increasingly aware of the transformative potential of the Fifth Industrial Revolution (5IR)—including artificial intelligence, immersive technologies, and user-centric service models—implementation remains uneven and hindered by systemic barriers such as infrastructural deficits, limited funding, and skill gaps. Academic libraries demonstrate moderate progress through digitization and professional training initiatives, yet public libraries lag significantly in adopting human-centered innovations and inclusive digital services. Moreover, despite efforts to repackage information in user-friendly formats, persistent underutilization reflects deeper issues tied to user behavior, environmental constraints, and inadequate engagement strategies. The evolving expectations of library users—demanding personalized, accessible, and ethical digital services—underscore the urgent need for libraries to shift from traditional models to adaptive, interactive, and socially responsive frameworks. This study contributes to existing knowledge by proposing a comprehensive, context-specific strategic model that integrates technological innovation with institutional reform and user engagement in Nigerian libraries. It fills the gap by addressing not just technological readiness but also cultural adaptability, service repackaging effectiveness, and the librarians' evolving role, offering actionable insights for sustainable transformation in under-resourced settings.

Methodology

This study adopted a mixed-methods research design combining quantitative and qualitative approaches to provide a comprehensive analysis of how libraries in Southeast Nigeria are repackaging services to meet the evolving demands of the Fifth Industrial Revolution (5IR). The quantitative component involved a structured survey administered to 164 librarians which are the total number of librarians from five federal universities in the Southeast region: Nnamdi Azikiwe University, Awka (38); University of Nigeria, Nsukka (41); Federal University of Technology, Owerri (48); Michael Okpara University of Agriculture, Umudike (26); and Alex Ekwueme Federal University, Ndufu-Alike Ikwo (11), based on official staff records from each institution (2025).). Among these respondents, 73 were male and 91 were female. In addition, 150 library users were randomly selected and surveyed, comprising 120 public library users and 30 special library users, ensuring representation across diverse user environments. To enrich the data, interviews were also conducted with two librarians, two policymakers, and two technology experts. The study employed structured questionnaires for librarians and library users, and semi-structured interview guides for key informants. Instruments were validated by three experts in Library and Information Science and Educational Measurement, UNN. The survey instrument yielded a Cronbach's alpha of 0.82, indicating high internal consistency. Data were collected through on-site questionnaire administration and in-depth face-to-face interviews with selected informants. Two null hypotheses were tested using independent sample t-tests to examine whether gender or library type significantly influenced user expectations for digital, AI-driven, and human-centric library services. The results showed no statistically significant differences across gender (H_{01}), while a notable difference was observed only in digital learning expectations between public and special library users (H_{02}), indicating a heightened need for digital access in special libraries. The qualitative aspect of the study featured semi-structured interviews with six key informants: two librarians, two policymakers, and two technology experts to provide contextual depth. Thematic analysis of interview responses highlighted several barriers to effective 5IR service integration in Southeast Nigerian libraries, including inadequate infrastructure, limited funding, and the lack of advanced technology such as AI, robotics, and real-time digital systems. This methodological approach enabled the study to achieve its objectives: assessing current service conditions, understanding user expectations, evaluating existing strategies, and proposing a strategic framework for enhancing access, innovation, and engagement in Nigerian libraries amid the demands of the 5IR.

Statement of Findings

1. Investigate the current state of library services in Southeast Nigeria in the context of the 5th Industrial Revolution (5IR)

	Item Statement	Mean	SD	Decision
1	Library services in Southeast Nigeria are equipped with the necessary infrastructure to support 5IR technologies.	2.21	0.60	Disagree
2	Libraries have integrated AI and machine learning technologies into their services.	1.93	0.83	Disagree
3	Most libraries in Southeast Nigeria offer access to digital resources such as e -books and online databases.	3.48	0.74	Agree
4	Libraries are actively working to enhance their digital infrastructure to match the demands of the 5IR.	2.67	0.69	Agree
5	Libraries provide adequate user training on the use of emerging digital technologies.	2.54	0.51	Agree
6	The use of robotics and automation is evident in library operations in Southeast Nigeria.	2.02	0.51	Disagree
7	The current state of library services in Southeast Nigeria is aligned with the goals of the 5IR.	1.93	0.47	Disagree
8	Libraries in Southeast Nigeria actively collaborate with tech companies to improve service delivery.	2.75	0.80	Agree
	Aggregate	**2.44**	**0.64**	**Disagree**

The analysis of the current state of library services in Southeast Nigeria in relation to the 5th Industrial Revolution (5IR) reveals a mixed but generally underdeveloped landscape. While a few advancements have been made—such as the widespread provision of digital resources like e-books and online databases (Mean = 3.48) and ongoing efforts to enhance digital infrastructure (Mean = 2.67)—several critical indicators show significant gaps. Most libraries are not yet equipped with the necessary infrastructure to support 5IR technologies (Mean = 2.21), and the integration of advanced technologies such as artificial intelligence and machine learning remains minimal (Mean = 1.93). Additionally, the use of robotics and automation in library operations is barely evident (Mean = 2.02), and overall alignment with 5IR goals is lacking (Mean = 1.93). Although there is some effort in user training (Mean = 2.54) and collaboration with tech companies (Mean = 2.75), these initiatives appear limited in scope. The aggregate mean score of 2.44, which falls below the 2.50 benchmark, further indicates that the current state of library services in Southeast Nigeria does not meet the expectations or requirements of the 5IR. This suggests an urgent need for infrastructural investment, strategic technology integration, and capacity-building to prepare libraries for the demands of the new industrial era.

The interview responses reveal a shared acknowledgment among librarians, policymakers, and technology experts that while some progress has been made in integrating digital resources into libraries in South East Nigeria, there remains a significant gap in advanced technology adoption and readiness for the Fifth Industrial Revolution (5IR). The librarian stated, "We're doing what we can with the little we have. We do offer digital resources like e-books and databases, which students appreciate, but when it comes to things like AI or robotics, that's still far from our reality. The infrastructure and funding just aren't there yet, though we are gradually improving." This sentiment was echoed by the policymaker, who remarked, "There's a genuine interest from the government side to support digital growth in libraries, but I'll admit—most libraries in the Southeast aren't fully 5IR-ready yet. We're seeing some progress in digital access and training, but the integration of advanced tech like AI and machine learning is still lacking. More structured partnerships with tech companies could help." The technology expert/user further added, "Whenever I visit the library, I mostly rely on online databases. They've made good progress there. But honestly, there's a big gap in tech use. You don't see AI or automation in action, and user training is still basic. If we're talking 5IR, we need to think bigger—interactive systems, smarter search tools, real-time services." Collectively, these perspectives suggest that although foundational digital steps have been taken, a comprehensive and strategic effort is still needed to elevate libraries to true 5IR-capable institutions.

2. Explore the evolving needs and expectations of library users in the era of human-centric technological advancement

	Item Statement	Mean	SD	Decision
9	Library users in Southeast Nigeria expect easy access to digital learning resources.	3.21	0.69	Agree
10	There is a growing demand for personalized services in libraries, powered by AI and big data.	3.45	0.73	Agree
11	Library users prefer online services over in-person visits.	2.49	0.46	Disagree
12	Users expect libraries to offer resources that support both academic and professional development in the digital age.	2.87	0.84	Agree
13	Library users expect libraries to offer mobile-friendly access to library services and resources.	2.91	0.78	Agree
14	There is an increasing demand for real-time assistance and chat services in libraries.	3.12	0.53	Agree
15	Library users in Southeast Nigeria expect an interactive experience with virtual or augmented reality.	3.06	0.52	Agree
16	Users are increasingly interested in accessing research data and scholarly materials in digital formats.	2.54	0.52	Agree
	Aggregate	**2.96**	**0.63**	**Agree**

The findings reveal that library users in Southeast Nigeria have evolving needs and expectations that are increasingly shaped by human-centric technological advancements. With an aggregate mean of 2.96, the data indicates a general agreement among respondents that users are shifting toward more digitally enhanced and personalized library services. Specifically, there is strong agreement that users expect easy access to digital learning resources (M = 3.21) and personalized services powered by AI and big data (M = 3.45). Additionally, there is a recognized demand for mobile-friendly access (M = 2.91), real-time chat assistance (M = 3.12), and interactive experiences using virtual or augmented reality (M = 3.06). Library users are also keen on accessing academic and professional development resources (M = 2.87) as well as research data and scholarly content in digital formats (M = 2.54). However, a notable exception was recorded in users' preference for online services over in-person visits (M = 2.49), which fell just below the agreement threshold, suggesting a balanced or transitional preference in access modes. Overall, these findings highlight the growing expectations for technologically integrated, user-centred library environments that cater to diverse learning and information needs in the digital era.

The interview responses reveal a unified demand for the digital transformation of library services to align with the evolving expectations of modern users. The librarian highlighted this shift by stating, "*These days, most of our users come in asking for e-books or want help accessing something online. They're expecting us to be fast, mobile-friendly, and even offer things like live chat. It's not just about books anymore—it's about giving them tools that fit into their digital lives*." This reflects the growing need for libraries to adopt interactive, tech-based services that resonate with digitally-savvy patrons. Similarly, the policymaker, a Ministry of Education official, emphasized the broader policy implications of this shift, stating, "*We're seeing a clear shift—students and researchers want more digital access, AI-powered recommendations, and support that goes beyond academics. Our policies must reflect this transformation and invest in digital infrastructure that supports personalized, tech-driven library services*." This statement reinforces the necessity of institutional commitment and investment to enable libraries to keep pace with educational and technological change. Supporting these views, the user and technology expert, a postgraduate student and app developer, expressed his expectations: "*When I visit the library, I'm looking for more than just books. I expect seamless access to databases on my phone, maybe even an AR learning tool or AI that curates research materials based on my study patterns. Libraries need to catch up with what users are already doing online*." His insights illustrate the urgency for libraries to incorporate mobile access, artificial intelligence, and immersive technologies in their services. Collectively, these verbatim responses emphasize that the future of libraries lies in their ability to deliver innovative, user-centred, and technology-driven experiences.

3. Evaluate the effectiveness of existing repackaging strategies aimed at attracting and retaining user interest in libraries

	Item Statement	Mean	SD	Decision
17	Repackaging library services, such as digital resources and training materials, has increased user engagement.	3.04	0.57	Agree
18	Existing repackaging strategies meet the needs of both students and researchers in Southeast Nigeria.	2.87	0.66	Agree
19	Library staff in Southeast Nigeria are well-trained in implementing repackaging strategies effectively.	2.97	0.62	Agree
20	Repackaging strategies, such as offering online courses or workshops, have contributed to the growth of library user numbers.	3.21	0.57	Agree
21	Repackaging library services in a more user-friendly digital format has increased user retention.	2.94	0.69	Agree
22	The use of social media and digital marketing strategies has been successful in attractin g new users to libraries.	2.50	0.51	Agree
23	Library repackaging strategies are regularly updated to meet the evolving technological needs of users.	2.75	0.57	Agree
24	Feedback from users is actively incorporated into repackaging strategies to enhance library service offerings.	2.69	0.60	Agree
	Aggregate	2.87	0.60	Agree

The findings reveal a generally positive assessment of the effectiveness of existing repackaging strategies employed in libraries across Southeast Nigeria to attract and retain user interest. With an aggregate mean score of **2.87** and a standard deviation of **0.60**, the data indicates a consensus among librarians that repackaging efforts are having a beneficial impact. Respondents agreed that initiatives such as offering digital resources, training materials, and online courses have notably increased user engagement and contributed to growing library patronage (M = 3.04 and 3.21 respectively). The perception that library staff are adequately trained to implement these strategies (M = 2.97) suggests a supportive human resource capacity for innovation. Furthermore, the use of user-friendly digital formats (M = 2.94), social media outreach (M = 2.50), and regular updates to align with technological advancements (M = 2.75) are seen as valuable strategies. Importantly, incorporating user feedback (M = 2.69) into service design reflects a participatory approach to service delivery. Overall, the results affirm that current repackaging strategies are effective in enhancing library relevance and user satisfaction in the context of rapidly evolving user expectations.

The interview responses from key stakeholders illustrate both optimism and critical insights regarding the transformation of library services through digital innovation. The *Librarian* observed that *"More students and researchers are now getting involved since we started offering digital training materials and online workshops. It's not perfect yet, but these new formats are definitely helping us stay relevant and keep users interested,"* reflecting how digital initiatives are reinvigorating user engagement despite existing imperfections. From a policy standpoint, the *Policymaker* highlighted both progress and systemic obstacles, stating, *"I'd say the effort to repackage library services is promising. The real challenge is scaling it—many libraries still lack the resources and trained staff to fully implement these strategies across the board,"* thereby acknowledging the uneven implementation of such reforms due to

infrastructural and human capacity limitations. Adding a user-centred and tech-driven perspective, the *User/Technology Expert* appreciated the digital shift but called for deeper transformation by saying, *"I love that some libraries now use social media and offer digital content, but it needs to go further. Libraries should keep updating their platforms and really listen to what users want—interactive tools, mobile access, and maybe even gamified learning options."* Altogether, the responses underscore a shared recognition of the value of digital services in modern libraries, while simultaneously pointing to the need for sustained investment, scalability, user responsiveness, and continued technological adaptation to meet evolving expectations.

4. Propose a strategic framework for enhancing information access, research productivity, and community development through technology integration in libraries

	Item Statement	Mean	SD	Decision
25	A strategic framework is needed to guide the integration of emerging technologies in libraries.	3.67	0.63	Agree
26	Technology integration in libraries has the potential to significantly improve information access for all users.	3.28	0.76	Agree
27	The proposed framework will enhance research productivity by providing better access to digital resources and tools.	2.87	0.53	Agree
28	The proposed framework will encourage stronger partnerships between libraries and local communities for mutual development.	2.95	0.66	Agree
28	Providing government support for technology integration in libraries is essential for the success of the proposed framework.	3.11	0.69	Agree
30	Training programs for library staff on emerging technologies are essential for successful framework implementation.	2.62	0.47	Agree
31	The strategic framework will enhance the ability of libraries to deliver remote learning services to underserved populations.	3.05	0.69	Agree
32	The integration of technology in libraries will lead to better resource-sharing and collaboration among institutions.	2.76	0.52	Agree
	Aggregate	**3.04**	**0.62**	**Agree**

The findings from the study indicate strong support among respondents for the development and implementation of a strategic framework aimed at enhancing information access, research productivity, and community development through technology integration in libraries. With an aggregate mean score of 3.04 and a standard deviation of 0.62, the overall response shows consistent agreement across all evaluated items. The highest-rated item, with a mean of 3.67, underscores the perceived importance of having a guiding framework for the integration of emerging technologies in libraries. Respondents also recognized the potential of technology to improve access to information (M=3.28), facilitate research productivity (M=2.87), and foster community partnerships (M=2.95). There was notable agreement on the need for government support (M=3.11) and training programs for staff (M=2.62) as essential components of successful implementation. Additionally, the framework is seen as instrumental in supporting remote learning services for underserved populations (M=3.05) and enhancing collaboration among institutions (M=2.76). These findings highlight a collective awareness of the transformative impact of technology in library services and the necessity for a structured, multi-stakeholder approach to achieving sustainable digital integration.

The interview responses emphasize the urgent need for a structured and well-supported framework to guide the digital transformation of libraries, especially in the context of rapidly evolving technology and user expectations. The Librarian stressed the challenges faced by library professionals in keeping pace with technological change, stating, "we need a clear roadmap, and Technology is moving so fast, and without proper training and support, it's hard to keep up. A solid framework would really help us know where to focus and how to serve our users better, especially in digital access," pointing to the need for direction, training, and focus in enhancing service delivery. Echoing this need, the Policymaker acknowledged the broader implications of such a framework by stating, "There is need to back a framework like this. It's not just about tech—it's about improving education, research, and community development. If we align funding and training with a solid strategy, libraries can really drive transformation across sectors," highlighting the potential of libraries as catalysts for wider societal growth when properly empowered. From the user perspective, the Technology Expert/User emphasized rising expectations and the importance of purposeful implementation, stating, "Most users today expect digital services that are smart and fast. If libraries have a structured plan to adopt tech and train their staff, it's a win-win. It's not just about putting computers in libraries—it's about using them to actually connect people to what they need." Together, these insights underscore the consensus that while technology offers immense opportunities for libraries, its impact will only be fully realized through coordinated planning, adequate training, and meaningful integration into educational and community ecosystems.

Inferential Analysis Results

Null Hypothesis 1 (H_{01}): There is no significant difference between male and female library users in their expectations regarding digital and personalized library services.

Item	Male Mean	Female Mean	p-value	Decision
Easy access to digital learning	3.10	3.14	0.743	✓ Fail to reject H_o
Personalized AI services	3.47	3.46	0.827	✓ Fail to reject H_o
Preference for online services	2.51	2.49	0.758	✓ Fail to reject H_o
Support for development	2.77	2.88	0.343	✓ Fail to reject H_o
Mobile-friendly access	2.81	2.92	0.346	✓ Fail to reject H_o
Real-time assistance	3.20	3.14	0.371	✓ Fail to reject H_o
VR/AR experience	3.10	3.06	0.613	✓ Fail to reject H_o
Access to research data	2.58	2.64	0.468	✓ Fail to reject H_o

Conclusion: There are *no statistically significant differences* between male and female users.

➡ **H_{01} is supported**.

The analysis of gender differences in library users' expectations regarding digital and personalized services revealed no statistically significant differences across all eight evaluated items. Male and female users rated expectations for features such as mobile-friendly access, AI-driven personalization, and access to research data similarly, with p-values far above the 0.05 threshold. This suggests that both genders in Southeast Nigeria share comparable views and needs in the context of technologically enhanced library services. These results may reflect a general alignment in how technology is perceived and valued by users, regardless of gender, particularly in increasingly digital academic and professional environments.

Null Hypothesis 2 (H_{02}): There is no significant difference in expectations between users of public libraries and users of special libraries regarding human-centric technological services in libraries.

Item	Public Mean	Special Mean	p-value	Decision
Easy access to digital learning	3.17	3.45	**0.013**	✗ Reject H_o
Personalized AI services	3.41	3.36	0.694	✓ Fail to reject H_o
Preference for online services	2.61	2.70	0.406	✓ Fail to reject H_o
Support for development	2.81	2.98	0.185	✓ Fail to reject H_o
Mobile-friendly access	2.86	2.96	0.451	✓ Fail to reject H_o
Real-time assistance	3.09	3.19	0.336	✓ Fail to reject H_o
VR/AR experience	3.04	3.05	0.922	✓ Fail to reject H_o
Access to research data	2.59	2.71	0.280	✓ Fail to reject H_o

Conclusion: Only one item shows a **statistically significant difference**:
Special library users have **higher expectations for digital learning access**.

➡ **H_{02} is *partially rejected***.

In contrast, the comparison between public and special library users uncovered a significant difference in one critical area: **easy access to digital learning resources**. Special library users rated this expectation notably higher than public library users, indicating a stronger demand or reliance on digital content in specialized settings—perhaps due to their research-intensive or professional focus. While other items such as real-time assistance or mobile-friendly access showed no significant divergence, this specific result implies that special libraries may need to invest more heavily in robust digital infrastructures to meet their users' elevated expectations. It reflects how user environments (academic vs. professional) can shape the demand for certain technological services.

Discussion of Findings

The current state of library services in Southeast Nigeria reflects a landscape of both emerging progress and persistent limitations in relation to the demands of the Fifth Industrial Revolution (5IR). While some digital infrastructure, such as access to e-books and online databases, is increasingly available, more sophisticated

technologies—particularly those driven by artificial intelligence, robotics, and machine learning—remain largely aspirational. Interviews with librarians, policymakers, and technology users reinforce this observation, noting that despite offering digital resources, libraries struggle with inadequate funding, training, and strategic direction necessary to fully transition into 5IR-ready institutions. As Hotsonyame (2023) points out, these gaps are compounded by infrastructural and financial constraints, making the adoption of intelligent systems difficult. Gillespie et al. (2023) similarly argue that without deliberate strategic planning and sustainable funding, the transformative potential of AI and automation in libraries will remain unrealized. Thus, the foundational elements for digital transformation exist, but the integration of advanced technologies is still in its infancy, leaving Southeast Nigerian libraries far from meeting the holistic expectations of 5IR. Beyond technological insufficiencies, many libraries in the region also lag in implementing the kind of social innovation necessary to make library services more inclusive and human-centered—key characteristics of 5IR. As Ajani, Tella, and Oladokun (2024) observe, public libraries face organizational and cultural barriers that limit their responsiveness to changing user needs. Resistance to change, lack of multi-stakeholder engagement, and inadequate programming all hinder their ability to redefine their roles within communities. Gupta and Mangla (2020) emphasize that for libraries to truly align with 5IR principles, they must become platforms for digital inclusion and lifelong learning, rather than merely digital repositories. Encouragingly, some academic libraries, particularly those in institutions like the National Open University of Nigeria, are exhibiting growing awareness of 5IR tools, spurred by professional exposure and evolving ICT skills. However, as Hotsonyame (2023) and Gillespie et al. (2023) suggest, without stronger advocacy, consistent funding, and culturally responsive strategies, most Southeast Nigerian libraries will continue to fall short of becoming transformative, tech-integrated hubs for education and community development in the 5IR era.

In the era of human-centric technological advancement, the expectations of library users in Southeast Nigeria are shifting dramatically, reflecting a broader global trend toward personalization, digital access, and immersive engagement. The findings from the study, as well as insights from user interviews, reveal that library patrons are no longer satisfied with static, physical collections; instead, they increasingly demand smart, responsive, and digitally integrated services. As Ekpolomo (2024) explains, today's academic library users actively seek immersive learning environments and personalized digital content that supports both academic achievement and user empowerment. The results show clear user interest in tools such as real-time digital assistance, mobile access, and AI-driven services that enhance learning efficiency and convenience. These expectations align with Hassans (2025)'s assertion that libraries must redesign their offerings around the realities of digitally literate patrons, integrating platforms and services that are responsive to their evolving information behaviours. Interview responses reinforce this shift, with users highlighting the need for augmented reality, smart search systems, and remote learning access—all indicators that libraries are now viewed as dynamic, user-centred ecosystems rather than passive repositories of information. Alongside these technological expectations is a parallel evolution in the roles and responsibilities of librarians and institutional stakeholders. Thiruppathi (2024) notes that librarians must now operate as digital navigators and data curators, tasked with enabling user access to complex digital tools and training communities in digital literacy. This was echoed in the interviews, where librarians expressed the need for a structured roadmap and consistent training to better support users' digital needs. Moreover, as Isiaka et al. (2024) emphasize, libraries are critical to addressing digital divides in under-resourced areas by offering inclusive, technology-enhanced services that support lifelong learning and community development. Policymakers interviewed acknowledged that meaningful investment in infrastructure and training is key to positioning libraries as agents of transformation in education, research, and innovation. Together, these perspectives make it clear that the digital transformation of libraries is not merely a technical upgrade but a strategic reorientation—one that places user needs, equity, and relevance at the heart of library service delivery in the 5IR age.

The effectiveness of repackaging strategies in libraries across Southeast Nigeria is evident in both the empirical data and stakeholder interviews, which collectively point to a positive transformation toward user-centered, technology-driven service delivery. The findings reveal that digital resources, training materials, and online engagement platforms have become essential in attracting and retaining library users. This shift supports the assertion by Ugwuogu (2015) that libraries have evolved to include digital repository management and virtual reference services, aligning with modern information consumption habits. As the librarian in the interview noted, “More students and researchers are now getting involved since we started offering digital training materials and online workshops. It's not perfect yet, but these new formats are definitely helping us stay relevant and keep users interested.” This reflects an active repurposing of library functions to meet emerging user needs. Similarly, Efemini (2023) emphasizes the value of formats such as videos and podcasts, which make information more appealing and accessible, reinforcing the success of these initiatives as perceived by library staff. However, the policymaker's concern that “many libraries still lack the resources and trained staff to fully implement these strategies across the board” highlights the uneven reach and limited scalability of such efforts, despite their proven value. Nevertheless, challenges persist, particularly in terms of user engagement, infrastructure, and the perception of libraries as outdated. According to Uwakwe and Iwuchukwu (2023), low library usage remains an issue, often rooted in poor reading habits and the belief that libraries are no longer relevant. This

suggests that while repackaging efforts have potential, their impact can be diluted without systemic improvements and active user reorientation. The User/Technology Expert's call for more dynamic tools—"Libraries should keep updating their platforms and really listen to what users want—interactive tools, mobile access, and maybe even gamified learning options"—underscores the need for sustained innovation and user-responsive planning. Uwandu and Osuji (2022) also note that user orientation and face-to-face engagement help bridge the gap between resource availability and user adoption, suggesting that human interaction remains crucial even in digital spaces. To achieve long-term effectiveness, repackaging strategies must therefore be part of a broader ecosystem that prioritizes not just technological enhancement but also user education, comfort, and sustained dialogue between libraries and their patrons.

The findings from the study strongly indicate that stakeholders—librarians, policymakers, and users—support the establishment of a strategic framework that will enhance access to information, research productivity, and community development through deliberate technology integration in libraries. Respondents collectively emphasized the importance of such a framework not only for improving service delivery but also for guiding digital transformation in a structured and inclusive manner. This aligns with the views of Rafiq (2024), who notes that academic libraries must transcend their traditional roles and actively embrace digital platforms to enrich user experiences and foster scholarly growth. The interviewees expressed that having a clear roadmap would help libraries navigate the complexities of evolving technologies and address gaps in digital access, especially through targeted training and institutional support. In line with Hazan and Ayub (2024), who highlight the utility of digital catalog systems and services in improving operational efficiency even in under-resourced settings, the study underscores that digital initiatives must be backed by consistent policy support and a commitment to training librarians for long-term sustainability. Furthermore, the responses and literature collectively stress that meaningful digital transformation in libraries cannot occur without addressing the human and organizational dimensions of implementation. Mubofu (2025) notes that many librarians, even when digitally competent, are constrained by a lack of resources and practical support needed to apply their skills effectively. Similarly, Nakaziba and Ngulube (2024) emphasize the role of continuous professional development and organizational learning in ensuring that technology adoption is not just a superficial fix but a sustainable advancement. Both the empirical data and interviews affirm that users expect intelligent, fast, and responsive digital services, and these expectations can only be met when libraries have well-trained staff and a coherent, inclusive strategy. Such a strategy must incorporate infrastructural development, responsive policy alignment, and a focus on user-centered design, thereby positioning libraries not just as service providers but as strategic partners in education, research, and community advancement.

Framework for Enhancing Information Access, Research Productivity, and Community Development through Technology Integration in Libraries

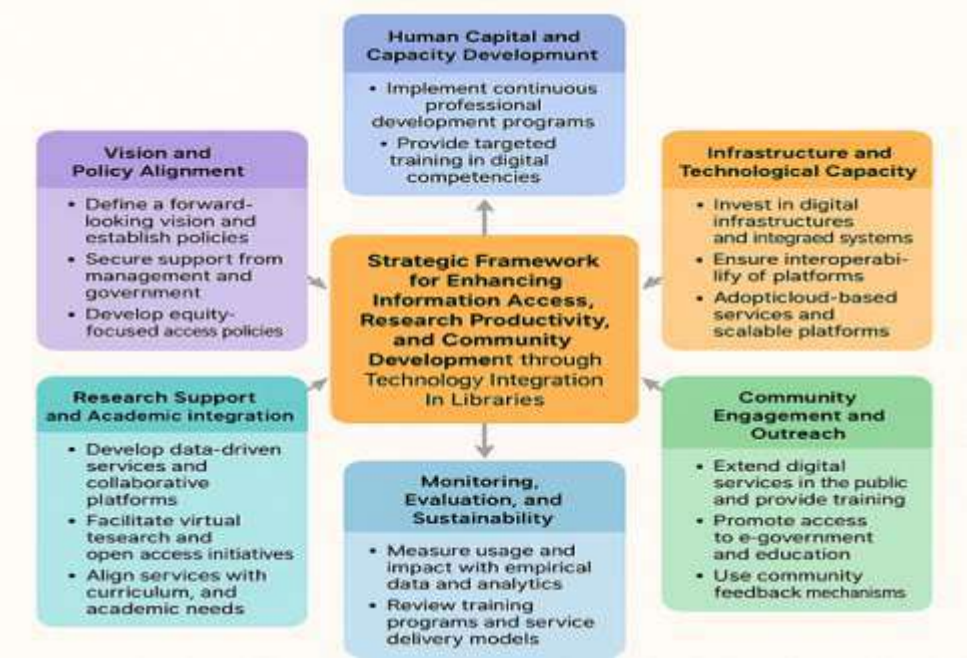


Figure: Framework self-developed by the authors (2025)

The **Strategic Framework for Enhancing Information Access, Research Productivity, and Community Development through Technology Integration in Libraries** outlines six interconnected pillars that guide library transformation in the digital era:

1. **Vision and Policy Alignment**: This foundational pillar emphasizes the need for libraries to define a clear, forward-looking mission aligned with digital innovation. It includes establishing supportive policies and securing institutional and governmental backing, especially to ensure equitable access across communities.
2. **Infrastructure and Technological Capacity**: Libraries must invest in reliable digital infrastructures, such as integrated library systems and cloud-based platforms. Ensuring interoperability and scalability is vital for sustaining digital services and enabling broader access to information resources.
3. **Human Capital and Capacity Development**: The framework prioritizes continuous professional development for library staff. By equipping librarians with practical digital competencies and encouraging lifelong learning, libraries can ensure that technology integration is effectively implemented and sustained.
4. **Research Support and Academic Integration**: Libraries serve as research facilitators by offering data-driven services, virtual collaboration tools, and open-access resources. These efforts help align library services with academic priorities, thereby enhancing research productivity and interdisciplinary engagement.
5. **Community Engagement and Outreach**: Beyond academia, libraries should extend digital services to underserved communities, promoting digital literacy, access to e-government services, and inclusive educational opportunities. This reinforces the library's role as a hub for community empowerment.
6. **Monitoring, Evaluation, and Sustainability**: To maintain relevance and impact, libraries must continuously assess their programs using empirical data and analytics. Regular evaluation ensures that training, infrastructure, and service models remain effective, scalable, and aligned with evolving user needs.

Conclusion

In conclusion, the study underscores a dynamic yet uneven journey toward digital transformation within libraries in Southeast Nigeria, especially in the context of the Fifth Industrial Revolution. While progress is evident in the adoption of digital resources, emerging user needs and expectations reveal that libraries must do more than merely digitize their collections—they must evolve into intelligent, user-centric ecosystems capable of supporting immersive, inclusive, and responsive services. Interviews with stakeholders and supporting literature consistently highlight gaps in infrastructure, funding, and strategic alignment, all of which hinder the full integration of advanced technologies such as AI, machine learning, and real-time digital assistance. Repackaging strategies and user-centered innovations show promise, but their success is limited by inconsistent implementation and inadequate support systems. The future of library services in the region depends on a shift from ad hoc solutions to a coordinated and sustainable model for transformation.

To this end, the proposed Strategic Framework for Enhancing Information Access, Research Productivity, and Community Development through Technology Integration offers a comprehensive blueprint for progress. Its six pillars—ranging from policy alignment and infrastructure to human capital development and evaluation—serve as a guide for libraries seeking to reposition themselves as strategic enablers of academic and community growth. The empirical findings affirm the urgency of this transformation, as both users and librarians call for more responsive, intelligent, and inclusive services. Gender-neutral expectations for technological enhancements further reinforce the need for universally accessible solutions, while the differing needs of special and public libraries highlight the importance of context-sensitive service delivery. Ultimately, libraries in Southeast Nigeria must embrace this holistic framework not only to remain relevant but also to become vital drivers of digital inclusion, research excellence, and sustainable community empowerment in the 5IR era.

References

Adigun, Ganiyu O., Ajani, Yusuf Ayodeji and Enakrire, Rexwhite T.(2024). The Intelligent Libraries: Innovation for a Sustainable Knowledge System in the Fifth (5th) Industrial Revolution" Libri, vol. 74, no. 3, 2024, pp. 211-223. https://doi.org/10.1515/libri-2023-0111 https://www.degruyterbrill.com/document/doi/10.1515/libri-2023-0111/html?lang=en

Ajani, Y. A., Tella, A., & Oladokun, B. D. (2024). Social innovation in Nigerian public libraries: A roadmap for navigating the challenges and opportunities of inclusivity and diversity in the 5IR era. Business Information Review, 0(0). https://doi.org/10.1177/02663821241289845

Azizi, S., Nair, G., Rabiee, R., & Olofsson, T. (2020). Application of Internet of Things in academic buildings for space use efficiency using occupancy and booking data. Building and environment, 186, 107355.

Bello, S. A., & Ojo, R. F. (2018). Information Repackaging Services in Nigerian Public Libraries. East African Scholars Journal of Education, Humanities and Literature, 1(1) 2018. https://easpublisher.com/media/features_articles/EASJEHL_11_30-39_c_jBFTomt.pdf

Byrkovych, T., A. Humenchuk, N. Kobyzcha, L. Akimova, L. Grinberg, and O. Akimov. 2023. "Economic Effectiveness of State Policy in Reforming Higher Library and Information Education in Ukraine." *Economic Affairs* 68 (1). https://doi.org/10.46852/0424-2513.1.2023.28.

David-West, B. T. (2021). Knowledge Management and Information Professionals in 21st Century Academic Libraries in Nigeria. Library Progress (International), 41 (1), 72-78.

Doğan, S., and İ. Z. Niyet. 2024. "Artificial Intelligence (AI) in Tourism." In *Future Tourism Trends Volume 2:Technology Advancement, Trends and Innovations for the Future in Tourism*, 3–21. Emerald Publishing

Limited.10.1108/978-1-83753-970-320241001
Efemini, E., (2023). Information Packaging And Repackaging As A Panacea For Under Utilization Of Libraries And Library Resources In Academic Libraries In Nigeria. https://www.academia.edu/101402169/

Ekpolomo, O., (2024). Understanding and Serving Library Users: Part 2 - The Changing Needs of Academic Library Users https://www.linkedin.com/pulse/understanding-serving-library-users-part-2-changing-ekpolomo-o2gaf
Ekwueme, L. O., Oluwaseun, B. O., Ajie, I. A., Ofodu, P. N., Ambrose, S. E. (2024). Awareness, Perception, And Skills Of Librarians For The Implementation Of 5 Th Ir In Academic Libraries: Implications On Open And Distant Learning. Journal Of Science Technology And Education 12(2), June, 2024 https://www.atbuftejoste.com.ng/index.php/joste/article/viewFile/2145/pdf_1513
Gillespie, N., Lockey, S., Curtis, C., Pool, J. and Akbari, A. 2023. Trust in artificial intelligence: a global study. [Online]. https://assets.kpmg.com/content/dam/kpmg/au/pdf/2023/trust-in-ai-global-insights-2023.pdf
Green, A. 2023. "Academic Library Employees and Their Work Modality Options and Preferences." The Journal of Academic Librarianship 49 (5): 102764. https://doi.org/10.1016/j.acalib.2023.102764
Gupta, N. and Mangla, R. 2020. Artificial intelligence basics: a self-teaching introduction. Dulles, Virginia:Mercury Learning & Information.
Hassans, A., (2025). The Future of Libraries: Evolving Roles in the Digital Age. Eurasian Experiment Journal of Arts and Management (EEJAM) ISSN: 2992-412X ©EEJAM Publications 7 Issue 3. https://kiu.ac.ug/assets/publications/3535_the-future-of-libraries-evolving-roles-in-the-digital-age.pdf
Hotsonyame, G.N. 2023. Significance of academic libraries in recent times: a review of articles. Library Philosophy and Practice, 7736. [Online]. https://www.researchgate.net/profile/George-Hotsonyame
Isiaka, Abdullahi Olayinka; Soliu, Abdulfatai; Aremu, Biliamin Abiola; Bamidele, Benjamin Adebisi; SabaJibril, Saidu; and Ibitoye, Adelani Rotimi, "The Evolving Role of Libraries in the Fourth Industrial Revolution: Navigating Digital Transformation" (2024). Library Philosophy and Practice (e-journal). 8141. https://digitalcommons.unl.edu/libphilprac/8141
Kraft-Terry, S. D., & Brown, J. (2023). Data-Informed Planning and Decision-Making. In Academic Advising Administration (pp. 181–194). Routledge.
Nigerian Content Development and Monitoring Board (NCDMB, 2024). Local Content Digest 2024. https://ncdmb.gov.ng/lcdm/LocalContentDigest2024.pdf
Nwobu, B. K., Dumbiri, R., Ibia, M. J., & Oladokun, B. D. (2024). Libraries in the Fifth Industrial Revolution: Skills and Knowledge Required in Preparing Librarians for an Uncertain Future. . In U. C. Udofot et al. (Eds.), Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria. (3 – 13). Port Harcourt: Chadick Printing Press
Onwuekwe, C. N. & Onah, E. E. (2024). Relationship between Information Repackaging and Service Delivery by Academic Librarians in Donald Ekong Library, University of Port Harcourt. UNIZIK Journal of Research in Library and Information Science (UJOLIS) 8(1&2), October, 2024.
Oyeniran, K. G. & Olajide, A. A. (2015). An Emperical Study of Strategic Approach to Marketing and Promotion of Information Products and Services in Nigeria University Libraries. International Research: Journal of Library & Information Science | Vol.5 No.1, Mar. 2015 https://www.researchgate.net/publication/346719477_An_Emperical_Study_of_Strategic_Approach_to_Marketing_and_Promotion_of_Information_Products_and_Services_in_Nigeria_University_Libraries
Rodrigues, M.C. and Mandrekar, B. 2020. Impact of academic library services on students' success and performance. Library Philosophy and Practice, 1-19.
Spotti, G. & Windelband, L. (2020). The 4th Industrial revolution: Its impact on vocational skills. Journal of Education and work, 34 (1), 29-52.
Tella, A., & Ajani, Y. A. (2022). Robots and public libraries. Library Hi Tech News, 39(7), 15–18.
Thiruppathi, Librarian's Role in The Digital Age: Reimagining the Profession in The ERA of Information Abundance, International Journal of Library and Information Science (IJLIS), 13(1), 2024, pp. 1–9. https://iaeme.com/Home/issue/IJLIS?Volume=13&Issue=1
Ugwuogu, U. O. (2015). Expectations and Challenges of Information Repackaging In Nigerian Academic Libraries. International Journal of Learning & Development, 5(2) 2015 https://scispace.com/pdf/expectations-and-challenges-of-information-repackaging-in-2qli5npnrh.pdf
Uwakwe, B. S., & Iwuchukwu, C. O. (2023). Conducive library environment: A motivational factor for library use in public university libraries in Nigeria. Journal of Library Services and Technologies, 5(1), 132 – 142, March, 2023 https://credence-publishing.com/journal/uploads/archive/20231688760803680074403 3.pdf
Uwandu, Linda Ijeoma and Osuji, Chioma Esther, "Strategies Used by Librarians in Marketing Information Resources and Library Services in Federal University of Technology, Owerri and Imo State University, Owerri" (2022). Library Philosophy and Practice (e-journal). 7336. https://digitalcommons.unl.edu/libphilprac/7336
Valette, E., Bril El-Haouzi, H., & Demesure, G. (2023). Industry 5.0 and its technologies: A systematic literature review upon the human place into IoT- and CPS-based industrial systems. Computers & Industrial Engineering, 184, 109426. https://doi.org/10.1016/j.cie.2023.109426
Vasić, M. (2014). Change of needs of library users caused by the changes of conceptualisation of experiencing time and information under the influence of modern technologies. INFOtheca Vol. 14, No. 2, December 2013
Zhang, H., Cui, Y., Shan, H., Qu, Z., Zhang, W., Tu, L., & Wang, Y. (2020, June). Hotspots and trends of virtual reality, augmented reality and mixed reality in education field. In 2020 6th International Conference of the Immersive Learning Research Network (iLRN) (pp. 215–219). IEEE.
Zondi, N. P., Epizitone, A., Nkomo, N., Mthalane, P. P., Moyane, S., Luthuli, M., Khumalo, M. & Phokoye, S. (2024). A review of artificial intelligence implementation in academic library services. https://journals.co.za/doi/full/10.7553/90-2-2399

An Evaluative Analysis of the Perceived Role of Librarian Spotlight Africa (LSA) Advocacy Programmes in Promoting Librarianship in Africa

Sylvester Israel EBHONU (CLN)
Admiralty University of Nigeria, Library Ibusa, Delta State
Email: didigitallibrarian@gmail.com

Ramatu A Haliru (CLN)
Ahmadu Bello University Zaria
Email: ramatu4me@gmail.com, rahaliru@abu.edu.ng

Bolaji David Oladokun
Department of Library and Information Technology,
Federal University of Technology, Ikot Abasi, Akwa Ibom, Nigeria
Email: Bolaji.oladokun@yahoo.com

Abstract

This study investigates the role of advocacy programmes in advancing librarianship in Africa, focusing specifically on the Librarian Spotlight Africa (LSA) initiative. In the face of widespread misperceptions and declining interest in the library and information science (LIS) profession, LSA adopted an innovative, media-driven, storytelling format to spotlight the contributions and professional journeys of African librarians. The study was guided by three objectives: to determine the level of engagement with LSA among stakeholders, explore how LSA shapes perceptions of librarianship, and assess the extent to which it inspires the implementation of professional ideas. A cross-sectional survey design was employed, involving 124 respondents (librarians, lecturers, and students) across nine African countries. Data were collected via an online structured questionnaire and analyzed using descriptive statistics (frequency counts, percentages and charts) and inferential tests (ANOVA). Findings revealed that LSA was perceived as highly engaging, particularly by lecturers and librarians, with statistically significant variations across professional categories. The programme was effective in reshaping perceptions of librarianship, presenting librarians as dynamic professionals engaged in digital transformation and community development. Notably, 48% of respondents reported implementing ideas from LSA episodes in areas such as advocacy, digital literacy, and open access. These outcomes affirm LSA's dual impact on perception and practice. The study concludes that media-based, person-centered advocacy models like LSA are essential for revitalizing librarianship in Africa.

***Keywords**: Librarian Spotlight Africa, advocacy, professional identity, digital storytelling, librarianship in Africa.*

Introduction

In recent years, librarianship in Africa has faced significant challenges stemming from widespread misperceptions, limited societal awareness, and diminishing interest in the profession. Despite the critical role librarians play in promoting access to knowledge, preserving cultural heritage, and supporting educational advancement, the librarianship has continued to suffer from undervaluation and misconceptions. Numerous studies have pointed out that students and even academics frequently misunderstand the role and relevance of librarians in contemporary society. Adetayo et al. (2024) revealed that inaccurate perceptions of libraries and librarians contribute to the declining enrollment in Library and Information Science (LIS) programs among students in Nigerian universities. Similarly, Datig (2014) found that international students often held vague or outdated conceptions of libraries, further emphasizing the global nature of the challenge.

To confront this identity crisis, various library associations and institutions have deployed advocacy initiatives aimed at promoting librarianship and raising awareness about the diverse roles of information professionals. However, most of these efforts have centered around traditional methods such as conferences, policy dialogues, and formal publications. A noticeable gap remains in harnessing innovative, media-based storytelling and person-centered approaches to reshape public narratives. It is within this context that *Librarian Spotlight Africa (LSA)* emerges as a revolutionary and timely intervention.

Librarian Spotlight Africa (LSA) is a pioneering initiative designed to recognize, celebrate, and amplify the contributions of librarians and information professionals across Africa. Through monthly live-streamed interviews and storytelling formats, LSA features honorees who share their professional journeys, innovations, and challenges. As of February 2025, LSA has featured ten honorees from seven African countries, including Nigeria, South Africa, Uganda, Ethiopia, Ghana, Namibia, and Kenya. These interviews are streamed via platforms such as LinkedIn, Facebook, and YouTube, reaching diverse audiences including students, practicing librarians, and academics. With the intention to showcase the lived experiences and achievements of African librarians, LSA directly challenges the misleading philosophies and practice that have stunted the growth of librarianship in many parts of the continent. Personal observation suggests that LSA has inspired a new generation of LIS students and professionals.

Despite the growing visibility and anecdotal successes of the LSA program, there has been no systematic empirical investigation into its reach, influence, and effectiveness. While earlier studies such as those by Mubofu and Malekani (2024), and Saleh and Tsagem (2019) have examined the role of professional associations in advancing librarianship, none have explored how a media-centric advocacy program like LSA contributes to reshaping perceptions, enhancing engagement, or inspiring implementation of new ideas among diverse stakeholders in Africa. Faulkner and Reiter (2025) revealed the need for innovative professional development models in librarianship, and LSA seems to offer such a model, yet without empirical assessment, its impact remains speculative. It is against the background, this study becomes crucial to evaluate innovative advocacy efforts of LSA.

The perception of librarianship across many African societies remains poorly defined and misunderstood, often

shaped by outdated stereotypes, limited awareness, and undervaluation of the profession. This has led to persistent challenges in attracting new entrants into the field, gaining institutional recognition, and influencing national development agendas through information and knowledge services. Studies such as Adetayo, Asiru, and Oladokun (2024), and Brunskill and Hanneke (2021) have shown that misperceptions and a lack of visibility contribute significantly to the decline in enrollment in library and information science (LIS) programs and underutilization of library services.

While professional associations and institutional programs have attempted to address these issues, interventions specifically designed to spotlight individual librarians' achievements, contributions, and professional journeys remain underexplored. One such initiative is the Librarian Spotlight Africa (LSA) program, which brings to the fore inspiring narratives of accomplished African librarians in a bid to reposition librarianship as a vibrant, impactful, and rewarding profession. Despite its growing visibility and perceived influence, no empirical study has been conducted to examine the actual reach, engagement, and impact of advocacy programmes such as LSA on advancing librarianship in Africa.

Existing literature (e.g., Mubofu & Malekani, 2024; Adomi, 2005; Saleh & Tsagem, 2019) has acknowledged the role of library associations and mentorship in promoting professional growth. However, there is a paucity of research that investigates how media-driven advocacy platforms like LSA influence stakeholders' perceptions, professional identity, and practical implementation of learned ideas across geographical and professional divides. This study, therefore, seeks to fill this gap.

Objectives of the Study

The general objective of the study is to investigate the Librarian spotlight Africa's advocacy programmes in promoting librarianship in Africa. Specifically, the study seeks to:

1. Determine the level of engagement with the LSA advocacy program among librarians, students, and lecturers across Africa;
2. Ascertain the extent in which LSA advocacy program shapes perceptions of librarianship in Africa; and
3. Determine the extent to which it inspires the implementation of professional ideas.

History of Librarian Spotlight Africa

In 2024, Librarian Spotlight Africa made significant strides in recognizing and celebrating exceptional librarians across the African continent. As a flagship initiative of the African Librarians Spotlight program, it highlighted the remarkable contributions of library and information professionals who are advancing literacy, education, and community engagement in innovative and impactful ways (The Nations, 2025; Independent Nigeria, 2025). Launched in February 2024, the program honored eleven distinguished librarians throughout the year. In February 2024, Prof. Yetunde Zaid from Nigeria was honored for her trailblazing efforts in promoting inclusivity within library services and for being the first librarian to adopt artificial intelligence in library operations at Lagos State University. Her recognition emphasized the importance of focus and determination in achieving professional goals.

The March 2024 spotlight fell on Pastor Dominic Omokaro, President of the Nigerian Library Association. His leadership introduced innovative initiatives that boosted membership and strengthened the association's voice on issues affecting librarianship in Nigeria, positioning him as a notable figure in NLA's history. Also, Mr. Kepi Madumo, National Librarian of South Africa, was recognized in April 2024 for his exemplary leadership and advocacy for social cohesion through libraries. He was also commended for promoting the preservation of South African cultural heritage through legal deposit, raising awareness about safeguarding cultural assets.

In May 2024, Dr. Fatima Jibril Abduldayan received recognition for her leadership and community outreach. Her advocacy centered on open access to knowledge, the importance of local-to-international partnerships, teamwork, and promoting data generation and research data management within libraries. Going forward, Mr. Peter Balaba was honored in June 2024 for his innovative work in Nakaseke, Uganda. His ICT training programs empowered community members with digital skills, highlighting the role of libraries in economic development. His partnerships with UNESCO, EIFL, and AfLIA reflected the significance of collaboration in extending the reach of library services.

In July 2024, Naomi Ubogu was celebrated for pioneering digital librarianship. Her work demonstrated the necessity of embracing technology, continuous learning, and passion in librarianship, resulting in transformative outcomes for both institutions and professionals. August 2024 spotlighted Mr. Mulugeta Woldetsadik of Hawassa University, Ethiopia, for his contributions to library services in the Sidama region. Through influential blogging and partnerships with international organizations, he promoted school libraries and led community outreach efforts, enhancing access to information in rural areas.

Dr. Sola Owolabi was recognized in September 2024 for his pioneering use of bibliotherapy, cinematherapy, and game therapy as tools to address youth-related social challenges. His leadership in integrating automation, digitization, and artificial intelligence into library services demonstrated the evolving role of libraries in therapy and education. The October 2024 edition featured Paul Mensah of Ghana, whose initiatives like “Library Corner” and “Libraries Without Walls” reached over 14,000 children and schools. His work focused on combating educational poverty and improving access to knowledge through innovative outreach strategies.

In November 2024, Dr. Nkem E. Osuigwe was celebrated for her leadership and commitment to digital literacy. Her #1Lib1Ref initiative promoted African knowledge representation on Wikipedia, challenging librarians to embrace digital tools and advocate for open access. Through AfLIA, she organized training programs to empower librarians in promoting open-source knowledge. The December 2024 spotlight concluded the year with Hon. Sagir Musa Ahmed, who underscored the essential qualities of modern librarians, including digital literacy and a deep understanding of librarianship's cultural and developmental impact. His reflections encapsulated the evolving identity and indispensable role of librarians in contemporary society. Throughout 2024, Librarian Spotlight Africa not only honored excellence but also amplified the voices of librarians committed to innovation, advocacy, and transformative leadership across Africa (Digital Librarian, 2025; My Librarianship, 2025).

Literature Review

Adetayo et al. (2024) investigated how perceptions of libraries and librarians among Nigerian university students influence their interest in pursuing LIS as a career. The study adopted a descriptive survey design and utilized a structured questionnaire administered to 600 undergraduate students across five Nigerian universities. The population was drawn from non-LIS students in arts, sciences, and education faculties. The findings revealed that a significant proportion of students perceived librarianship as monotonous, underpaid, and lacking in career progression, which discouraged their interest in enrolling in LIS programs. The study concluded that these negative perceptions must be addressed through targeted advocacy and awareness campaigns to reshape public understanding of the profession. Also, Klain Gabbay and Shoham (2019) conducted a study to evaluate how academic libraries support research productivity and teaching effectiveness in Israeli universities. Using a mixed-methods design, the study combined surveys and interviews involving 342 academic staff and 25 librarians across six institutions. The findings indicated a strong positive correlation between faculty perception of library relevance and their actual use of library services for research and instruction. Notably, faculty members who engaged in continuous dialogue with librarians reported better integration of information literacy into their courses. The study concluded that proactive advocacy and collaborative outreach by librarians significantly enhance their institutional visibility and relevance.

Further, Mubofu and Malekani (2024) investigated how professional associations in Tanzania contribute to the development of young LIS professionals. The study employed a survey design and involved 215 librarians under the age of 40. The data collection instrument was a structured questionnaire. Results showed that active engagement with the Tanzania Library Association significantly enhanced the professional identity, networking, and capacity building of young librarians. Participants reported that the visibility of librarian achievements motivated them to remain in the profession. The study concluded that professional advocacy through national associations is vital in reshaping the future of librarianship.

Mubofu (2025) explored how advocacy and training programs organized by the association influenced job performance among librarians. Adopting a survey design, the study collected data from 120 librarians across public libraries in Tanzania using questionnaires. Findings indicated that librarians who participated in advocacy-driven training reported improved professional commitment, innovation, and recognition within their institutions. The conclusion emphasized the transformative potential of well-structured advocacy initiatives to elevate professional standards and morale. Adomi (2005) explored the strategic vision, challenges, and achievements of the Nigerian Library Association in promoting librarianship in Nigeria. Ms. Okojie discussed advocacy programmes, public engagement, and policy dialogues as tools for advancing the LIS profession. She emphasized the importance of role modeling and showcasing excellence, which aligns directly with LSA's approach to advocacy through spotlighting individuals. The study concluded that the association's visibility drivers are key to strengthening the profession's image and relevance.

Brunskill and Hanneke (2021) sought to understand the reasons behind students' disengagement with library resources and personnel. The review examined over 40 empirical studies published between 2000 and 2020. The findings revealed that students who do not use library services often lack awareness of librarians' expertise or hold negative stereotypes about libraries. The authors concluded that advocacy and orientation programs should be emphasized to correct misconceptions. Datig, I. (2014), in a study, used a qualitative design to explore how students from different cultural backgrounds perceive libraries. Semi-structured interviews were conducted with 30 international students at an American university. The study found that cultural factors heavily influenced students' understanding of libraries, often limiting their appreciation of library services and the librarian's role. The study concluded that libraries need culturally adaptive outreach and storytelling techniques to bridge perception gaps.

Saleh and Tsagem (2019) investigated the advocacy and development roles played by the NLA. The study adopted a descriptive design, drawing data from NLA activity reports and interviews with 10 senior members of the association. Findings indicated that the NLA had made significant strides in organizing conferences, policy lobbying, and mentorship initiatives. However, it lacked a strong media presence and youth-focused engagement. The authors concluded that modern platforms could complement traditional association efforts in reaching wider and younger audiences. Iglesias et al. (2023) explored what influences career entry into librarianship. Using a longitudinal design and survey method, the researchers studied 158 recent LIS graduates across four countries. The study revealed that visibility of successful librarians and access to career narratives positively influenced students' interest and career pursuit. The conclusion highlighted the value of mentorship, role models, and public storytelling.

Faulkner and Reiter (2025) found that professional visibility, engagement in advocacy, and mentorship were critical to advancement. It concluded that programs that publicize librarian achievements can serve as catalysts for broader professional growth. Adekoya and Fasae (2021) further showed that mentorship significantly improves professional confidence and innovation, and that mentees benefited from hearing personal success stories. The study concluded that storytelling and visibility-driven mentorship are powerful tools in shaping professional trajectories. Finally, Munshi et al. (2024) used a survey design to examine the changing roles of librarians in India and found that visibility and advocacy within academic communities enhanced embedded roles and recognition. The authors recommended regular promotion of librarian contributions through social media and interviews.

Although a few studies, such as those by Mubofu (2025) and Mubofu & Malekani (2024) offer Tanzanian perspectives, many others are concentrated in Nigeria or outside Africa. There remains a lack of comparative regional studies across African countries to understand how advocacy efforts are perceived and adopted in diverse cultural and geographical contexts. Since LSA spans multiple African countries (e.g., Nigeria, South Africa, Kenya, Ghana, Ethiopia, Uganda, Namibia), it provides a unique opportunity to address this gap.

Methodology

This study adopted a cross-sectional survey design to investigate the LSA advocacy programmes in advancing librarianship in Africa. The cross-sectional design was chosen due to its effectiveness in gathering data from a population at a single point in time, which is suitable for assessing perceptions, levels of engagement, and reported behaviors across diverse groups simultaneously. This design also allows for the comparison of various respondent categories (e.g., librarians, lecturers, students) and geographical region.

The use of a cross-sectional design was particularly appropriate for this study because the goal was not to track changes over time but rather to evaluate and analyze the current state of engagement, perception, and implementation of LSA content. Furthermore, the design allowed the researchers to examine relationships and differences among variables such as professional category, gender, and regional representation without requiring longitudinal follow-up.

To collect primary data, a structured questionnaire was developed and administered online. The questionnaire was designed to capture a range of responses related to engagement with the LSA programme, the perceived relevance of its content, the extent of implementation of ideas learned, and overall perceptions of inclusivity and accessibility. The instrument comprised both closed-ended and open-ended questions, offering both quantitative and qualitative insights into the experiences of the respondents. To ensure content validity, the questionnaire was reviewed and validated by experts in Library and Information Science, who provided feedback on question clarity, relevance, and alignment with the study objectives.

The study population consisted of librarians, lectures and students in library and information science who had participated in or followed the LSA intervention programme between February 2024 and March 2025. A total of 124 respondents across various African countries, including Nigeria, Botswana, Kenya, South Africa, Ethiopia, Ghana, Namibia, Equatorial Guinea, and Uganda, completed the questionnaire. These participants were drawn from three primary stakeholder categories: librarians, lecturers, and students in Library and Information Science or related fields.

The sampling technique employed was purposive sampling, a non-probability technique suitable for identifying and selecting individuals who are especially knowledgeable about or experienced with a phenomenon of interest. In this study, purposive sampling enabled the selection of participants who had attended or interacted with the LSA programme during the specified period, thereby ensuring the relevance of the data collected to the study objectives. The sampling strategy also helped capture diverse regional and professional perspectives on the LSA's influence.

Data analysis was conducted using descriptive statistical methods. These included frequency counts, percentages, and visual representations such as charts and graphs. The descriptive analysis provided insights into respondents' engagement levels, perceptions of relevance and impact, implementation behaviors, and views on LSA's inclusivity and accessibility. The use of descriptive statistics allowed for clear summarization of large volumes of data and enabled meaningful comparisons across respondent categories and geographical locations. Also, Inferential Statistics such as Analysis of Variance (ANOVA) were employed and tested at 0.05 level of significance.

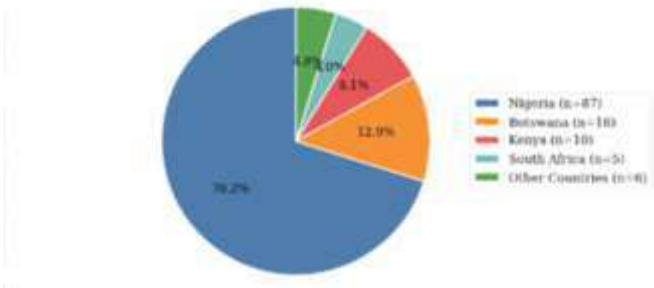
In compliance with ethical research standards, the researchers ensured voluntary participation, anonymity, and confidentiality throughout the study. Respondents were informed of the purpose of the research, the voluntary nature of their participation, and their right to withdraw at any point without penalty. No personally identifiable information was collected, and all responses were used solely for research purposes. The research adhered to ethical principles consistent with institutional and international guidelines for social science research.

Results

Demographic information of respondents

The demographic analysis of the respondents provided insight into the composition of individuals who participated in the *Librarian Spotlight Africa (LSA)* Impact and Feedback Survey as seen in Figures 1 and 2, and Table 1.

Figure 1: Distribution of Respondents by Geographical Location



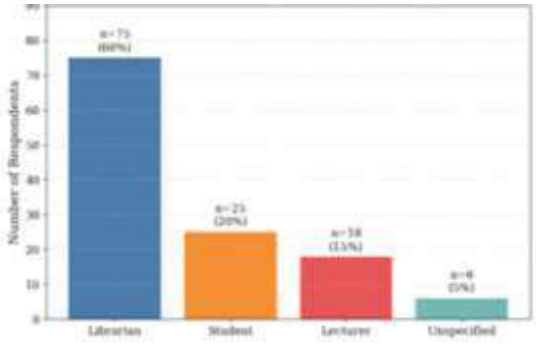
Regarding geographical distribution, it was evident as seen in fig 1 that respondents hailed from several African countries, including Nigeria, South Africa, Botswana, Kenya, Ethiopia, Ghana, Uganda, Namibia, and Equatorial Guinea. Nigeria accounted for the largest share of participants, followed by Botswana, Kenya, and South Africa. This distribution reflects the strong presence and awareness of the LSA program in these countries and supports the pan-African reach of the initiative.

Table 1: Distribution of Respondents by Gender

Frequency	Percent	Percentage
Female	67	54.0
Male	57	46.0
Total	124	100.0

As seen in Table 1, a total of 124 respondents from diverse countries across Africa took part in the study. The gender distribution was relatively balanced, with 67 females (54%) and 57 males (46%), indicating that both genders were almost equally represented in the survey.

Figure 2: Distribution of Respondents by Category

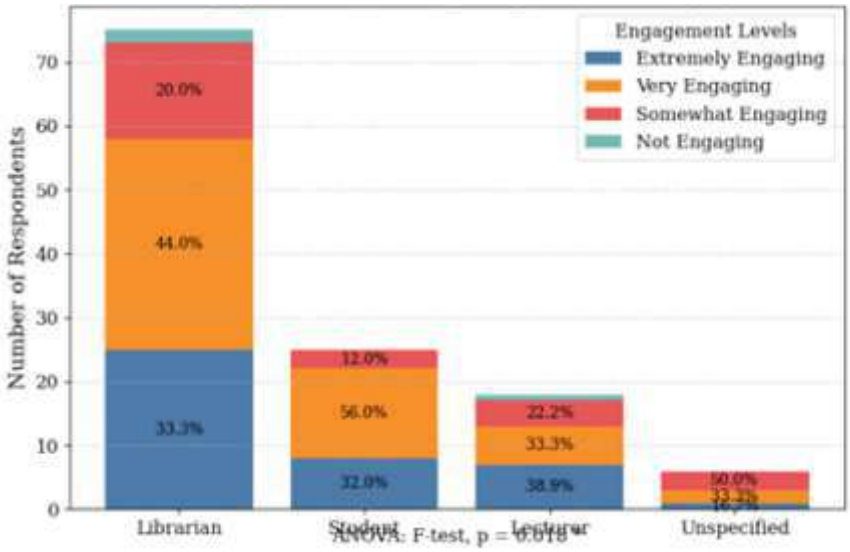


In terms of professional category, the majority of respondents identified as librarians, followed by students and lecturers (Figure 2). This composition is important, as it reflects the program's diverse audience, encompassing both current professionals and future entrants into the field of librarianship. The inclusion of students and lecturers alongside practicing librarians is crucial to understanding how the LSA program influences perceptions and practices at different stages of professional development.

Objective 1: Level of engagement with the LSA programme

This objective determined the extent to which different respondent categories, including librarians, students, and lecturers, engaged with the LSA program.

Figure 3: Engagement levels of respondent by category



As presented in the results in Figure 3, most respondents described their engagement with LSA as either "Very Engaging" (44%) or "Extremely Engaging" (33%), indicating a generally positive reception of the initiative. Only a minimal percentage (3%) found the program “Not Engaging,” which reflects the effectiveness of LSA's content and delivery in maintaining audience interest.

Table 2: There is no significant difference in engagement levels across respondent categories

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6.843	2	3.422	5.12	0.018
Within Groups	80.987	121	0.669		
Total	87.83	123			

For deeper analysis, a one-way Analysis of Variance (ANOVA) was used to test for differences in engagement levels across professional categories as indicated in Table 2. The analysis revealed a statistically significant difference ($F = 5.12$, $p = 0.018$), indicating that engagement levels varied meaningfully by professional group.

Research Objective 2: Perceptions of librarians, students, lectures on LSA advocacy program in advancing librarianship

The second objective explored the opinion of stakeholders regarding the LSA program in advancing librarianship in Africa as demonstrated in Figures 4 and 5. The findings show that LSA significantly influenced the perception of the profession across different groups. A large portion of respondents agreed that LSA shifted their views of librarians from traditional book custodians to active professionals driving innovation, digital transformation, and community engagement.

Figure 4: Perception impact of LSA programmes on librarianship

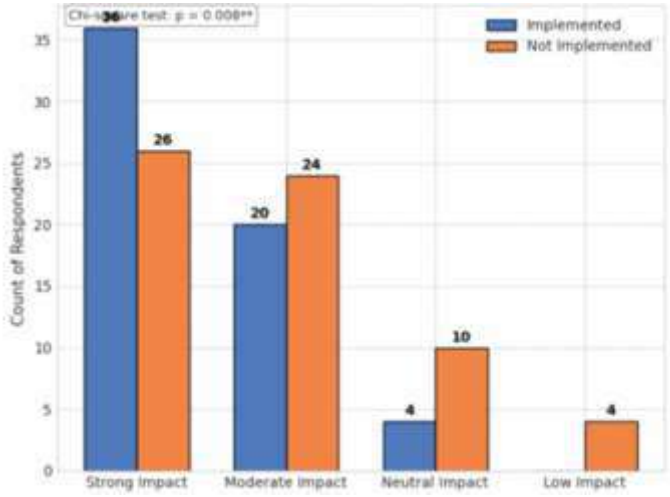
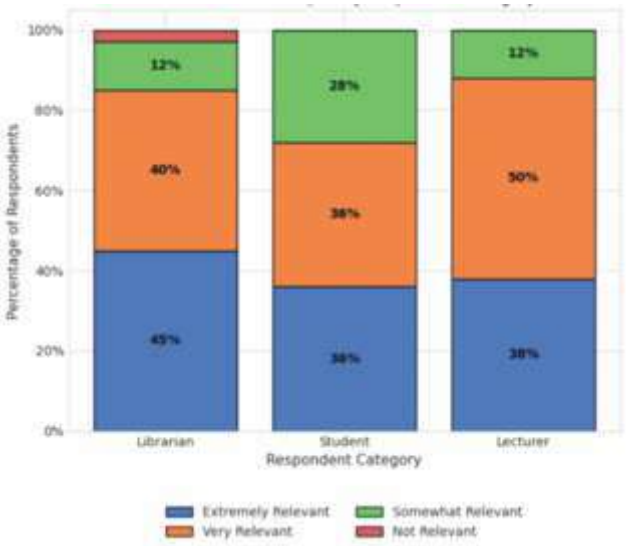


Figure 5: Perceived relevance of LSA programme



Respondents consistently described the LSA as impactful in showcasing the diversity of roles and achievements of African librarians. Specifically, lecturers reported the highest levels of positive perception change, followed by librarians and then students. The qualitative responses highlighted several recurring themes, including: (1) expansion of professional identity, where LSA helped reframe librarians as leaders and change agents; (2) promotion of innovation, especially in digital services and literacy; and (3) enhancement of professional pride, where participants felt more connected to the profession through the stories of honored librarians. These findings indicate the success of LSA in redefining the public and internal image of librarianship, particularly through its storytelling and live-stream format.

Research Objective 3: Extent to which it inspires the implementation of professional ideas

The third objective focused on determining the extent to which respondents implemented ideas or concepts learned from LSA episodes, and the nature of these implementations. The data revealed that 48% of respondents (60 out of 124) reported having implemented ideas or initiatives inspired by the LSA program. This shows that nearly half of the audience translated learning and inspiration into tangible actions, validating the program's role in not just shaping perceptions but also influencing professional behavior.

The most common types of implementations included advocacy initiatives (37%), digital literacy programs (30%), open access promotion (23%), community engagement projects (20%), and professional development strategies (17%). This variety of implementation types illustrates the multifaceted influence of LSA across various dimensions of librarianship and information service delivery.

Figure 6: Types of implementation ideas (Top 5)

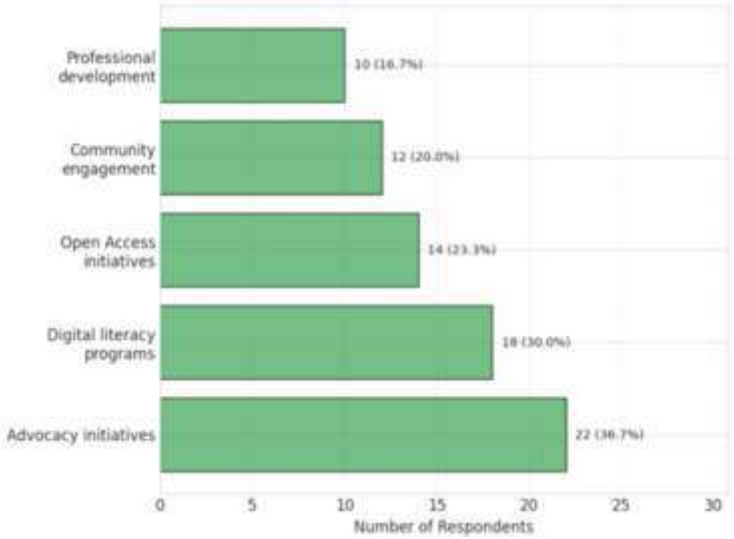
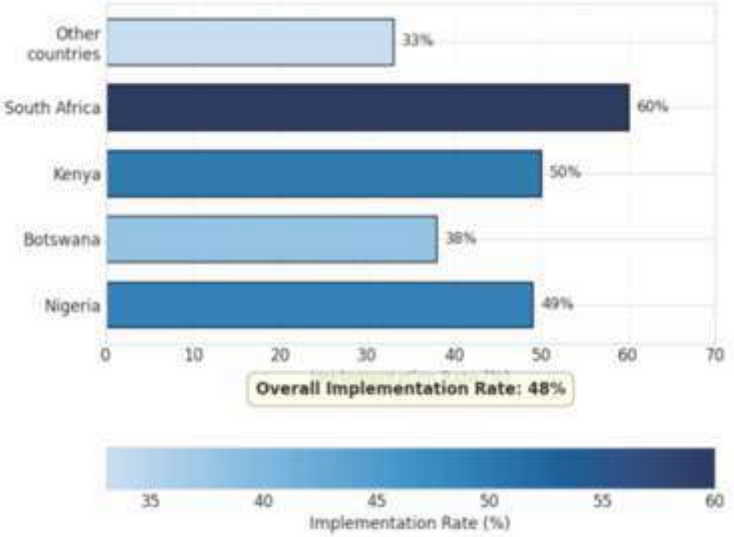
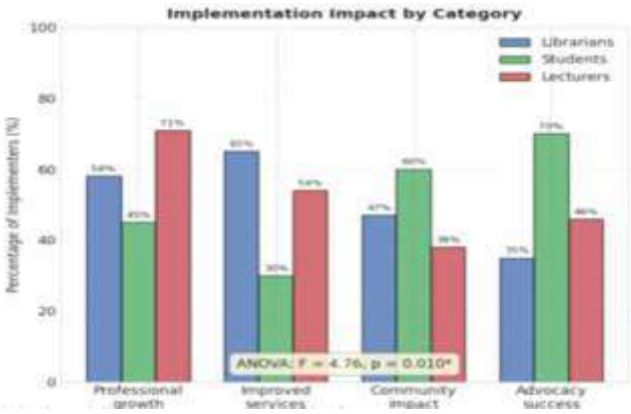


Figure 7: Geographic Variation in Implementation



In terms of geographical variation, implementation rates were highest in South Africa (60%), followed by Kenya (50%), and Nigeria (49%), though these differences were not statistically significant. The reported impacts of these implementations varied by category: librarians emphasized improved service delivery, students highlighted increased advocacy participation, and lecturers focused on professional development outcomes. These findings affirm that LSA serves not only as a platform for learning and inspiration but also as a catalyst for practice-oriented change.

Figure 8: Implementation Impact by Category



A further breakdown by professional category indicated that lecturers had the highest implementation rate (67%), followed by librarians (51%), and students (40%). The variation in implementation by category was statistically significant ($\chi^2 = 6.84$, $p = 0.012$), suggesting that professional status and experience level influence one's ability or readiness to implement ideas. Respondents who rated LSA as "Extremely Engaging" were also more likely to implement ideas, suggesting a strong link between engagement level and behavioral impact.

Discussion of the Findings

Level of Engagement with the LSA Programme

The findings assessed the level of engagement with the Librarian Spotlight Africa (LSA) program, demonstrating that the initiative is broadly engaging for diverse respondents, with a majority rating it as "Very Engaging" or "Extremely Engaging." Lecturers were found to have the highest engagement levels, followed by librarians and students. This finding aligns strongly with Klain Gabbay and Shoham (2019), who emphasized that proactive advocacy and continuous dialogue between librarians and faculty members lead to increased institutional engagement. The fact that lecturers find LSA highly engaging may be attributed to their familiarity with academic narratives and interest in innovations within the profession, which LSA successfully delivers through its live storytelling format. Furthermore, the study's indication that social media presence significantly correlates with engagement resonates with Munshi et al. (2024), who recommended regular promotion of librarian contributions via digital platforms such as social media and interviews to enhance professional visibility. The success of LSA in fostering high engagement through such platforms supports this assertion and highlights the relevance of digital advocacy in modern professional development efforts.

Additionally, the relatively high engagement among librarians aligns with Mubofu and Malekani (2024), who found that association engagement enhances professional identity and networking. However, the slightly lower engagement among students may reflect findings from Adetayo et al. (2024) and Brunskill and Hanneke (2021), both of whom noted students' limited awareness of the value of librarianship and the expertise of librarians. The engagement gap among students, although not extreme, suggests that additional targeted interventions may be necessary to fully captivate and convert this demographic, further validating calls for tailored youth engagement strategies by Saleh and Tsagem (2019).

Influence of LSA on Perceptions of Librarianship

The findings reveal a significant shift in how respondents, especially lecturers and librarians, view the profession. Many reported that LSA helped them see librarianship as dynamic, impactful, and central to community development and digital transformation. This directly supports the conclusions of Adetayo et al. (2024), who argued that targeted advocacy is essential to correcting misconceptions about librarianship among the public and potential LIS students. LSA's storytelling method, which highlights professional achievements and lived experiences, seems to effectively counteract the monotony and invisibility often associated with the profession.

This outcome is also in strong agreement with Iglesias et al. (2023) and Faulkner and Reiter (2025), who found that visibility of successful librarians positively influences professional interest and career progression. Similarly, Adekoya and Fasae (2021) emphasized that storytelling and visibility-driven mentorship enhance professional confidence and innovation, a finding echoed in the qualitative feedback from LSA participants who reported feeling more inspired and professionally validated after viewing the program. Moreover, this supports Adomi's (2005) assertion that advocacy must go beyond policy dialogues and involve showcasing excellence and professional fulfillment.

Implementation of Ideas Learned from LSA

The results further indicated respondents implemented ideas from LSA, findings show that nearly half (48%) of the respondents applied concepts learned from the program into their professional practices. These included initiatives in advocacy, digital literacy, open access, and community engagement. This high level of practical implementation confirms the assertion of Mubofu (2025) that well-structured advocacy and training initiatives significantly improve job performance, professional innovation, and recognition. Respondents who were more engaged with LSA were also more likely to implement learned ideas, emphasizing the transformative power of immersive and relatable advocacy content.

The strong implementation rate among lecturers and librarians, particularly in areas such as digital literacy and advocacy, also echoes Klain Gabbay and Shoham (2019), who highlighted the importance of librarians' active involvement in research and instructional collaborations. It is evident that LSA has not only influenced how librarians see themselves but has also provided actionable insights that are being incorporated into service delivery and community programs.

Furthermore, the geographical diversity in implementation, with South Africa and Nigeria leading in uptake, suggests that LSA's influence transcends national boundaries and cultural contexts, thus echoing Datig (2014), who emphasized the need for culturally adaptive outreach. Interestingly, the types of implementations observed, especially in advocacy and open access, also validate Faulkner and Reiter's (2025) argument that advocacy and visibility are precursors to professional growth and service innovation. Respondents' testimonials about how LSA encouraged them to initiate community-focused projects and digital transformation activities also align with the transformative role of professional engagement highlighted in Mubofu and Malekani (2024).

Conclusion

The findings of this study affirm that the *Librarian Spotlight Africa (LSA)* initiative has made a significant and multifaceted contribution to the advancement of librarianship in Africa. The program has achieved wide geographical reach and strong engagement among librarians, lecturers, and students. Participants rated LSA as highly engaging, with lecturers and librarians expressing particularly high levels of interest and involvement.

Crucially, LSA has reshaped perceptions of the profession, repositioning librarians as innovative, influential, and integral to community and digital development. Given the findings, LSA has successfully countered outdated stereotypes and showcased librarianship as a dynamic, fulfilling, and impactful career. Beyond shaping perceptions, LSA has catalyzed behavioral change. Nearly half of the respondents reported implementing professional ideas gleaned from the program, including advocacy campaigns, digital literacy initiatives, and open access promotion. These tangible outcomes demonstrate that LSA not only informs but also inspires action across professional categories and regions. This study further confirms that media-driven, human-centered advocacy models like LSA are not only timely but essential for the revitalization and repositioning of librarianship in Africa.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. The Nigerian Library Association should institutionalize initiatives like LSA across national and regional library associations to spotlight member achievements and raise public awareness of librarianship. Also, they should develop and maintain digital channels for advocacy that feature local success stories, mentorship interviews, and user testimonials.
2. Individual librarians and practitioners should translate insights from LSA episodes into practice by initiating digital literacy workshops, advocacy drives, or community services. Alternatively, they should participate in storytelling and visibility platforms by sharing experiences, innovations, and lessons learned to inspire peers and mentees.

Limitations

This study has some limitations. Firstly, the research employed a cross-sectional survey design, which captures data at a single point in time. As a result, the study cannot account for changes in perceptions or behaviors over time, nor can it assess the long-term impact of the LSA programme on professional practice. Secondly, the use of purposive sampling, although appropriate for targeting individuals familiar with the LSA programme, limits the generalizability of the findings. The study relied on self-selected participants who had interacted with the programme, which may introduce bias, as individuals with positive experiences or higher motivation may have been more inclined to respond. This could result in an overrepresentation of favorable perceptions and engagement levels. Additionally, the sample size of 124, while diverse in terms of geography and professional category, may not be sufficiently large to represent the entire African LIS community. The concentration of respondents from countries like Nigeria and South Africa further suggests that some regional perspectives may have been underrepresented.

References

Adekoya, C. O., & Fasae, J. K. (2021). Mentorship in librarianship: Meeting the needs, addressing the challenges. *The Bottom Line*, *34*(1), 86-100.

Adetayo, A. J., Asiru, M. A., & Oladokun, B. D. (2024). Student perceptions of libraries and librarians: Factors in non-enrollment in LIS programs. *The Journal of Academic Librarianship*, *50*(5), 102935.

Adomi, E. E. (2005). Interview with Ms Victoria Okojie, President of the Nigerian Library Association. *Library Hi Tech News*, *22*(9), 24-27.

Brunskill, A., & Hanneke, R. (2021). Students who are non-users of their academic library: A scoping review. *The Journal of Academic Librarianship*, *47*(5), 102423.

Datig, I. (2014). What is a library?: International college students' perceptions of libraries. *The Journal of Academic Librarianship*, *40*(3-4), 350-356.

The Digital Librarian. (2025). *Librarian Spotlight Africa (LSA)*. https://thedigital-librarian.com/lsa/

Faulkner, A., & Reiter, L. (2025). Career advancement in academic libraries: A systematic review. *The Journal of Academic Librarianship*, *51*(3), 103046.

Iglesias, A., Mahama, L., Gard, C., & Schirmer, T. (2023). Pursuing academic librarianship: Factors affecting job attainment. *The Journal of Academic Librarianship*, *49*(4), 102751.

Independent Nigeria. (2025). *Librarian Spotlight Africa recognises Ayodele Alonge for advancing library modernisation*. https://independent.ng/librarian-spotlight-africa-recognises-ayodele-alonge-for-advancing-library-modernisation/

Klain Gabbay, L., & Shoham, S. (2019). The role of academic libraries in research and teaching. *Journal of Librarianship and Information Science*, *51*(3), 721-736.

Mubofu, C., & Malekani, A. (2024). The contribution of Tanzania library association in enhancing the librarianship profession: Views from the under 40-year-Olds-a quantitative study. *Alexandria*, *34*(1-2), 28-45.

Mubofu, C. (2025). Library Associations as A Catalyst for Job Performance Among Librarians: Experience from Tanzania Library and Information Association. *International Information & Library Review*, 1-11.

Munshi, S. A., Koner, S., & Barsha, S. (2024). The future of academic librarianship: the imperatives of embedded librarianship practice and implementation. *Library Management*, *45*(5), 362-375.

My Librarianship. (2025). *Home*. https://mylibrarianship.wordpress.com/

Saleh, I. I., & Tsagem, A. M. (2019). Strategies and activities of the Nigerian Library Association (NLA) to the development of library and information profession in Nigeria from 2000. *Journal of Library Services and Technologies*, *1*(2), 32-42.

The Nation. (2025, May 31). *Embrace digital transformation to sustain African libraries, Alonge urges*. The Nation Nigeria. https://thenationonlineng.net/embrace-digital-transformation-to-sustain-african-libraries-alonge-urges/

Application of Artificial Intelligence for Delivering of Library and Information Service in Selected Libraries in Abuja

IBRAHIM, Mariam Gambo
gmariam@noun.edu.ng +2348034355104

Prof. **ECHEZONA,** R.I
ifeoma.echezona@uniabuja.edu.ng+2348035483000

AKAAKA, Dooshima
dooshitessy@gmail.com + 2347068256612

Abstract

The study investigated the application of Artificial Intelligence for delivering of Library and Information Service in selected libraries in Abuja. The study was guided by four objectives. The study adopted a survey research design. The population of the study consisted of 76 librarians from National Open University of Nigeria and 74 librarians from university of Abuja. The total enumeration sampling was used to get a sample size of 150 librarians. The instrument for data collection was closed ended questionnaire titled Artificial Intelligence Advancement Questionnaire (AIAQ). The data was collected via online Google forms. The data was analysed using frequency, percentages and mean. The findings revealed that AI is currently applied but at a low level with a mean of 2.9, AI had very high impact on improving the efficiency and effectiveness of library services (M=3.2), librarian had positive perception of AI enhancing the quality of library and information services (M=3.0) and the challenges and barriers faced by library staff in adopting and using AI technologies in library services included high cost of AI tools, unreliable power source, fear of it replacing humans, lack of AI policies in the library and training of library staff. The study concluded the application of AI in libraries can improve library service delivery. The study recommended that institutions management should support the implementation of AI in those libraries, provision of funds for AI infrastructure, training should be given to library staff on the use of AI, constant power supply should be provided and formulation of policies that will guide the use of AI in libraries.

Keywords: *Artificial intelligence (AI), academic library, library service delivery*

Introduction

Libraries have long been responding to new technological trends that offer improvements to the field of librarianship. For instance, automation and digitization are just two of such processes expanding library services and workflow capabilities. However, over the last two decades, no technological advancement has been as dominant as that of Artificial Intelligence (AI). AI has infiltrated much of modern technology to the point there are hardly people who are unaware of its presence (AlKhalidi, 2022).

Artificial intelligence (AI) stands as a revolutionary disruptor within the library domain, fundamentally reshaping the fabric of information services. In the face of exponential digital expansion and ever-growing patron demands, libraries find themselves navigating uncharted waters, grappling with the monumental task of harnessing vast oceans of data (Omame & Alex-Nmecha, 2020). However, amidst this complexity, AI emerges as a beacon of promise, offering libraries transformative tools needed to revolutionize their operations and seamlessly adapt to evolving user needs. Through the seamless integration of AI-driven tools and applications, libraries transcend traditional boundaries, bolstering their capabilities across diverse domains such as information retrieval, cataloging, recommendation systems, and user engagement. Harnessing sophisticated data analytics and machine learning algorithms, AI empowers libraries to extract invaluable insights from sprawling repositories of information, facilitating highly efficient and deeply personalized services. Furthermore, AI-powered chatbots and virtual assistants emerge as indispensable assets, offering patrons instant support and intuitive guidance in navigating the labyrinth of library resources (Halburagi & Mukarambi, 2023).

Moreover, AI-enabled predictive analytics empower libraries to anticipate user preferences and needs, heralding a new era of proactive service delivery and resource allocation. In addition, AI facilitates real-time access to vast datasets, enabling researchers and scholars to identify patterns, correlations, and emerging trends with unprecedented speed and accuracy. In this ever-evolving landscape, the integration of artificial intelligence in libraries serves as a cornerstone for building a dynamic and responsive information ecosystem. Embracing AI-driven innovations, libraries assert their role as indispensable hubs of knowledge dissemination and discovery, shaping the future trajectory of information services in an increasingly digitized world (Bisht et al., 2023).

According to Adesina and Zubairu (2024), the integration of artificial intelligence (AI) into library operations is rapidly gaining traction, with a primary focus on augmenting services and bolstering performance. While the adoption of AI aims to replicate human thought processes and behaviours, it

presents a dual landscape of challenges and opportunities. Within contemporary library settings, AI manifests through a spectrum of applications, including expert systems for reference assistance, automated book shelving facilitated by robotics, and immersive educational experiences delivered through virtual reality platforms. These advancements not only streamline routine processes but also open avenues for personalized learning experiences and interactive engagement.

Perception refers to how individuals interpret and make sense of sensory information from the environment. In the context of library, the perception of AI may be seen as how library professionals view the use of AI in library operations and services (Nicholas & Huntington, 2022). It encompasses their understanding of AI applications, acceptance of AI tools for improving information services, challenges regarding the impact of AI on traditional library settings, readiness to integrate AI in daily library operations, and overall receptiveness towards AI advancements in libraries (Nicholas & Huntington, 2022). In as much as AI application in library is promising, concerns regarding application in libraries in developing countries is the major issue. Thus, this study wishes to explore the application of Artificial Intelligence for delivering of Library and Information Service in selected libraries in Abuja.

Problem Statement

Libraries have historically played a crucial role in collecting, organizing, and providing access to information resources for their users. Over time, they have evolved structurally and in content delivery across different eras—ranging from the use of clay tablets and stone inscriptions in ancient times to papyrus and parchments in the medieval period, and later to paper, microforms, and, more recently, digital and electronic media (Omame & Alex-Nmecha, 2020). This continuous transformation has been driven by the need to adapt to changing information needs and technological advancements. To remain relevant and effectively serve their users, libraries have consistently integrated emerging technologies, transitioning from traditional formats to computerized systems, the Internet, virtual libraries, and cloud computing. In the contemporary digital landscape, artificial intelligence (AI) has emerged as a revolutionary technology with significant potential to enhance library and information service delivery. AI applications, such as machine learning, natural language processing, and intelligent automation, offer innovative ways to improve access, retrieval, and management of information resources.

Despite the growing interest in AI applications within libraries, most existing studies on this subject lack empirical evidence, focusing primarily on theoretical and conceptual discussions. This gap in research highlights the need for a systematic investigation into the role of AI in enhancing library services. Therefore, this study seeks to explore the application of Artificial Intelligence for delivering of Library and Information Service in selected libraries in Abuja, providing empirical insights into its adoption, challenges, and potential benefits.

Objectives of Study

The objectives of the study are to:

1. Examine the current applications of Artificial Intelligence (AI) in library services within the selected academic libraries in Abuja.
2. Aasess the impact of AI-driven technologies on improving the efficiency and effectiveness of library services.
3. Explore the perceptions of library users and staff regarding the role of AI in enhancing the quality of library and information services.
4. Identify the challenges faced by library staff and users in adopting and using AI technologies in library services.

Literature Review

Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems. Artificial intelligence is the programming and development of computers to perform human required-intelligence task, such as speech recognition, decision-making, visual perception, language translation, talking and emotional feelings (Irizarry-Nones, Palepu & Wallace, 2017). According to Heath (2018), artificial intelligence is the technology that enables machines to have the abilities to plan, learn, reason, solve problems, move, and to some extent be creative. From the above, it can be concluded that

AI is the ability of the computer to think and carry out operations like a human being. Library services are services provide to library users to ensure that their information needs are met. Library services are categorized into two broad terms which are; conventional library services and services for promoting library use (Ike et al, 2023). The conventional or traditional services include; circulation; reprography and

inter-library loan while the services for promoting library use are as follow; Initiation/orientation service, reference service, current awareness service/selective dissemination of information service, information brokerage, community information service, ICT related services, internet services, new book display, and press clipping service (Ike et al, 2023). Libraries have various statutory functions and services they provide to their users that have relevance to her mission and to the users.

By using AI systems based on radio frequency identification (RFID), libraries optimise the location of resources and work intelligently, enabling autonomous functions (Okunlaya, Syed Abdullah & Alias 2022). For users, AI simplifies the search for relevant research materials by using generative AI to streamline search procedures and save valuable time (IFLA 2023a). Librarians are freed from repetitive tasks and can spend their time getting to know and serve their clientele better. The applications of AI within library contexts encompass a wide spectrum, including expert systems for reference services, robotic systems for tasks like book reading and shelf management, and virtual reality for immersive learning experiences in technical assistance (Omame & Alex-Nmecha 2020). This infusion of AI not only reshapes the landscape of library services, but also signifies a paradigm shift in technical and patron services, promising innovative solutions that transcend traditional boundaries (Omame & Alex-Nmecha 2020; Banerjee 2022).

Adjei (2023) also intimated that academic libraries face challenges in incorporating tools of the 4th Industrial Revolution, some of which include insufficient budgets, inadequate ICT infrastructure and networks, inadequate training, lack of ICT skills on the part of librarians, lack of institutional support, lack of staff motivation, fear of losing jobs, technological obsolescence and poor data infrastructure, general lack of interest, among others. Those challenges highlighted by Adjei maybe common to academic libraries in Abuja which may as well hinder effective adoption of AI in library services. Tripathi (2024) explored the potential of Artificial Intelligence (AI) to bring about transformation in library services and information management. The research used a thorough scale to assess the degree of artificial intelligence (AI) integration into libraries, as well as the resulting consequences for user experience and the encountered challenges. The results indicate improved effectiveness in the organisation and classification of materials, as well as increased user contentment, inside libraries that have integrated artificial intelligence technology. Even though the study explored AI in libraries, the study has location and coverage gap. The previous study was conducted in different location while the present study focused on selected libraries in Abuja and aims to bridge the gap.

Ali et al. (2022) highlights the limitations of existing IT infrastructure in handling advanced AI products. Similarly, a study in Southern Nigeria by Emiri (2023) reveals low AI adoption rates due to insufficient ICT infrastructure to meet global standards. The study was conducted in a different location in the southern part of Nigeria covering the libraries in the location. However, the study is limited by location and the population was large than the present study. To bridge the gap, the current study is in Abuja and cover selected libraries. The expenses related to staff training and consulting investments further weigh heavily on AI adoption Job security is a significant concern, with worries that AI technology could replace human roles, leading to job losses and reduced employment opportunities (Ajani et al. 2022). However, contrary perspectives suggest that AI adoption may not necessarily result in significant job losses, as libraries could assume additional roles related to content acquisition, data exploration, user assistance and content evaluation (Cox, Pinfield & Rutter 2019). This is corroborated by research conducted by Huang (2022) in Taiwan, a developed country, indicating that librarians in that context do not foresee being replaced by AI. The previous study was conducted outside Nigeria, in a developed country with different cultural and economic background. However, the current study is in Nigeria, Abuja.

Methodology

This study employed a quantitative research approach using a cross-sectional survey design to gather data at a single point in time. A cross-sectional survey was chosen because it allows for the collection of comprehensive data on existing conditions, trends, and perceptions regarding artificial intelligence (AI) in library services (Zuleika & Siswo, 2022). The study focused on academic librarians in two selected institutions in Abuja: The National Open University of Nigeria (NOUN) and the University of Abuja (UA). These institutions were chosen due to their significant roles in higher education and their adoption of digital library services. The total population of librarians in these institutions was 150**,** consisting of 76 librarians at NOUN and 74 at the University of Abuja. Sampling was not employed in this study because the entire population of librarians (150) was relatively small and manageable for a full-population survey. Given the small size, including all librarians ensured a more comprehensive and representative dataset, reducing the risk of sampling errors and ensuring that every librarian's perspective on AI adoption and implementation was captured. A census approach was, therefore, deemed more appropriate to obtain a holistic and accurate assessment of AI applications in library services. Data were collected using a structured questionnaire titled *Artificial Intelligence Advancement Questionnaire (AIAQ)*. The questionnaire was designed to obtain relevant information across five key sections: Section A: Demographic information, Section B: Current applications of artificial intelligence in library services Section C: Impact of AI-driven technologies on service efficiency, Section D: Perceptions of AI technologies among librarians, Section E: Challenges and barriers to AI adoption in libraries

The collected data were analyzed using descriptive statistical methods, including frequencies, percentages

and mean with the assistance of the Statistical Package for Social Sciences (SPSS). To interpret the findings effectively, a mean benchmark of 3.0 was set as the decision threshold, ensuring that only responses with a significant level of agreement or impact were considered in drawing conclusions.

Results and Discussion

Table 1: Current Applications of Artificial Intelligence (AI) in library Services

		University of Abuja (n=65)					National Open University of Nigeria (n=71)				
/ N	AI-driven Tools and Technologies	SA	A	DA	SD	Mean	SA	A	DA	SD	Mean
1	Expert systems are used in the classification, cataloguing, and indexing of library materials.	22 (33.8 %)	31 (47.7 %)	8 (12.3 %)	4 (6.2%)	3.09	31 (43.7 %)	33 (46.5 %)	7 (9.9%)	0 (0.0%)	3.34
2	Natural language processing for translation in libraries	19 (29.2 %)	28 (43.1 %)	14 (21.5 %)	4 (6.2%)	2.95	20 (28.2 %)	30 (42.3 %)	15 (21.1 %)	6 (8.5%)	2.9
3	AI robotics for enhanced self-checkout and book return	17 (26.2 %)	24 (36.9 %)	15 (23.1 %)	9 (13.8 %)	2.76	21 (29.6 %)	28 (39.4 %)	14 (19.7 %)	8 (11.3 %)	2.87
4	Ex Libris Primo integration with library management systems for easy access to information	20 (30.8 %)	30 (46.2 %)	10 (15.4 %)	5 (7.7%)	3	22 (31.0 %)	34 (47.9 %)	10 (14.1 %)	5 (7.0%)	3.03
5	LibChat for real - time	23 (35.4 %)	27 (41.5 %)	9 (13.8 %)	6 (9.2%)	3.03	25 (35.2 %)	30 (42.3 %)	10 (14.1 %)	6 (8.5%)	3.04

The current applications of Artificial Intelligence (AI) in library services in the libraries studied are; expert systems are used in the classification, cataloguing and indexing of library materials, natural language processing for translation in library, AI robotics for enhance self-checkout and book return, Ex Libris Primo integration with library manage systems for easy access to information, Libchat for real time interaction with users , DuraCloud for digital preservation of library materials, Chatbots for library Virtual Assistants for users , Optical character recognition and neural networks for bibliographic records of books, AI robotics for real time shelf management and Speech to text AI changing text to word with a grand mean of 2.95 for University of Abuja and 2.98 for NOUN, indicating that AI is currently applied but the application is low in both Universities. the findings indicated the need for both libraries to put in place modalities that will make sure application of AI in the library is improved on. The findings agreed with Ali, Naeem, and Bhatti, (2024) in a study on Artificial intelligence (AI) applications and usage among the LIS professionals of Pakistan found Natural language processing, voice searching, and chatbots are the most familiar and popular tools currently used in libraries.

Table 2: Impact of AI-driven technologies on improving the efficiency and effectiveness of library services

	University of Abuja (n=65)						**National Open University of Nigeria (n=71)**				
/ N	**Items**	**VHI**	**HI**	**LI**	**VLI**	**Mean**	**VHI**	**HI**	**LI**	**VLI**	**Mean**
1	**Improving Information Retrieval and Discovery**	**28 (43.1 %)**	**30 (46.2 %)**	**5 (7.7%)**	**2 (3.1 %)**	**3.29**	**32 (45.1 %)**	**34 (47.9 %)**	**6 (8.5%)**	**2 (2.8 %)**	**3.31**
2	Automation of Routine and Time - Consuming Tasks	21 (32.3 %)	32 (49.2 %)	9 (13.8 %)	3 (4.6 %)	3.09	24 (33.8 %)	38 (53.5 %)	7 (9.9%)	2 (2.8 %)	3.18
3	**Personalized User Experience**	**20 (30.8 %)**	**34 (52.3 %)**	**8 (12.3 %)**	**3 (4.6 %)**	**3.09**	**22 (31.0 %)**	**37 (52.1 %)**	**9 (12.7 %)**	**3 (4.2 %)**	**3.1**
4	Enhanced Information Accessibility	30 (46.2 %)	26 (40.0 %)	6 (9.2%)	3 (4.6 %)	3.28	34 (47.9 %)	29 (40.8 %)	5 (7.0%)	3 (4.2 %)	3.32
5	**Improve Data-Driven Decision Making**	**23 (35.4 %)**	**34 (52.3 %)**	**6 (9.2%)**	**2 (3.1 %)**	**3.2**	**25 (35.2 %)**	**37 (52.1 %)**	**6 (8.5%)**	**3 (4.2 %)**	**3.18**
6	Supporting Research and Academic Success	26 (40.0 %)	31 (47.7 %)	7 (10.8 %)	1 (1.5 %)	3.26	28 (39.4 %)	34 (47.9 %)	7 (9.9%)	2 (2.8 %)	3.24
7	**Ensuring Long-Term Sustainability and Digital Preservation**	**19 (29.2 %)**	**36 (55.4 %)**	**7 (10.8 %)**	**3 (4.6 %)**	**3.1**	**22 (31.0 %)**	**41 (57.7 %)**	**5 (7.0%)**	**3 (4.2 %)**	**3.16**

The impact of AI-driven technologies on improving the efficiency and effectiveness of library services are improving Information Retrieval and Discovery, automation of Routine and Time Consuming Tasks, personalized User Experience, enhanced information accessibility , improve Data-Driven Decision Making, supporting Research and Academic Success, ensuring long term sustainability and digital preservation, transforming library operations such as self-checkout systems and enabling 24- hour services, Support expert shelf-reading systems in libraries and support provision of online and virtual service with a grand mean of 3.19 for UA and 3.2 for NOUN, indicating that AI have very high impact on effectiveness of library services. The findings indicated high impact. Both libraries need to ensure incorporation of AI in library services to bring the impact to their library services. The findings collaborated that of Isaiaka (2024) in a study on application and use of Artificial Intelligence (AI) Technologies for Library Services Delivery in Academic Libraries in Kwara State, Nigeria revealed that AI cataloguing, AI classification, AI indexing, information retrieval tools, and robotics referencing, among others, are the purposes of AI applications for library service delivery. It was found out by the study that the use of AI makes it easy for library staff to do complex work without stress, and the use of AI prevents repetitive tasks, which is one of the benefits of AI applications and for library services delivery.

Table 3: Challenges and barriers faced by library staff in adopting and using AI technologies in library services

	University of Abuja (n=65)						**National Open University of Nigeria (n=71)**				
	Items	SA	A	DA	SD	**Mean**	SA	A	DA	SD	**Mean**
1	**Data privacy concerns when using AI**	**22 (33.8 %)**	**32 (49.2 %)**	**11 (16.9 %)**	**0 (0%)**	**3.17**	**24 (33.8 %)**	**34 (47.9 %)**	**13 (18.3 %)**	**0 (0%)**	**3.16**
2	High cost of AI tools	28 (43.1 %)	31 (47.7 %)	6 (9.2%)	0 (0%)	3.34	40 (56.3 %)	28 (39.4 %)	3 (4.2%)	0 (0%)	3.52
3	**Training of staff on use of AI technologies**	**20 (30.8 %)**	**38 (58.5 %)**	**7 (10.7 %)**	**0 (0%)**	**3.20**	**25 (35.2 %)**	**42 (59.2 %)**	**4 (5.6%)**	**0 (0%)**	**3.30**
4	Fear of replacing humans on the jobs among librarians	27 (41.5 %)	26 (40%)	12 (18.5 %)	0 (0%)	3.23	24 (33.8 %)	31 (43.7 %)	16 (22.5 %)	0 (0%)	3.11
5	**Lack of skills among librarians**	**19 (29.2 %)**	**37 (56.9 %)**	**9 (13.9 %)**	**0 (0%)**	**3.15**	**19 (26.8 %)**	**44 (62%)**	**8 (11.3 %)**	**0 (0%)**	**3.16**
6	Unreliable power source	35 (53.8 %)	24 (36.9 %)	6 (9.2%)	0 (0%)	3.45	35 (49.3 %)	25 (35.2 %)	11 (15.5 %)	0 (0%)	3.34
7	**System failures of AI technologies**	**23 (35.4 %)**	**29 (44.6 %)**	**13 (20%)**	**0 (0%)**	**3.15**	**25 (35.2 %)**	**29 (40.8 %)**	**17 (23.9 %)**	**0 (0%)**	**3.11**
8	System integration of AI technologies	22 (33.8 %)	30 (46.2 %)	10 (15.4 %)	3 (4.6 %)	3.09	26 (36.6 %)	31 (43.7 %)	10 (14.1 %)	4 (5.6 %)	3.11
9	**Lack of AI**	**24 (36.9**	**34 (52.3**	**7 (10.8**	**0**	**3.26**	**24 (33.8**	**37 (52.1**	**10 (14.1**	**0**	**3.20**

Challenges and barriers faced by library staff and users in adopting and using AI technologies in library services include; data privacy concerns when using AI, high cost of AI tools, training of staff on use of AI technologies, fear of replacing humans on the jobs among librarians, lack of skills among librarians ,unreliable Power Source, System Failures of AI technologies System Integration of AI technologies lack of AI policies in libraries and lack of support from management for integration of AI in libraries with a grand mean of 3.2. for UA and NOUN. The findings collaborate the studies of Emiri (2023) reveals low AI adoption rates due to insufficient ICT infrastructure to meet global standards. The expenses related to staff training and consulting investments further weigh heavily on AI adoption (Dorhetso & Quarshie 2023), and Farag et al.'s (2021) study in Saudi academic libraries identified a lack of AI training as a significant barrier. Similarly, a lack of funding for staff training and limited time for workshops hinder the use of chatbots for digital library capabilities among librarians (Kaushal & Yadav 2022). Concerns about job displacement due to AI advancements have been raised in developing countries, reflecting fears that AI and robotics may jeopardise librarians' careers (Ajani et al. 2022)

Table 4: Perceptions of library staff regarding the role of AI in enhancing the quality of library and information services

	University of Abuja (n=65)						**National Open University of Nigeria (n=71)**				
S/N	**Perceptions**	**SA**	**A**	**DA**	**SD**	**Mean**	**SA**	**A**	**DA**	**SD**	**Mean**
1	**AI is a threat to librarianship and information profession**	**14(21.5%)**	**26(40%)**	**18(27.7%)**	**7(10.8%)**	**2.72**	**14(19.7%)**	**26(36.6%)**	**19(26.8%)**	**8(11.3%)**	**2.74**
2	It enhances productivity in Library service delivery	22(33.8%)	36(55.4%)	7(10.8%)	0	3.23	24(33.8%)	40(56.3%)	7(9.9%)	0	3.25
3	**It enhances efficiency in library service delivery**	**20(30.8%)**	**38(58.5%)**	**7(10.8%)**	**0**	**3.2**	**22(31%)**	**41(57.7%)**	**8(11.3%)**	**0**	**3.19**
4	It improves librarians' performance in the library	21(32.3%)	41(63.1%)	3(4.6%)	0	3.28	23(32.4%)	41(57.7%)	7(9.9%)	0	3.22
5	**Makes information access and retrieval easier**	**26(40%)**	**34(52.3%)**	**5(7.7%)**	**0**	**3.32**	**29(40.8%)**	**37(52.1%)**	**5(7.1%)**	**0**	**3.34**
6	AI is a game changer in library service provision	19(29.2%)	38(58.5%)	6(9.2%)	2(3.1%)	3.14	21(29.6%)	40(56.3%)	7(9.9%)	3(4.2%)	3.12

Majority of the respondents perceived AI is a threat to librarianship and information profession, enhance productivity in Library service delivery, enhances efficiency in library service delivery, improve librarians performance in the library, make it easy for information access and retrieval in the library, is a game changer in library service provision enhance user experience in library services delivery, AI can help us better understand our users' needs, can enhance personalized user recommendations, and AI will take over library profession and render librarians jobless which a grand mean of 3.1 for UA and 3.0 for NOUN, indicating a positive perception of AI role in the library. The findings agreed with Omane and Alex-Nmecha (2020) who found positive attitude and perception toward AI and robotics.

Findings

The findings of the study are:

1. Artificial Intelligence is currently applied in library services delivery but the application is low.
2. Artificial Intelligence has very high impact on improving the efficiency and effectiveness of library services.
3. The respondents had positive perception of AI enhancing the quality of library and information services.
4. Challenges and barriers faced by library staff in adopting and using AI technologies in library services included high cost of AI tools, unreliable power source, and fear of it replacing humans, lack of AI policies in the library and training of library staff.

Conclusion

Artificial intelligence innovation has change the way libraries around the world render services and carry out other operational activities. The study affirmed that Artificial intelligence is now applied in library to aid different tasks such as the use of expert systems in classification, indexing, natural language in translation in library, robotics for self-checkout. Further, AI help in automation of routine, enhance information access, and provision of virtual library services. In as much as AI enhances library service delivery, it has some challenges that hinders its effective utilization in library such as high cost of AI tools, unreliable power source, fear of it replacing humans, lack of AI policies in the library and training of library staff. The study concluded that in as much as AI has a lot of impact when used in the library, it is still at the developmental stage in the libraries studied.

Recommendations

The study recommended the following:

1. Institutions management should support the implementation of AI in those libraries
2. Provision of funds for AI infrastructure, training should be given to library staff on the use of AI
3. Constant and alternative power supply should be provided
4. Formulation of policies that will guide the use of AI in libraries.

References

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullahi, F. (2022). Perspectives of librarians on awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services in Nigeria. *Internet Reference Services Quarterly, 26*(4), 213–230.

Ali, M. Y., Naeem, S. B., & Bhatti, R. (2024). Artificial intelligence (AI) applications and usage among the LIS professionals of Pakistan. *Journal of Librarianship and Information Science.* Advance online publication. https://doi.org/10.1177/09610006241241306

Ali, M. Y., Naeem, S. B., Bhatti, R., & Richardson, J. (2022). Artificial intelligence application in university libraries of Pakistan: SWOT analysis and implications. *Global Knowledge, Memory and Communication, 73*(1/2), 219–234.

Al-Khalidi, S. A. (2022). Evaluation of students' awareness and usage of digital learning sources in academic libraries: College of Business- King Khalid University, Saudi Arabia. Source: Journal of Information Studies & Technology (JIS&T), 2(3). DOI: https://doi.org/10.5339/jist

Banerjee, M. S. (2022). Application, advantage, and disadvantage of artificial intelligence in library services. *International Journal of Creative Research and Thoughts, 10*(11), 723–729.

Bisht, S., Nautiyal, A. P., Sharma, S., Sati, M., Bathla, N., & Singh, P. (2023). The role of artificial intelligence in shaping library management and its utilization. In *2023 International Conference on Disruptive Technologies (ICDT)* (pp. 467–472). IEEE. https://doi.org/10.1109/ICDT.2023.12345678

Cox, A. M., & Mazumdar, S. (2022). Defining artificial intelligence for librarians. *Journal of Librarianship and Information Science, 00*(0), 1–11.

Dorhetso, S. N., & Quarshie, B. D. (2023). Ratings of driving factors for the adoption and implementation of artificial intelligence in the public sector. *Open Access Library Journal, 10*(5), 1–20.

Emiri, O. T. (2023). Adoption and utilisation of artificial intelligence by librarians in university libraries in

Southern Nigeria. *Library Philosophy and Practice*, 1–16.
Farag, H. A., Mahfouz, S. N., & Alhajri, S. (2021). Artificial intelligence investing in academic libraries: Reality and challenges. *Library Philosophy and Practice*, 1–34.
Halburagi, S., & Mukarambi, P. (2023). Use of artificial intelligence (AI) technology futures in library. *International Journal of Research in Library Science (IJRLS), 9*(2), 14–19
Huang, Y.-H. (2022). Exploring the implementation of artificial intelligence applications among academic libraries in Taiwan. *Library Hi Tech*. Retrieved from https://www.emerald.com/insight/content/doi/10.1108/LHT-03-2022-0159/full/pdf?title=exploring-the-implementation-of-artificial-intelligence-applications-among-academic-libraries-in-taiwan
IFLA. (2023a). ChatGPT in libraries? A discussion. Retrieved from https://blogs.ifla.org/cpdwl/2023/05/14/chatgpt-in-libraries-a-discussion/
Ike, N. I., Amadi, C., Madu-Malachy, V., Iheagwam, S. N., Iheanacho, K. O., & Nwagu, O. J. (2023). The library services and users' satisfaction in academic libraries in Imo State, Nigeria. *Library Philosophy and Practice (e-journal),* 7727. https://digitalcommons.unl.edu/libphilprac/7727
Irizarry-Nones, A., Palepu, A., & Wallace, M. (2017). Artificial intelligence (AI). Retrieved from: www.bu.edu/lernet/artemis/years/2017/projects/FinalPresenations/A.I.%20Presentation.pdfJacknis
Isiaka, A. O. (2024). Application and use of artificial intelligence (AI) for library services delivery in academic libraries in Kwara State, Nigeria. *Library Philosophy and Practice (e-journal),* 7998. https://digitalcommons.unl.edu/libphilprac/7998
Nicholas, D. & Huntington, P. (2002). The evaluation of a book recommendation system. Library Review, 51(3), 122-128.
Okunlaya, R. O., Syed Abdullah, N., & Alias, R. A. (2022). Artificial intelligence (AI) library services: Innovative conceptual framework for the digital transformation of university education. *Library Hi Tech, 40*(6), 1869–1892.
Omame, I. M., & Alex-Nmecha, J. C. (2020). Artificial intelligence in libraries. In N. E. Osuigwe (Ed.), *Managing and adapting library information services for future users* (pp. 120–144). Hershey, PA: IGI Global.
Omame, I., & Alex-Nmecha, J. (2020). Artificial intelligence in libraries. In *Advances in Library and Information Science* (pp. xx-xx).
Omane, I. & Alex-Nmecha, J. C. (2020). Artificial Intelligence in Libraries. Retrieved from https://www.pega.com
Shaheen, M. A., & Khurshid, A. (2023). *Perceptions and experiences of artificial intelligence (AI) use in libraries: A study of library users in Pakistan.* Library Philosophy and Practice, 7905. https://digitalcommons.unl.edu/libphilprac/7905
Tripathi, A. (2024). The impact of artificial intelligence on library services and information management. *Library Philosophy and Practice (e-journal)*, (8148). https://digitalcommons.unl.edu/libphilprac/8148
Zuleika, P. & Siswo, L. (2022). Cross-Sectional Study as Research Design in Medicine. Archives of The Medicine and Case Reports. 3. 256-259. 10.37275/amcr.v3i2.193.

Artificial Intelligence (AI) and the Revolutionising of Academic Libraries: A Study of Early Career and Experienced Librarians in Ekiti State, Nigeria

Olabode OLAJIDE (CLN)
College of Medicine Library, Federal University Oye-Ekiti
olabode.olajide@fuoye.edu.ng
08036250056

&

Rotimi James OMOLEHIN
University Library, Federal University Oye Ekiti
James.omolehin@fuoye.edu.ng
08033257702

Abstract

Artificial Intelligence (AI) is one of the latest technologies that is transforming academic libraries, reshaping how information is managed, accessed, and disseminated. This study examines the impact of AI on academic libraries in Ekiti State, Nigeria, focusing on the perspectives of early career and experienced librarians. The study adopted a survey research design, and a structured questionnaire was designed to collect quantitative data. All library and information professionals (librarians) in tertiary institutions in the state formed the population of the study. Through survey approach, the research explores how librarians across different age groups perceive and adapt to AI-driven tools and technologies. The findings reveal generational differences in the adoption and use of AI, with early career librarians demonstrating greater adaptability and proficiency compared to their experienced/senior counterparts, who often face technological and training barriers. Also, it was found that early career librarians claimed that the use of AI tools has revolutionised library operations to a great extent, while experienced/senior librarians reported a moderate extent. Both early career librarians and experienced/senior librarians had a positive perception of AI use. Furthermore, early career librarians possessed moderate AI skills, while experienced/senior librarians had lower skills. The study underscores the importance of AI in discharging library activities in academic environment, and recommends continuous professional development to bridge the skill and AI literacy gaps, and help librarians leverage AI to enhance academic library services.

Keywords: *Artificial Intelligence, AI tools, Librarians, Academic libraries, Technologies*

Introduction

Digital technologies have revolutionised how people seek information, use information, and communicate with one another in the current era. The contemporary speed of technological development is outpacing the ability of society to fathom changes in the use of modern innovative technologies (Nestik et al., 2019). Technological innovations drive the growth of libraries from conventional storehouses of information resources to dynamic centres of digital learning and research. How libraries function and serve their communities is revolutionised by technology which includes artificial intelligence (AI), cloud computing, and data analytics. With digital cataloguing, virtual reference, digital lending, e-book services, and digital preservation and archiving, libraries are becoming more open, effective, and user-friendly.

AI is among the most innovative technologies that have revolutionised libraries in modern times (Akinyemi, 2023). AI refers to the ability of machines to execute functions that generally call for human intelligence, such as visual perception, speech recognition, decision-making, and language translation (Harris & Turner, 2021). Asemi et al. (2020) defined AI as a technology that develops solutions by simulating human intelligence which includes the power of thinking and rational behaviours. Studies have established that some libraries are now deploying AI technologies in their operations (Adetayo, 2023; Al-Aamri & Osman, 2022; Abayomi et al., 2020). These technologies include natural language processing (NLP), machine learning (ML), image recognition, and data analytics. AI can offer personalised recommendations, automate routine tasks, and support data-driven decision-making (Mallikarjuna, 2024). AI is revolutionising libraries' information delivery, organisation, and search processes thereby making library services more efficient and user-friendly.

How different innovative AI technologies have revolutionised libraries continues to attract more discussion in modern times. However, studies have shown that some librarians in African universities are not ready to adjust to the current revolutionary realities in libraries as AI technologies require possessing skills for effective application. Enakrire and Oladokun (2023) raised a fundamental question that "Would phobia in adaptation not discourage librarians' readiness to accept and use AI?" While there are defensible skepticisms and anxiety that the vast majority of librarians may find it difficult to use AI technologies, it has also been ascertained in some studies that people who are familiar with and possess technological skills are at an advantage to make more use of AI technologies (Neumann, 2024). This study, therefore, investigates how AI revolutionises academic libraries by juxtaposing the extent the use of AI tools has revolutionised

libraries, the perception of the use of AI in libraries, and skills in using library AI tools among experienced/senior and early career librarians.

Statement of the Problem

The advent of AI technology has posed both challenges and opportunities for academic libraries (Das & Islam, 2021). While early career librarians often embrace technological innovations, senior librarians may have reservations due to traditional practices and the rapid pace of change (Agboke & Oladokun. 2024; Oyelude & Oladele, 2014). This study seeks to assess how AI tools are perceived by librarians of different generations and their implications for library services, management, and user interaction.

Research Questions (RQ)

The following research questions guide the study.

RQ1: To what extent has AI tools revolutionised library operations?

RQ2: What is the perception of librarians about the use of AI in libraries?

RQ3: What extent of skills do librarians have in using library AI tools?

RQ4: What are the challenges librarians encountered in using library AI tools?

Literature Review

AI Tools in Libraries

Libraries are early adopters of technologies (Al-Aamri & Osman, 2022). Technologies have revolutionised significant areas of libraries thereby improving operational efficiency in the libraries. AI is nowadays implanted in most of the tools libraries are using: web search engines, social media applications, and speech recognition services, among others (Andersdotter, 2023). Most of academic libraries in the United Kingdom, France, Germany, the United States of America, and Canada are now incorporating AI in their operations (Mupaikwa, 2024). However, libraries in developing countries like Nigeria and Ghana continue to face challenges in establishing a solid foundation in the use of AI (Tella, 2020). Meanwhile, AI is capable of revolutionising libraries' mode of operation, providing improved services to users, enhancing management efficiency, and offering novel manners of interacting with and discovering library resources.

AI is the buzz of the moment (Cripps, 2023). Using AI tools in libraries transcends using the general regularly used ICTs of computers, institutional repositories, webpages, and other infrastructure (cell phone, internet, digital cables, and mobile systems) that are common among most libraries (Enakrire & Oladokun, 2023). There is a need to acknowledge AI application areas in libraries which include knowledge management, process automation, conversational agents and assistants, predictive analytics, security and threat detection, resource allocation, collection development, and answering use queries (Wirtz et al., 2019).

The most used AI tools in libraries are recommendation systems, Natural Language Processing (NLP) tools, chatbots, and data analytics (Shaheen & Khurshid, 2023). AI-powered recommendation systems can analyse user behaviour and preferences to recommend appropriate information resources (Crawford & Paglen, 2021). Natural language processing tools are used by libraries for automation of tasks which include cataloguing and indexing. This results in easier location of resources and increased precision of search results. AI-driven chatbots can offer support to library users by answering frequently asked questions. They also guide users through the library websites (Sanji et al. 2022). Librarians employ AI to analyse usage data and identify styles and arrangements that necessitate decisions about collection development and resource allocation.

Perception of Librarians about the Use of AI in Libraries

Library activities are influenced by technological advancements in AI. Libraries use AI systems for many purposes among which are digitisation of collections, collection development, answering of user queries, and management of circulation (Subaveerapandiyan, 2023). A declaration concerning libraries and AI that emphasised the swift advancement of AI was made by the IFLA (2020) in October 2020. The declaration stated that AI and machine learning provide novel dimensions and methods to knowledge management processes in libraries (Andersdotter, 2023). However, the adoption and use of technology are determined by users' perceptions (Park & DeLong, 2009). Positive perceptions which include recognising AI as a useful and supportive technology can increase eagerness and readiness to use AI applications. On the other hand, negative perceptions, such as worries about job dislodgment or cynicism concerning the efficacy of AI, can cause hesitancy and unwillingness to adopt the technology (Smith & Jones, 2020).

The perception of librarians about the use of AI in libraries may vary from country to country, and from individual to individual. Librarians in technologically advanced countries may perceive AI as technology for daily use. However, librarians in developing countries may see AI as a new technology that has come to disrupt the existing technologies in libraries. Perceptions of AI among librarians in academic libraries in Canada and the United States were explored by Hervieux and Wheatley (2021). It was found

that the librarians perceived AI as a technology that required more training for its application in libraries. This indicates that the general information and communication technology skills are not enough to use AI.

Lund et al., (2020) investigated the perception of librarians in academic libraries towards adopting AI. The result indicated a positive perception of AI adoption and use among the librarians. The librarians indicated their readiness to embrace and use the technology. Huang (2022) perceived that library activities have become more complex since the arrival of AI. As such, there is a need for more inventive and creative thinking among librarians in designing and executing library services. The perception of Memela (2023 that AI is the fresh assurance for libraries to offer enhanced automated services is due to the acknowledgment that the technology can be significant in the 5th Industrial Revolution (5IR).

Coming to Africa, Subaveerapandiyan et al. (2023) investigated how the librarians in Zambia perceived AI. The researcher knew that the librarians were aware of AI and its various functionalities but wanted to know their perception of the technology and their determination to use technology in their libraries. It was reported that the librarians perceived AI as a technology that can improve libraries. The librarians pledged their readiness and enthusiasm to be at the vanguard in implementing the technology.

Even though Nigeria has not reached the expected level of technological inventions, librarians in Nigerian universities appreciate the development technologies have brought to the performance of library operations. This manifests in the way they adopt and use technologies in libraries. Eiriemiokhale and Sulyman (2023) explored awareness and perceptions of artificial intelligence among librarians in university libraries in Kwara State, Nigeria. Most respondents perceived that AI technologies can be adopted in university libraries. Others perceived that AI can replace human librarians as time goes on. Some perceive that AI is a constructive improvement for library professionals. Abayomi et al. (2021) explored the perception of librarians in Nigerian universities concerning the use of AI in performing library operations. It was found that the librarians perceived that adopting AI in their libraries may make them lose their jobs. Moustapha and Yusuf (2023) perceived that technological defects in academic libraries in Nigeria make the adoption of AI difficult.

Skills for Using Library AI Tools

Librarians are strong campaigners for adopting novel technological innovations in libraries (Lund et al., 2020). AI is a novel technology that requires skills for its use. As such, librarians need to have skills in using AI tools. The EU DigComp framework of the year 2022 presented AI skills as essential common skills in the future job market (Andersdotter, 2023). AI literacy and AI skills are at times used interchangeably in literature. AI literacy or AI skills are a set of skills that allow people to painstakingly assess AI technologies, connect and join forces commendably with AI, and apply AI as a tool in different areas (Long & Magerko, 2020). Four parts of AI literacy are described in IFLA's AI statement (IFLA, 2020). These include knowledge of the way AI works, knowledge of the possible influences and effects of AI, personal data management skills, and general media and information literacy.

Librarians should know what AI stands for, its abilities, limitations, and different AI skills. This is because AI skills are vital for the effective integration and operation of AI technologies. Studies by Neumann et al. (2022) and Oyetola et al. (2023) indicated that librarians have to possess data literacy skills for successful navigation of AI operations in libraries. Recognising this vital role of library information literacy, it is expedient for librarians to develop skills that will enable them to take advantage of the numerous areas in which AI can enhance library operations (Andersdotter, 2023). These skills enable librarians to execute AI solutions that ameliorate library services, make information more accessible, reform processes, and enhance the user experience. Enakrire et al. (2023) identified software skills that librarians should have. Using software skills enables librarians to address the information needs of library users.

Challenges Librarians Encounter in Using Library AI Tools

AI is the current technological tool in the evolution of computing technology (Lund et al., 2023). Hervieux and Wheatley (2021) appreciated the historically quick response of librarians to innovative technological inventions that ameliorate library practice. Eiriemiokhale and Sulyman (2023) noted that AI is among the technological tools that have triggered a substantial disruption and improvement in library operations. Libraries and librarians encounter significant challenges in the adoption and use of AI tools. Moustapha and Yusuf (2023) posited that even though adopting AI in libraries will enhance library operations, libraries in Nigeria have not maximally embraced the technology because of particular challenges. Enakrire and Oladokun (2023), relying on their years of working in various universities in Africa, asserted that the preparedness of librarians to upgrade their technological skills is the main worry with the adoption and use of AI. Not all librarians are inclined to the use of library technologies. Even some librarians inclined to existing library technologies are not ready to embrace any new ones. This manifests in the reluctance of some librarians towards the use of AI.

Effective use of AI requires being AI literate. That is, librarians should understand what AI entails, and the needed skills for its effective use. Liu et al. (2022) averred that the major concerns about the use of AI information retrieval technology in libraries are difficulty learning novel information, indistinctive representation of knowledge, and low level of understanding of natural language. Effective operation and management of AI systems requires attending training and conferences on the use of AI in libraries. Weijia

(2022) posited that being AI literate needs training.

Technology, especially the Internet, has reduced traffic on physical libraries. Students and researchers now connect the Internet to their phones and computers to access the information they need online. Johnson (2018) noted that the development of AI reduces the rate one goes to libraries and librarians for information. This means that AI can render librarians redundant as time goes on. Korinek and Stiglitz (2017) expressed their apprehension about the possible loss of jobs that the use of AI in libraries can cause.

Some librarians are not aware of AI and those who are not inclined to use digital technologies in libraries may not know the significance of AI technologies in libraries. Abayomi et al. (2021) asserted that awareness of AI among librarians is unsatisfactory. Ajani et al. (2022) explored the willingness of libraries in Nigerian universities to employ AI in their operations and services. The findings showed that the libraries are not ready to incorporate the technology into their routine operations. It was perceived that the librarians may not be fully equipped to use the technology. Obiano et al (2022) stated that despite the perceived usefulness of AI to librarians, factors that include inadequate required AI tools and insufficient planning militate against adopting the technology.

Methodology

The study adopted a descriptive survey research design. The population of the study was 61 librarians in higher educational institutions in Ekiti State, Nigeria. A questionnaire was used for data collection. Two academic librarians at Afe Babalola University, Ado-Ekiti validated the data questionnaire. The final version of the questionnaire was pre-tested to ensure that the questions functioned as intended. The researchers administered 8 copies of the questionnaire to librarians at the University of Ibadan, who were not part of the study population. Cronbach alpha method was used to analyze the paired score generated from the test. A reliability coefficient index of 0.71 was achieved. The value was strong and positive. The population of the study comprises of all the librarians of tertiary institutions in Ekiti State (See Table A).

Table A: Population of the study

S/N	Institutions	No of Librarians
1	Federal University Oye-Ekiti	14
2	Ekiti State University, Ado-Ekiti	12
3	Bamidele Olumilua University of Education, Science & Technology, Ikere-Ekiti	8
4	Afe Babalola University, Ado-Ekiti	8
5	Venite University, Iloro-Ekiti	1
6	Hillside University, Okemesi-Ekiti	4
7	Federal Polytechnic, Ado-Ekiti	6
Total		**53**

Source: Field Visit

The questionnaire had five parts; Part A: Demographic information which include ages and institutions of the respondents; Part B: Extent AI tools to revolutionised library operations; Part C: Perception of librarians about the use of AI in libraries; Part D: Extent of skills librarians have in using library AI tools; and Part E: Challenges librarians encounter in using library AI tools. In Part A, the respondents were asked to choose from the age bracket where their ages fell, and the institutions they were working - whether universities or polytechnics. Answers to Parts B and D were given on a 5-point Likert-type scale of Very Great Extent, Great Extent, Moderate Extent, Low Extent, and Very Low Extent. Answers to Part C were given in a 5-point Likert-type scale of Strongly Agree, Agree, Moderately Agree, Disagree, and Strongly Disagree. Agree and Disagree were used for Part E.

The questionnaire was administered to the respondents with a guarantee of confidentiality and anonymity. The respondents were informed that the research was an empirical examination of their views about how academic libraries have been revolutionised by AI. The participants were not notified that the responses of experienced/senior and early career librarians would be juxtaposed to know their perceptions and skills about the use of AI in libraries. This helped in avoiding possible bias in the responses of

participants. Sixty-two copies of the questionnaire were administered, and 53(85.5%) were filled and returned. Twenty-five copies of the questionnaire were filled out by experienced/senior librarians (i.e. librarians that were above 50 years), while the remaining 28 were filled out by early career librarians (i.e. librarians that were 50 years and below). The researchers verified the returned copies of the questionnaire to ensure they were correctly filled before coding them into a computer for analysis. Descriptive statistical tools which included frequency counts, mean and standard deviation were used to analyse the data collected. The analysis was facilitated using the Statistical Package for Social Sciences (SPSS). The criterion mean for the research questions was placed at 2.50. The mean above 2.50 was considered high while the mean below 2.50 was considered low.

Data Analysis and Presentation of Findings

The findings of the study derived from the questionnaire are presented under two sections (A and B). In section A, demographic information of the respondents is presented, while section B presents data gathered from the four (4) research questions for the study.

RQ1: To what extent has the use of AI tools revolutionised library operations?

Table 1: AI Tools and the Revolutionising of Library Operations

AI Tools	Early Career Librarians		Experienced/Senior Librarians	
	Mean ($\bar{x}$)	Std Dev.	Mean ($\bar{x}$)	Std Dev.
Koha (with AI-powered features)	4.02	.822	4.47	.606
Smart Library Systems (for automating several areas of library management, which include inventory checks, resource allocation, and circulation processes)	3.91	.974	3.52	.684
ChatGPT	3.67	.852	3.01	.779
OCLC WorldCat (Global catalogue and bibliographic database)	3.44	.917	2.89	.984
Security and fraud detection tools	3.39	.814	2.61	.777
Grammarly (for grammar checking)	3.32	.912	2.57	1.161
Turnitin (plagiarism detection tools in academia)	3.13	.883	2.51	1.001
LibAnswers (Chatbots and Virtual Assistants used to assist users navigate the library's res ources, answer frequently asked questions, and provide recommendations	2.87	.851	2.43	1.007
Natural Language Processing (NLP) tools for search (assisting libraries improve t heir search functionalities	2.41	1.088	2.32	.973
Recommendation systems (used t o analyse users' borrowing history and preferences to suggest books, articles, or digital content)	2.32	.855	2.17	.871
Image recognition for visual resources (t ools used to identify objects, people, or scenes within images or video content in the library's collection	2.14	1.112	1.98	1.217
Average Mean	**3.15**		**2.77**	
Criterion mean: < 2.0 (Very Low Extent), 2.0 0r <2.5 (Low Extent), 2.5 or < 3.0 (Moderate Extent), 3.0-3.99 (Great Extent), 4.00-50 (Very Great Extent)				

Table 1 reveals that early career librarians claimed that the use of AI tools has revolutionised library operations to a great extent (x=3.15) while experienced/senior librarians claimed that the use of AI tools has revolutionised library operations to a moderate extent (=2.77). This means that early career librarians greatly appreciate the revolutionary impact of AI in libraries.

RQ2: What is the perception of librarians about the use of AI in libraries?

Table 2: Perception of Librarians about the Use of AI in Libraries

Perception	Early Career Librarians		Experienced/Senior Librarians	
	Mean ($\bar{x}$)	Std Dev.	Mean ($\bar{x}$)	Std Dev.
AI technologies improves library activities	4.67	.995	3.32	1.052
It is good to adopt AI technologies in libraries	4.43	.836	3.26	1.016
AI increases global recognition of libraries	4.21	.780	3.03	.928
AI is a positive development for librarians	4.05	.943	3.16	1.016
AI can bridge librarian performance gaps	3.96	.972	2.89	1.060
AI has ability to improve information retrieval and user service	3.74	.811	3.14	1.014
Adopting AI will lead to employee retrenchment	3.33	1.016	4.11	.802
The use of AI requires too much training	3.27	1.192	4.06	.867
AI is capable of replacing human libr arians in the future	3.17	.843	3.96	.989
Adoption of AI technologies will ease library stress	3.09	.972	2.84	.975
AI enhances library services	3.01	.911	3.11	1.003
AI makes library staff lazy	2.47	1.016	3.77	.911
AI is difficult to operate	2.42	1.192	4.07	.976
Average Mean	**3.27**		**3.44**	
Criterion mean: < 2.0 (Strongly Disagree), 2.0 0r <2.5 (Disagree), 2.5 or <3.0 (Moderate Agree), 3.0-3.99 (Agree), 4.00-50 (Strongly Agree)				

Table 2 reveals that the average mean recorded for both early career librarians (x=3.27) and experienced/senior librarians (=3.44) are higher than 3.00. This means that both early career librarians and experienced/senior librarians have a positive perception about the use of AI in libraries. However, while experienced/senior librarians perceive that AI is difficult to operate (=4.07) and will makes library staff lazy (=3.77), the perception of early career librarians is contrary.

RQ3: What extent of skills do librarians have in using library AI tools?

Table 3: Skills of Librarians in Using Library AI Tools

Skills	Early career Librarians		Experienced/Senior Librarians	
	Mean ($\bar{x}$)	Std Dev.	Mean ($\bar{x}$)	Std Dev.
Information retrieval skills	4.29	.933	3.06	1.105
Data collection and curation skills	4.01	.937	2.88	.944
Data analysis and interpretation skills	3.07	.889	2.01	1.110
Collaboration and teamwork skills	3.69	1.103	3.73	.985
Data management skills (skill to structure, organise, and manage large datasets)	2.53	.966	2.13	.799
Model training and evaluation skills (basic skills on machine learning models)	2.42	.912	2.09	.901
Data cleansing and preprocessing skills (skills in data cleaning, transforming, and arranging data for machine learning)	2.35	1.117	2.03	.887
Chatbot development and integration skills	2.31	.992	1.88	1.107
Voice assistant integration skills	2.27	.941	1.92	1.003
Natural language processing skills **(skill to** process text data, like for cataloguing, indexing, or improving search functionality)	2.14	.776	1.36	.874
Programming language skills (skills relating to use of Python, R, or JavaScript)	1.87	.886	1.33	.903
Average Mean	2.81		2.22	
Criterion mean: < 2.0 (Very Low Extent), 2.0 0r <2.5 (Low Extent), 2.5 or < 3.0 (Moderate Extent), 3.0-3.99 (Great Extent), 4.00-50 (Very Great Extent)				

Table 3 shows that early career librarians have a moderate extent of skills (x=2.81) and experienced/senior librarians have a low extent of skills (=2.22) in using library AI tools. This indicates that experienced/senior librarians will not be able to make effective use of library AI tools.

RQ4: What are the challenges librarians encountered in using library AI tools?

Challenges Librarians Encounter in Using Library AI Technologies

Challenges	Early career Librarians		Experienced/Senior Librarians	
	Agree	Disagree	Agree	Disagree
Inadequate ICT facilities	28(100%)	0(0%)	23(92%)	2(8%)
Low level of support from government and funding agencies	28(100%)	0(0%)	22(88%)	3(12%)

Epileptic power supply	24(85.7%)	4(14.3%)	19(76%)	6(24%)
Poor internet connectivity	23(82.1%)	517.9(%)	21(84%)	4(16%)
Inadequate funding	19(67.9%)	9(32.1%)	24(96%)	1(4%)
Lack of expertise among librarians	19(67.9%)	59(32.1%)	19(76%)	6(24%)
Inadequate preparedness of librarians to upgrade their technological skills	17(60.7%)	11(29.3%)	11(44%)	14(56%)
Repetitive nature of AI tasks	12(42.9%)	16(57.1%)	22(88%)	3(12%)
Fear that another technology may come to replace AI	11(39.3%)	17(60.7%)	22(88%)	3(12%)
Resistance to change	11(39.3%)	17(60.7%)	9(36%)	16(64%)
Low level of awareness of AI among librarians	7(25%)	21(75%)	20(%)	5(%)

The challenges librarians encounter in using library AI tools are shown in Table 4. The responses of early career librarians and experienced/senior librarians are different in some of the items that constitute challenges. While early career librarians claimed that inadequate preparedness of librarians to upgrade their technological skills 17(60.7%), experienced/senior librarians hold a contrary opinion. Also, while experienced/senior librarians claimed that repetitive nature of AI tasks 22(88%), and fear that another technology may come to replace AI 22(88%) are challenges to the use of AI, early career librarians responded to the contrary. This implies that the librarians are not on the same page regarding the challenges librarians face in using library AI tools.

Discussion

AI appears as a catalyst for evolution, revolutionising libraries amid quick technological developments. This study juxtaposed the responses of experienced/senior and early career librarians on how AI has revolutionised academic libraries. The findings in Table 1 shows early career librarians believe AI tools have greatly revolutionised library operations, while experienced/senior librarians asserted that the use of AI tools has revolutionised library operations to a moderate extent. The results suggest AI technologies are helpful for libraries. Key tools identified comprise Koha, Smart Library Systems, ChatGPT, OCLC WorldCat, AI-driven security tools, Grammarly, Turnitin, and LibAnswers for user assistance and resource navigation. The findings are in line with that of Garg et al. (2023) who claimed that Koha, an open-source ILS, has revolutionised library operations with AI-powered cataloguing, search enhancements, and inventory management. Osaroluka et al. (2024) noted that the integration has simplified resource allocation and circulation, making libraries more user-responsive. Also, academic libraries are now integrating AI-driven recommendation systems that use machine learning to analyse users' borrowing history and preferences. Using machine learning algorithms, these systems can recommend appropriate information resources, thus personalising the library experience and encouraging user engagement (Kalisdha, 2024).

This study found OCLC WorldCat as a dynamic revolutionary tool for libraries. As a global catalogue of library collections, it leverages AI to manage extensive bibliographic data, improving access, cataloguing, and resource sharing (University of Florida, 2022). Also, NLP tools have revolutionised how library databases handle searches by interpreting user queries in a human-like manner, enhancing correctness and germaneness of search outcomes. This ability permits library users to locate resources using conversational language (Khurana et al., 2023).

In line with the findings of this study regarding the revolutionary power of image recognition tools in libraries, Gupta et al. (2021) observed that contemporary libraries use image recognition tools to identify objects, scenes, and people in visual resources, simplifying cataloguing and retrieval. This improves user interaction with multimedia and supports advanced searches. Libraries likewise employ Grammarly to assist students, staff, and scholars improve their writing, with AI-driven tools refining educational and professional work (Zinkevich & Ledeneva, 2021; Park, 2019). This reduces the workload on library professionals whose editorial assistance may be sought.

The findings in Table 2 reveal that both early career librarians and experienced/senior librarians have a positive perception of the use of AI in libraries. The librarians perceived that technologies improve library activities, increase global recognition of libraries, and improve information retrieval and user service. A related study by Kalbande et al. (2024) explored the perspectives of librarians in India on the integration of artificial intelligence in academic libraries and found that the librarians mostly displayed

optimistic perceptions toward using AI in libraries. Also, studies by Smith and Jones (2020), and Thompson and Howard (2019) found a positive perception of AI among librarians, specifically concerning the capability of the technology to enhance information retrieval and user services. Miller (2020) averred that AI restructures cataloguing, improves information retrieval systems, and provides personalized user experiences. Martinez (2019) emphasized that AI-powered tools which include chatbots and automated recommendation systems can greatly improve user engagement through the provision of real-time assistance. Nevertheless, worries are demonstrated by some librarians that these technological applications can wear away the personal touch that is needed in library services (Clark & Perez, 2019).

In line with the finding of this study that librarians perceive that the use of AI in libraries can lead to employee lay-off, Nakhoda and Tajik (2017) revealed that librarians at Tehran University demonstrated significant reluctance to adopt AI technologies in the library. This is because they perceive that the technology may usurp their jobs. A study by Sambo and Oyovwe-Tinuoye (2023) found that the certified librarians in Nigerian libraries perceived that using technologies in libraries could lead to employee lay-off. It was stated in an earlier study by the World Bank (2016) that developing nations might be more hinted at the acceptance of robot technologies due to the possibility of a great extent of job loss. A similar apprehension is shown by Frey and Osborne (2017) who claimed that AI would render almost 35% of employees in the United Kingdom in the two decades to come. Enakrire and Oladokun (2023), relying on their years of working in various universities in Africa, asserted that the preparedness of librarians to upgrade their technological skills is the main worry with the adoption of AI.

The findings in Table 3 show that early career librarians have a moderate extent of skills and experienced/senior librarians have a low extent of skills in using library AI tools. The reason may be that experienced/senior librarians did not have the privilege of using ICTs, particularly computers when they were young. More importantly, some experienced/senior librarians may consider learning the application of ICTs in library operations as too arduous. However, early career librarians who graduated recently from universities were comprehensively taught information and communication technology skills which make the use of AI tools easy for them. In the current era of digital technologies, there is a need for librarians to possess data literacy skills for the successful navigation of AI operations in libraries (Oyetola et al., 2023). The skills will make it easy for librarians to implement AI solutions that improve library services, make information more accessible, restructure processes, and improve the user experience. Although there was a condescension about the earlier inauspicious approach of experienced/senior librarians toward ICTs due to lack of adequate ICT skills, modern studies can no more validate the assertion as the greater proportion of people (including librarians) of 65 years and above in various nations now have adequate ICT skills (Nimrod, 2018).

The findings in Table 4 show that both early career librarians and experienced/senior librarians agree on some of the various challenges librarians encounter in using library AI tools. However, while early career librarians claim that librarians encounter challenges such as inadequate preparedness to upgrade their technological skills, fear that another technology may come to replace AI, and resistance to change, experienced/senior librarians hold a contrary opinion. Similarly, while experienced/senior librarians claimed that a low level of awareness of AI is a challenge to using AI tools among librarians, early career librarians responded to the contrary. In agreement with the findings of this study, a study by Eiriemiokhale and Sulyman (2023) found that the challenges to the use of AI by university libraries in Nigeria include poor internet connectivity, unstable electricity supply, low level of proficiency among librarians, and inadequate support from funding organizations.

Even though studies have revealed that using AI in libraries can improve library services, providing users with trustworthy information needed for growth and development in the information era (Oladokun et al., 2023), not all librarians endear using the technology. Ali et al. (2020) found that librarians are not receptive to introducing technologies. Zondi et al. (2024) averred that it is challenging for library leadership to integrate AI into library systems due to insufficient knowledge of the technology. Ali et al. (2020) noted that library staff will use AI when they are sufficiently knowledgeable about the need to provide routine services using the technology. They also perceive that the technology will not be difficult to use. A study by Sambo and Oyovwe-Tinuoye (2023) found that using technologies poses many challenges to librarians. The challenges include staff downsizing, inadequate funds, unstable power supply, insufficient ICT infrastructure, and a low level of technology know-how. Despite the various challenges encountered in using library AI tools, librarians who fail to attune to the use of AI will become unemployable

Conclusion

The use of AI tools in libraries is setting a novel record in using technologies to perform library operations. Modern-era libraries are irresistibly revolutionised by AI, thereby improving operational efficiency. However, the perception of early career librarians and experienced/senior librarians about how different innovative AI technologies have revolutionised library operations has not been juxtaposed with modern research on the use of technologies in libraries. This study has shown that early career librarians claimed that the use of AI tools has greatly revolutionised library operations. Experienced/senior librarians claimed that the use of AI tools has moderately revolutionised. Early career librarians and experienced/senior librarians have a positive perception of the use of AI in libraries. The perception may

culminate in acceptance and use of the technology. However, the experienced/senior librarians do not possess the necessary skills to use AI technologies. The onus is, therefore, on library management and librarians to remove the obstacles hindering the use of AI in libraries.

Recommendations

In line with the findings of this study, the following are recommended.

1. Universities should sponsor their staff to conferences and seminars to learn AI skills so that they can effectively use AI tools in their libraries.
2. Librarians who have negative perceptions toward using library AI tools should change their perception of the technology so that they will not be rendered redundant when their libraries adequately integrate AI into their operations and services.
3. Librarians, especially the experienced/senior ones, should be ready to upgrade their skills in using AI technologies and should not be resistant to change.

Suggestion for Further Research

This study only adopted quantitative research method. Therefore, a similar study with research methodology (mixed methods) that incorporates qualitative aspects and vary the sampling techniques would provide a better understanding of generation bias among early career librarians and experienced/senior librarians in academic libraries.

References

Abayomi, O. K., Adenekan, F. N., Abayomi, A., Olateju, Ajayi, T. A., & Aderonke, A. O. (2020). Awareness and perception of the artificial intelligence in the management of university libraries in Nigeria. *Journal of Interlibrary Loan, Document Delivery & Electronic Reserve, 29*(1–2), 13–28. https://doi.org/10.1080/1072303X.2021.1918602

Adetayo, A. J. (2023). Artificial intelligence chatbots in academic libraries: The rise of ChatGPT. *Library Hi Tech News, 40*(3), 18–21. https://doi.org/10.1108/LHTN-01-2023-0007

Agboke, A. L. & Oladokun, B. D. (2024). Emerging Technologies in academic libraries:

prospects and challenges in Nigeria. Communicate: Journal of Library and Information Science, 26 (2), 10-20.

Akinyemi, O. (2023). Enhancing academic library service delivery using artificial intelligence (AI). *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/8042

Al-Aamri, J., & Osman, N. E. (2022). The role of artificial intelligence abilities in library services. *The International Arab Journal of Information Technology, 19*(3A), 566–573. https://doi.org/10.34028/iajit/19/3A/16

Ali, M. Y., Naeem, S. B., & Bhatti, R. (2020). Artificial intelligence tools and perspectives of university librarians: An overview. *Business Information Review, 37*(3), 1–9. doi:10.1177/0266382120952016

Andersdotter, K. 2023. Artificial intelligence skills and knowledge in libraries: Experiences and critical impressions from a learning circle. *Journal of Information Literacy, 17*(3), 108–130.

Asemi, A., Ko, A., & Nowkarizi, M. (2020). Intelligent libraries: A review on expert systems, artificial intelligence, and robot. *Library Hi Tech, 39*(2), 412–434. https://doi.org/10.1108/LHT-02-2020-0038

Clark, T., & Perez, M. (2019). Ethics and Technology in Modern Library Services. *Journal of Library Science, 45*(3), 234–247.

Crawford, K., & Paglen, T. (2021). Excavating AI: The politics of images in machine learning training sets. *AI & Soc* 36, 1105–1116. https://doi.org/10.1007/s00146-021-01162-8

Cripps, M. (2023). AI buzz: Separating the hype from reality in the age of artificial intelligence. https://medium.com/@marciacripps/ai-buzz-separating-the-hype-from-reality-in-the-age-of-artificial-intelligence-69b048b90d57

Das, R. K. & Islam, M. S. (2021). Application of Artificial Intelligence and Machine Learning in

Libraries: A Systematic Review. Arxiv preprint arxiv2112.04573. https://arxiv.org/abs/2112.04573

Ebaye, A. S., Orim, F. S., Barong, E. A. I., (2024). Librarian awareness, perception and acceptance and the utilization of artificial intelligence in library services in universities in South-South Nigeria. *ISAR Journal of Multidisciplinary Research and Studies, 2*(7), 20-26.

Eiriemiokhale, K. A., & Sulyman, A. S. (2023). Awareness and perceptions of artificial intelligence among librarians in university libraries in Kwara State, Nigeria. *Indonesian Journal of Librarianship, 4*(2), 107-118.

Enakrire, R. T., & Oladokun, B. D. (2023). Artificial intelligence as enabler of future library services: How prepared are librarians in African university libraries. *Library Hi Tech chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.emerald.com/insight/content/doi/10.1108/LHTN-09-2023-0173/full/pdf?title=retracted-artificial-intelligence-as-enabler-of-*

future-library-services-how-prepared-are-librarians-in-african-university- libraries

Enakrire, R. T., Scholtz, B., & Khulekani, Y. (2023). The importance of soft skills for computing graduates in the context of the fifth industrial revolution. 1st International Conference on Technological Advancement in Embedded and Mobile Systems (ICTAEMOS). ISBN 978-3-8142-2408-4.

Frey, C. B., & Osborne, M.A (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 1*(4), 254-280. https://doi.org/10.1016/j.techfore.2016.08.019

Garg, M., Hasan, N., & Gupta, A. (2023). Implementation of Koha in managing the e-resources of the library. *Journal of Information and Knowledge*, *60*(2), 127–132. https://doi.org/10.17821/srels/2023/v60i2/170972

Gupta, A., Anpalagan, A., Guan, L., & Khwaja, A. S. (2021). Deep learning for object detection and scene perception in self-driving cars: Survey, challenges, and open issues. *Array,* 10. https://doi.org/10.1016/j.array.2021.100057.

Harris, R., & Turner, P. (2021). Artificial intelligence and the transformation of library services. *Library Trends, 69*(2), 292-313.

Hervieux, S., & Wheatley, A. (2021). Perceptions of artificial intelligence: A survey of academic librarians in Canada and the United States. *Journal of Academic Librarianship, 47*(1). https://doi.org/10.1016/j.acalib.2020.102270

Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research, 21*(2), 155–172. https://doi.org/10.1177/1094670517752459

IFLA. (2020). IFLA statement on libraries and artificial intelligence. IFLA FAIFE (Committee on Freedom of Access to Information and Freedom of Expression).

Johnson, B. (2018). Libraries in the age of artificial intelligence. *Computers in Libraries*. https://www.infotoday.com/cilmag/jan18/Johnson--Libraries-in-the-Age-ofArtificial Intelligence.shtml

Kalbande, D., Yuvaraj, M., Verma, M. K., Subaveerapandiyan, A., Suradkar, P., & Chavan, S. (2024). Exploring the integration of artificial intelligence in academic libraries: A study on librarians' perspectives in India. *De Gruyter: Open Information Science*, 8, 1-15.

Kalisdha, A. (2024). The impact of artificial intelligence and machine learning in library and information science. *International Journal of Research in Library Science*, 10(1), 39-58.

Khurana, D., Koli, A., Khatter, K. *et al.* (2023). Natural language processing: state of the art, current trends and challenges. *Multimed Tools Appl.,* 82, 3713–3744. https://doi.org/10.1007/s11042-022-13428-4

Korinek, A., & Stiglitz, J. (2017). Artificial intelligence and its implications for income distribution and unemployment. NBER Working Paper No. 24174. National Bureau of Economic Research.

Liu, J., Liu, J., & Chen, Y. (2022). Application of artificial intelligence technology in information retrieval of university library. In J. C. Hung, J.-W. Chang, Y. Pei, & W. C. Wu (Eds.), *Innovative Computing* (pp. 221–228). Springer Nature. https://doi.org/10.1007/978-981-16-4258-6_28

Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. Proceedings of the 2020 CHI conference on human factors in computing systems, 1–16.

Lund, B. D., Omame, I., Tijani, S., & Agbaji, D. (2020). Perceptions toward artificial intelligence among academic library employees and alignment with the diffusion of innovations' adopter categories. *College and Research Libraries, 81*(5), 865–882. https://doi.org/10.5860/crl.81.5.865

Lund, B. D., Omame, I., Tijani, S., Agbaji, D. (2020). Perceptions toward artificial intelligence among academic library employees and alignment with the diffusion of innovations' adopter categories. *College & Research Libraries*, 865-882.

Mallikarjuna, C. (2024). An analysis of integrating artificial intelligence in academic libraries. *DESIDOC Journal of Library & Information Technology, 44*(2), 124-129.

Martinez, L. (2022). Chatbots and AI Personalization in Public Libraries. *Information Today, 36*(2), 12–15.

Memela, M.A. (2023). Artificial intelligence (AI): Enlightening academic libraries on the phenomenon. *Journal of Information Processing, 2*(3), 1-10. https://doi.org/10.13140/RG.2.2.32481.89443

Miller, J. (2020). Bridging the AI Training Gap for Librarians. *Professional Library Journal, 14*(1), 78–85.

Moustapha, A. A., & Yusuf, I. O. (2023). Adoption of artificial intelligence to improve library service delivery in academic libraris in Kwara State, Nigeria. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/7915

Mupaikwa, E. (2024). The application of artificial intelligence and machine learning in academic libraries. DOI: 10.4018/978-1-6684-7366-5.ch041

Nakhoda, M., & Tajik, S. (2017). A survey of the factors influencing the resistance of the employees of university libraries to technological changes: Study of libraries of Tehran University. *Library Management, 38(*8/9), 528-546. https://doi.org/10.1108/LM-02-2017-0025

Nestik, T., Zhuravlev. A., Eduard. P., et al. (2019). Technophobia as a cultural and psychological

phenomenon: Theoretical analysis. *Interação - Revista de Ensino Pesquisa e Extensão 20*(1), 266–281.
Neumann, O., Guirguis, K., & Steiner, R. (2024). Exploring artificial intelligence adoption in public organizations: Aa comparative case study. *Public Management Review, 26*(1), 114- 141.
Nimrod, G. (2016). The hierarchy of mobile phone incorporation among experienced/senior users. *Mobile Media & Communication*, 4, 149–168
Obiano, D. C., Onuoha, C. O., Adeoye, A. A., Nwosu, J. C., & Folarin, M. (2022). Aiding the exploration of artificial intelligence in Nigerian academic libraries in the 21st century. *Information Technology and Librarianship, 2*(1&2), 1-13.
Oladokun, B. D., Owolabi, A. K., Aboyade, M. A., Wiche, H. I., & Aboyade, W. A. (2023). Emergence of robotic technologies: Implications for Nigerian academic libraries. *Library Hi Tech News, 40*(6), 15-18.
Oyelude, A. A. & Oladele, B. A. (2014). The leadership dimention in information and communication technology adoption in African libraries. SAGE Open 4 (1). https://doi.org/10.1177/2158244014522071
Oyetola, S. O., Oladokun, B. O., Maxwell, C. E., & Akor, S. O. (2023). Artificial intelligence in the library: Gauging the potential application and implications for contemporary library services in Nigeria. *Data & Metadata, 2*(1), 5.
Park, J. (2019). An AI-based English grammar checker vs. human raters in evaluating EFL learners' writing. *Multimedia-Assisted Language Learning, 22*(1), 112-131.
Sambo, A. S., & Oyovwe-Tinuoye, G. (2023). Awareness and perception of certified librarians of Nigeria towards the use of robotic technologies in the libraries. *Ghana Library Journal, 28*(1), 26-34.
Sanji, M., Behzadi, H., & Gomroki, G. (2022). Chatbot: an intelligent tool for libraries. Library *Hi Tech News, 39*(3), 17-20. https://doi.org/10.1108/LHTN-01-20210002
Shaheen, M. A., & Khurshid, A. (2023). Perceptions and experiences of artificial intelligence (AI) use in libraries: A study of library users in Pakistan. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/7905
Smith, A., & Jones, B. (2020). The impact of librarian perceptions on AI adoption in academic libraries. *College & Research Libraries, 81*(5), 737-751.
Subaveerapandiyan, A. (2023). Application of artificial intelligence (AI) in libraries and its impact on library operations review. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/7828
Subaveerapandiyan, A., Sunanthini, C., & Amees, M. (2023). A study on the knowledge and perception of artificial intelligence. *International Federation of Library Associations and Institutions, 49(*3), 503–513. https://doi.org/10.1177/03400352231180230
Tella, A. (2020). Robots are coming to the libraries. Are librarians ready to accommodate them? *Library Hi Tech News, 37*(8), 13-17.
Thompson, J., & Howard, T. (2019). Perception and utilization of AI in special libraries. *Special Libraries Association Quarterly, 23*(4), 122-136.
University of Florida (2022). **Local practice for the cataloging of print material with OCLC copy.** https://guides.uflib.ufl.edu/c.php?g=147853&p=7064864
Weijia, G. U. O. (2022). Research on influencing factors of libraries' artificial intelligence readiness. *Journal of Agricultural Library and Information Science, 34*(5), 47–56. https://doi.org/10.13998/j.cnki.issn1002-1248.22-0016
Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2019). Artificial intelligence and the public sector—applications and challenges. *International Journal of Public Administration, 42*(7), 596– 615. doi:10.1080/01900692.2018.1498103.
World Bank. (2016). World Development Report: Digital dividends. https://www.worldbank.org/en/publication/wdr2016
Zinkevich, N. A., & Ledeneva, T. V. (2021). Using Grammarly to enhance students' academic writing skills. *Professional Discourse & Communication, 3*(4), 51-63, DOI:10.24833/2687-0126-2021-3-4-51-63
Zondi, N. P., Epizitone, A., Nkomo, N., Mthalane, P. P., Moyane, S., Luthuli, M., Khumalo, M., & Phokoye, S. (2024). A review of artificial intelligence implementation in academic library services. *South Africa Journal of Library & Information Science, 90*(2), 1-8.

Artificial Intelligence and the Future of Library and Information Service Delivery in Academic Libraries in Nasarawa State, Nigeria

Prof. Abiodun O. Iyoro
Federal University of Lafia, Library
08037172522
abiyoro@yahoo.com
&
Dr. Kingsley Emmanuel Enyi
Federal University of Lafia, Library
Department of Reference Service
08034367172
kingsleyenyi12@gmail.com
enyi.kingsley@fulafia.edu.ng

Abstract

The paper investigated artificial intelligence and the future of library and information service delivery. Four (4) research questions guided the study while two null hypotheses were tested in the study. Descriptive survey design was adopted for the study with the total population comprising of one hundred and fifty-nine (159) library staff from six selected academic libraries in Nasarawa State. Stratified random sampling technique was used in the selection of the respondents from the six academic libraries in Nasarawa State. The instruments for data collection include questionnaire and interviews and the data was analyzed using frequency and simple percentage, Mean (X) and standard deviation (SD). Findings of the study reveal the high effects of artificial intelligence to the future of library and information service delivery. It also pointed application of artificial intelligence by library staff in academic libraries for service delivery. Further findings from the study revealed that, addressing digital divide, transparency and accountability/ job displacement, equity and access/ partnership and collaborations, data quality and integrity, resource allocation/ change management, privacy and security are the main challenges face by artificial intelligence in library and information science service delivery in academic library. In conclusion, evaluation effectiveness was observed as a strategy that ould correct the challenges that alter the workforce of artificial intelligence in library and information service delivery. Recommendation shows that academic libraries should totally embrace the utilization of artificial intelligence and developing it services towards their activities in exploring its benefits for the effective future of library and information science profession. Also that AI-powered service should be designed in a manner that all users can access. In addition to transparency and accountability, AI systems should be transparent and accountable wit clear decision making process and its data privacy and security should be well secured.

Keywords: *Artificial Intelligence (AI), Library and Information, Service Delivery, University Libraries*

Introduction

Generally, intelligence is said to be the state of the capacity of mind, facts or meaning, truth, mainly to understand principles of life, acquired knowledge and apply it to practice; the willingness to comprehend and learn. Intelligence is the dexterity to ponder, seek, lucubrate facts and skills and apply them when necessary. Developing computers or machines that perceive, lucubrate, mull over and behave like human beings have excited many people. Human beings are born with inherent abilities to mull over and act, which develops and improves over time as a result of so many factors. Intelligence in humans is measured by the Intelligence Quotient (IQ) obtained through series of aptitude test focusing on different aspects of intellectual functioning. Similarly, developing intelligent computers that perceive, think and behave like humans is the crux of Artificial Intelligence.

Artificial intelligence (AI) is the ability of a computer system to perform tasks that would normally require human intelligence, like understanding natural language, recognizing images or objects, and making proper decisionEx Libris, (2019). AI computer systems are often designed in a way to learn and adapt to new idea or data to enable them become more effective, efficient and accurate from time to time. Few examples of AI are self-driving car, virtual assistance and chat bots. AI is a wide discipline that covers many different approaches to developing AI systems. The two major approaches include; machine learning and symbolic AI. Machine learning involves training logarithms to recognize patterns into data, while symbolic AI uses rules and knowledge to represent information(Romero, 2018).

Societal development in recent times have been expedited by the growing demand of access to information with library serving the prime source in providing this access. The paradigm shift in the format and dynamics of information and knowledge as a result of the rapid advancement in computer technology and software applications especially artificial intelligence, have shifted libraries to a demand commensurate to the supply of same technologies. Except libraries begin exploiting the new technologies and innovate their information and services delivery, they may face obsolescence in neoteric times (Vijayakumar & Vijayan 2011).

Artificial Intelligence is used in many areas such as; military, photography, business, accountancy, sales and advertising, gaming, education mainly in the libraries etc. The ideology of creating Artificial Intelligence systems in libraries dates back to 1990. These intelligent library systems provide enlightenment services to both the library staff and patrons (Asemi & Asemi, 2018). The application of Artificial Intelligence in the library system cut across descriptive cataloguing, subject indexing, reference services, technical services, shelf reading, collection development, information retrieval system etc. This has gone beyond Natural Language Processing (NLP) and knowledge-based services. With the advancement in Artificial Intelligence programming, creating a smart library is not only a possibility but a matter of time.

Libraries are growing living organismsspread in all forms of life with activities geared towards the development of man. It evolved basically and structurally and content-wise through different era: the ancient, medieval and modern era. In the ancient times, clay tablets and stones were used as medium for transmitting information, through the medieval era of papyrus and parchments and the modern era of paper, microform and now the digital or electronic media (Garcia-Febo, (2019). Libraries have acquired and maintained various forms of information resources throughout these eras so as to meet the information needs of its user communities. Similarly, a library was formally defined as a function of the physical building where books were kept for reading and other purposes. However, the definition of library today has gone beyond the physical building, it now centers on the collections and services offered, since virtual libraries have no physical walls and services could be rendered to users from remote locations. In the effort to satisfy the dynamic information needs of its users at the same time uphold its relevance in this ever-changing technological society, libraries have explored, incorporated and metamorphosed through different technological revolutions of clay tablets, stones, papyrus, parchments, paper, microforms, computers, internet, virtual libraries, library 2.0, cloud computing etc.

Artificial intelligence is the current technology that has evolved with huge prospects and promising applications in libraries. Hence, the need to explore this tech, its pros and cons, in order to adequately maximize its rich benefits for innovative and optimal services delivery in libraries. Corke (2013) asserts that artificial intelligent systems will be an important technology in this century. In a nutshell, the crux for applying artificial intelligent systems in libraries is the fact that they are less prone to errors unlike human beings; they can work for 24 hours/7 days without getting tired thereby freeing the librarians to do other jobs. Ultimately, since computers can operate efficiently at a scale and speed beyond human abilities, it will maximize speed, efficiency and effectiveness in processing library materials and enhance library services delivery at all levels. An in-depth knowledge to the study of artificial intelligence (AI) in the library services would provide some background information on AI and its potential applications in libraries. It would show and further explain how AI works and some of the common techniques used in other industries, such as machine learning and natural language learning processing. These would also provide an overview of how AI has so far been used in libraries, and some examples of successful implementations.

This work discusses the concepts, foundations, application and advancement in the field of artificial intelligence in libraries, application of robots, virtual, augmented and mixed realities in libraries, their promises, benefits and demerits they hold for future libraries.

Statement of the Problem

Library and information science generally play a key role in the building and promotion of high level tasks and service delivery to users in academic libraries, particularly in the present AI knowledge-based era. This development also underscores the importance attached to AI in all academic libraries. For instance, for any academic library to deliver effective information services to its patrons, it must embrace AI technology along-side its services since the technology is known to be reliable and effective in almost all library operations. When carrying out research in an academic library, AI technology will assist the researcher to carry out his work smoothly and effectively without any challenge, though with minimal and to get fast, quality and up-to-date information irrespective of the geographical location of the researcher. This fast and quality assignment performed by AI in an academic libraries, places it above other web technology sources.

It is in recognition of this, that the Federal Ministry of Education (FME) initiated AI and other web programmes designed to be lunch by academic libraries into the information global society. Among the programmes, according to Asemi & Asemi, (2018), include; automation of academic libraries using Management Information Systems (MIS) and Nigerian Universities Network (NUNET) which was aimed at developing a viable AI components with local and wide area network in the library of each institution. The idea is to encourage the use of AI technology in problem solving, data analysis, decision making with its direct involvement in library automation for academic activities in the academic library system.

Therefore, if quality services are delivered through digital process using AI technology such as Current Awareness Service, charging and discharging service, monitoring of users' activities, users' search, recalling among others that are available in the library, it will improve the librarians's work with quick access to information.

However, unavailability of Artificial Intelligencetechnology in the running of academic library operations will affect the future of the library and the extent of its service delivery to their users. This may

consequently have negative impact on the quality of their research work. As such, there is need forAI technology services in carrying out effective duties and research in the library. This is imperative as the technology provides libraries with quick access to a very large quality information(s) support multimedia content, provide user- friendly interface, enable 'link' representations to local/external objects (hypertext) and support advanced search and retrieval of information that enrich the quality of research. "The unavailability of and provision of AI technology to facilitate library activities will make the library unattractive to users" and as such the library will not be able to deliver quality and effective service at the right time (Udensi & Akor 2016)

In spite of the enormous effort made by the National Library of Nigeria, Nigerian Library Association, NUC and TETFund in educating tertiary institutions on the benefits of AI technology in improving library services and research work, it has been observed that most librarians in academic libraries are yet to come to the knowledge and benefit of AI technology for effective service delivery.

These scenarios if not urgently addressed may have far reaching negative effect on both the academic libraries, researchers, students and other library users. The library users may not efficiently derive quality services from the librarians to aid their research work. It is based on this assumption that the adoption of Artificial Intelligence is being clamored for to see how library and information services delivery could be improved upon.

Research Questions

The following research questions guided this study:

1. How can artificial intelligence be applied in academic libraries for enhanced service delivery in Nasarawa State, Nigeria?
2. What are the benefits of artificial intelligence to the future of library and information service delivery in academic libraries in Nasarawa State, Nigeria?
3. What are the effects of artificial intelligence on the future of library and information service delivery in academic libraries in Nasarawa State, Nigeria?
4. What are the challenges of the application of artificial intelligence in library and information service delivery in academic libraries in Nasarawa State, Nigeria?

Hypotheses

Two null hypotheses were formulated to guide the study and was tested at 0.05 level of significance.

Ho_1: Artificial intelligence (AI) has no significant effect on the future of library and information service delivery in academic libraries in Nasarawa State, Nigeria.

Ho_2: Application of Artificial intelligence (AI) has no significant influence on the future of library and information services delivery in academic libraries in Nasarawa State, Nigeria.

Theoretical Framework

It is expected that findings of this study will have both theoretical and practical significance. Theoretically, this study will be anchored on three theories: Technology acceptance model (TAM) Fred Davis (1989); The Unified Theory of Acceptance and Use of Information Technology (UTAUT) Venkatesh (2003); and The Theory of Planned Behaviour (TPB) Ajzen (1991). The Technology Acceptance Model (TAM) revealed that, when there is new technology, users will determine whether to accept or reject it, the use of technology is anchored on users' intent to use them. This will explain AI usage behavior by highlighting the importance and benefit of using the technology in the library. It will also increase satisfaction in using the library by patrons and by so doing leads to maximum research output. The Unified Theory of Acceptance and Use of Information Technology believes that performance expectancy, effort expectancy, social influence and facilitating condition are the main determinates of behavioral intention and actual ICT usage. This will provide a framework for understanding that will positively determine AI used in the academic libraries. The Theory of Planned Behavior (TPB) emphases on the users' perception of the ease or difficulty of performing e-task in the library.

Literature Review

Artificial Intelligence matters to libraries because it can be used for organizing and making available large collections of information (ALA, 2019). According to Sridevi and Shanmugam (2017), artificial intelligence is the modern technology which is used to manage the digital library. The ultimate promise of artificial intelligence is to develop computer systems or machines that think, behave and in fact rival human intelligence, and this clearly has major implications on librarianship. Artificial intelligence is not just an intelligent system or software program, it is a biologically motivated technology used to replicate human ways of perceiving and processing information (Sridevi & Shanmugam, 2017). Intelligent library automation systems rely on artificial intelligence technologies to provide knowledge-based services to library clientele and staff. Artificial intelligence in libraries should not be misconstrued with library automation (Jacknis, 2017). While the later implies the degree of mechanisation to routine library

operations, the former goes beyond just automating library activities, and create intelligent rational systems that behave and act like librarians and requires little or no human intervention. Artificial intelligent systems can replicate and thus replace a human being in the library, although Li, Huang, Kurniawan and Ho (2015) believed that this invention will never replace librarians, but will center on menial and time-consuming library operations such as shelf reading and leave the librarians to engage with the patrons. Corroborating this assertion, Murphy (2015) maintained that the application of robots in libraries will bring librarians and users closer together, against the notion that robots will alienate librarians from their users.

The modern information retrieval tools now used in libraries to provide quick and innovative access to information include: electronic databases, Online Public Access Catalogue (OPAC), web search engines, and robotic systems customised for book retrieval and delivery. Most web search engines today such as Google, incorporates speech recognition to their system. This enable their users to speak the word or phrase they want to search and the web search engines types it into the search box via the use of Natural Language Processing (NLP) before searching and displaying the search results. In addition, Murphy (2015) reported that robotics technology is being used to free space restraints and make information resources readily accessible to users.

The development of shelf reading robots and others gadgets shows that, it is now only a matter of time, the present generation libraries will be flooded with the impact and utility of new applications based on artificial intelligence (Shohana, 2016). There is no doubt that in the nearest future, artificial intelligence may revolutionize many sectors of life, including the library development of shelf reading robots as opined by Li, Huang, Kurniawan and Ho (2015) and others as it is a matter of time it is a matter of time. Information retrieval is another aspect of librarianship that has felt the touch of artificial intelligence. Library information retrieval deals with the recall of information or resources from a file or database, it is concerned with the structure, analysis, organization, storage, searching, and retrieval of information stored in a library collections, information centre or the Internet (Croft, Metzler & Strohman, 2015). As the information held in libraries grew, several types of information retrieval tools were invented to cope with the vast amount of information therein and make them accessible to users. Nowadays, the quantity of new information being generated is at an exponential rate, this led to the invention and use of computerised and artificial intelligence retrieval systems to facilitate information searching and retrieval from the library collection, be it paper-based or electronic (Unagha, 2010). Artificial intelligence has gained tremendous benefits in library information services, these include but are not limited to; automatic cataloguing and classification using Optical Character Recognition (OCR), automatic translation of foreign language materials using Natural Language Processing (NLP), automatic indexing using Expert Systems etc.

Furthermore, artificial intelligence facilitates human work with greater speed, efficiency and effectiveness in work environments such as the library. According to Vijayakumar and Vijayan (2011), artificial intelligence and expert systems are used in classification, cataloging and indexing of library materials. Via the use of optical character recognition and neural network, the system is able to obtain the bibliographic records of books and classify them accordingly. According to Asemi and Asemi (2018), natural language processing can be used to reduce language barriers. In addition, expertise is needed in the provision of qualitative service delivery in libraries, as such, artificial intelligence and expert systems will improve the performances of library services and reduce the rate of human errors and defects and can perform task faster than a human being can most likely (Shohana, 2016).

Romero (2018) submitted that artificial intelligence could expedite searching and retrieval of new media with greater efficiency and effectiveness by library patrons and introduce them to new material they may never have found otherwise. In addition to convenience and entertainment value, using artificial intelligence to suggest similar materials could also help library clientele who are carrying out research by combing the library database in an instant. Generally speaking, artificial intelligence systems can read to you, inform you, advice you, teach you, correct your mistakes, and patiently respond to your myriads demands. Thus artificial intelligence holds great potentials for library and information service.

A good librarian, through working with a user, can provide a much better tailored service, potentially using up time freed up by using AI. – IFLA Library Policy and Advocacy Blog

The benefits of artificial intelligence in libraries can be summarized as according to ex libris (2019), artificial intelligence in libraries can make research more discoverable which can boost research productivity among faculty members, bridge in time, bridge in space, maximization of efficiency, maximization of effectiveness, minimization of effort, improved and immersive user experience in library services delivery. Although artificial intelligence is a promising innovative idea in the library system, it is not without disadvantages. Shohana (2016) outlined some of the disadvantages of artificial intelligence as follows:Artificial intelligence systems have the ability to replace human jobs thereby increasing the rate of unemployment in the society. This is an issue of concern among librarians for decades. The fear is that intelligent machines with capabilities of shelving books, retrieving information, answering reference queries and attending to users have great potentials of replacing librarians, leaving them unemployed. Jasrotia (2018) also opines that as intelligent machines in libraries can read digitized resources, analyse and offer customized insights, answers and services faster than librarians, the possibility of AI being a 'threat' to librarians but not to libraries does exist. This is probably why many librarians do not like the issue of

concern among librarians for decades. The fear is that intelligent machines with capabilities of shelving books, retrieving information, answering reference queries and attending to users have great potentials of replacing librarians, leaving them unemployed. Jasrotia (2018) also opines that as intelligent machines in libraries can read digitized resources, analyse and offer customized insights, answers and services faster than librarians, the possibility of AI being a 'threat' to librarians but not to libraries does exist. This is probably why many librarians do not like the idea of artificial intelligence in libraries. Nevertheless, Guion (2019) argues that librarians would still be needed because machines with AI systems would still not be able to fully discern what a library user wants as sometimes search terms do not fully explain the need or even judge how well their outputs conforms to basic library principles of intellectual freedom, copyright and privacy, intelligent systems lack that common base of human knowledge, severely constraining the types of functions that they can perform, level of effort and technical expertise needed to create artificial intelligence systems in libraries. The level and nature of effort that must be invested to develop an intelligent library system is directly proportional to the power and complexity of the system. This implies that, the more intelligent the system is, the more the effort that must be invested therein. Currently, the required skilled personnel with expensive development tools or techniques, needed to develop sophisticated intelligent system in libraries are lacking or costly, hence, the lack of such systems in libraries, limited amount of artificial intelligence experts among library automation vendors. The field of artificial intelligence is complex and thus, requires a specialised knowledge in that aspect far beyond the development of conventional library automation systems. Consequently, this will require hiring new personnel in that area before any significant, widespread work can be done in the area of artificial intelligence systems in libraries.

Artificial intelligence systems can malfunction and perform task they were not programmed to do. The fear, according to Ex Libris (2019), is the possibility of AI systems propagating misinformation if the algorithms powering them become problematic, artificial intelligence systems can be misused leading to mass scale destruction, over dependence on artificial intelligence systems can make librarians forget the basic and fundamental processing involved in library operations such as cataloguing and classification, since a robot now handles that.Lacks the 'human touch'. Some users will prefer to interact with human beings directly and express their feelings rather than to a machine.

Artificial intelligence systems are generally not in operational use in most libraries today. The limitations to implementing artificial intelligence systems in libraries enormous as it include; lack of technical know-how to use and operate artificial intelligence systems among the library staff, lack of adequate funding to develop or procure artificial intelligence systems in libraries. Since the budgets for hardware and software are frequently tight, there's always constrain to the type of system the library can purchase or develop, high system development and maintenance cost of artificial intelligence systems in libraries, erratic power supply to power artificial intelligence systems in libraries especially in developing countries, inherent complexities of expert/artificial intelligence systems' development and limited natural language capabilities.

Methodology

A descriptive survey research design was adopted for the study to investigate artificial intelligence and the future of library and information service delivery in academic libraries in Nasarawa State, Nigeria. The population of the studies comprised of one hundred and fifty-nine library staff from the selected academic libraries in Nasarawa State, namely; Federal University of Lafia, Library, Nasarawa University, Keffi Library, Bingham University, Karu, Federal Polytechnic, Nasarawa, Isa Mustapha Agwai 1 Polytechnic, Lafia and College of Education, Akwanga Library. Stratified random sampling technique was used in the selection of the respondents from the six academic libraries in Nasarawa State. Sample size drawn was one hundred and fifty-nine (159) library staff from six selected academic libraries in Nasarawa State.

Data was collected using a close-ended questionnaire, and analysis was carried out using frequency counts, relative frequencies, means, tables, and charts.

Results and Discussion

This section was devoted to presenting the results from the research questions and subsequently the test of hypotheses.

Research Question 1: How can artificial intelligence be applied in library for enhanced services delivery in academic libraries Nasarawa State?

Table 1: How Artificial Intelligence can be Applied.

S/N	Items	VHE	HE	LE	VLE	X	Decision
1	Library Management	79 (30.0%)	127 (48.3%)	20 (14.1%)	37 (14.1%)	4.0	Agreed
2	Search Engine	77 (29.3%)	7 (2.7%)	14 (5.3%)	165 (62.7%)	1.2	Disagreed
3	Virtual Assistants	62 (23.6%)	12 (4.6%)	32 (12.2%)	147 (55.9%)	1.8	Disagreed

4	**Automated Cataloguing**	132 (50.2%)	72 (27.4%)	40 (15.2%)	19 (7.2%)	**3.1**	**Agreed**
5	**Data Analysis**	19 (7.2%)	189 (71.9%)	49 (18.6%)	6 (2.3%)	**3.0**	**Agreed**
6	**Research Assistance**	26 (9.9%)	154 (58.6%)	51 (19.4%)	22 (8.4%)	**3.2**	**Agreed**
7	**User Outreach**	14 (5.3%)	111 (42.2%)	78 (29.7%)	60 (22.8%)	**1.6**	**Disagreed**
8	**Recommendation System**	14 (5.3%)	67 (25.5%)	32 (12.2%)	127 (48.3%)	**3.0**	**Agreed**
9	**Collection Analysis**	22 (8.4%)	61 (23.2%)	115 (43.7%)	65 (24.7%)	**2.0**	**Disagreed**
10	**Digital Preservation**	32 (12.2%)	114 (43.3%)	91 (34.6%)	26 (9.9%)	**2.6**	**Agreed**

Key: VHE=Very High Extent, HE=High Extent, LE=Low Extent, and VLE=Very Low Extent

Table 5 shows librarians' responses regarding how artificial intelligence can be applied in library and information science for service delivery in academic library. From the table, majority of the librarians at great extent agreed thatLibrary Managementis one of the ways AI can be applied with mean score X = 4.0, Research Assistance (X= 3.2), Automated Cataloguing(X= 3.1), Data Analysis (X=3.0), Recommendation System (X = 3.0), and Digital Preservation (X=2.6). In another opinion, some responses from the librarians suggest Collection Analysis (X=2.0), Virtual Assistants(X=1.8), User Outreach (X=1.6) and Search Engine (X=1.2) in an insignificant manner.

Research Question 2: What are the benefits of artificial intelligence to the future of library and information service delivery in academiclibrariesin Nasarawa State?

Table 2: Benefits of Artificial Intelligence for Library and Information Service Delivery

Benefits of Artificial Intelligence	SA	A	D	SD	X	Decision
Resource optimization: AI can help libraries optimize resou rces allocation, reducing waste and improving efficiency.	19 (7.2%)	205 (77.9%)	18 (6.8%)	21 (8%)	2.8	**Agreed**
Personalized services: AI can provide personalized recommendations, search results and research assistance	25 (9.5%)	146 (55.5%)	92 (35.0%)	-	2.7	**Agreed**
24/7 Support: AI powered chat -bots can round -the-clock support and answer frequently asked questions	97 (36.9%)	80 (30.4%)	71 (27.0%)	15 (5.7%)	2.0	**Agreed**
Improved accessibility: AI can h elp make library resources and services more accessible t o users with disabilities.	77 (29.3%)	65 (24.7%)	44 (16.7%)	77 (29.3%)	2.5	**Agreed**
Text and data mining: AI powered text and data mining can help researchers extract insights and knowledge from large datasets.	10 (3.8%)	253 (96.2%)	-	-	3.0	**Agreed**
Search s trategies: AI can construct search strategies for locating information resources	32 (12.2%)	60 (22.8%)	131 (49.8%)	40 (15.2%)	2.3	**Disagreed**
Predictive analysis: AI powered predictive analysis that c an help libraries anticipate and prepare for future trends and demands	4 (1.5%)	251 (95.4%)	3 (1.1%)	5 (1.9%)	3.0	**Agreed**

Collaborative tools: AI powered - collaborative tools that can facilitate communication among researchers	52 (9.8%)	201 (76.4%)	10 (3.8%)	-	3.2	Agreed
Automated tasks: AI can automate routine tasks, such as cataloguing, classification and data entry.	40 (15.2%)	214 (81.4%)	9 (3.4%)	-	3.1	Agreed
Digital technology: AI can provide digital devices (i.e. the ability to use digital technology tools/devices)	25 (9.5%)	146 (55.5%)	92 (35.0%)	-	2.7	Agreed

Key: VHE= Very High Extent; HE= High Extent; LE = Very Low Extent, and VLE= Very Low Extent

Table 2 Attributes such as Collaborative tools: AI powered-collaborative tools that can facilitate communication among researcher scored high with X= 3.2. This is followed by Automated tasks: AI can automate routine tasks, such as cataloguing, classification and data entry with X= 3.2, and the next highest been Text and data mining: AI powered text and data mining can help researchers extract insights and knowledge from large datasets and Predictive analysis: AI powered predictive analysis that can help libraries anticipate and prepare for future trends and demands accordingly. Exception of Digital technology: AI can provide digital devices (i.e. the ability to use digital technology tools/devices) and Improved accessibility: AI can help make library resources and services more accessible to users with disabilities that recorded lower score of X = 2.7 and X = 2.5 respectively.

Research Question 3: What are the effects of artificial intelligence and the future of library and information service deliver in academic libraries in Nasarawa State?

Table 3: Effects of Artificial Intelligence

Items Regarding Extent of Agreement or Disagreement in terms of the Effects of Artificial Intelligence	VH	H	L	VL	X	Decision
Improved efficiency: AI automate routine tasks, freeing up staff to focus on more complex activities	11 (4.2%)	252 (95.8%)	-	-	3.0	Agreed
Enhanced users experience: AI -powered services provide personalized support and recommendation	100 (38%)	163 (62%)	-	-	3.4	Agreed
24/7 support: AI -powered chat -bots provide round-the-clock assistance	89 (33.8%)	92 (35%)	53 (20.2%)	-	3.2	Agreed
New services and programs: AI enable libraries to offer new services and programs, such as AI -powered research assistance	115 (43.7%)	148 (56.3%)	-	-	3.4	Agreed
Partnership and collaborations: libraries can partner with other organization to leverage AI technologies	121 (46.0%)	152 (57.8%)	19 (7.2%)	-	3.3	Agreed
Professional development: libraries can develop new skills to work effectively with AI technologies	116 (44.1%)	147 (55.9%)	-	-	3.4	Agreed
Continuous evaluation and improvement: libraries must reg ularly assess and improve AI-powered services.	24 (9.1%)	153 (58.2%)		-	3.1	Agreed
Integration with emerging technologies: AI will likely be integrated with other technologies, such as blockchain and IoT	239 (90.9%)	102 (38.9%)	8 (3.0%)	-	3.5	Agreed
AI-powered search engines: improve search results and relevance	11 (4.2%)	252 (95.8%)	-	-	3.0	Agreed
Content discovery: helps users discovered new resources and topics	252 (95.8%)	11 (4.2%)	-	-	3.0	Agreed

Key: VH = Very High; H = High; L = Low, and VL = Very Low

Table 3 shows the effects of artificial intelligence in the first and second column as"Very High" and "High" by the library staff. This is a proof that the respondents observed a high level of the effects of artificial intelligence that is needed for the future of library and information science operations such as; Integration with emerging technologies: AI will likely be integrated with other technologies, such as blockchain and IoT indicated by the X= 3.5; Enhanced users experience: AI-powered services provide personalized support and recommendation indicated by the X = 3.4; Professional development: libraries can develop new skills to work effectively with AI technologies indicated by the X = 3.4; New services and programs: AI enable libraries to offer new services and programs, such as AI-powered research assistance indicated by the X= 3.4; Improved efficiency: "AI automate routine tasks"freeing up staff to focus on more complex activities" as indicated by the X= 3.0;AI-powered search engines: improve search results and relevance as indicated by the X = 3.0; Content discovery: helps users discovered new resources and topics as indicated by the X= 3.0; Partnership and collaborations: libraries can partner with other organization to leverage AI technologies, Professional development: libraries can develop new skills to work effectively with AI technologies, 24/7 support: AI-powered chat-bots provide round-the-clock assistance

Research Question 4: What are the challenges of artificial intelligence in library and information service delivery in academic libraries in Nasarawa State, Nigeria?

Table 4: Challenges of Artificial Intelligence

S/N	Items	SA	A	D	SD		X	Decision
1	Privacy and Security: AI system requires access to use data arising concerns about privacy and security.	-	142 (54%)	121 (46%)	-		2.5	Agreed
2	Transparency and Accountability: AI systems can be complex, making it difficult to understand de cision making process	115 (43.7%)	148 (56.3%)	-	-		3.4	Agreed
3	Equity and Access: AI powered service may exacerbate existing inequality if not designed to be inclusive.	89 (33.8%)	174 (66.2%)	-	-		3.3	Agreed
4	User Trust and Acceptance: some users may b e hesitant to trust to trust AI -powered services.	12 (4.6%)	49 (54%)	142 (54%)	51 (19.4%)		2.0	Disagreed
5	Job Displacement: AI may automate some tasks currently performed by library staff	124 (47.1%)	132 (50.2%)	7 (2.7%)	-		3.4	Agreed
6	Data Quality and Integrity: AI systems requires require high - quality data to function effectively	44 (16.7%)	219 (82.3%)	-	-		3.2	Agreed
7	Partnership and Collaborations: Library may need to partner with other organization to leverage AI technologies.	72 (27.4%)	191 (72.6%)	-	-		3.3	Agreed
8	Addressing Digital Divide: AI - powered services may widen the digital divide if not designed to be accessible to all users.	217 (82.5%)	37 (14.1%)	9 (3.4%)	-		3.7	Agreed
9	Keeping up with rapid technological change: AI technologies a re rapidly evolving, making it challenging for libraries to stay up to date	-	137 (52.1%)	37 (14.1%)	89 (33.8%)		2.2	Disagreed

10	Resource Allocation: Implementing AI -powered services may require significant resources.	77 (29.3%)	120 (45.6%)	66 (25.1%)	-		3.0	Agreed
11	Change Management: Introducing AI -powered services may require significant to library operations.	188 (71.5%)	-	-	38 (14.4%)		3.0	Agreed
12	Evaluating Effectiveness: Libraries needs to develop methods to evaluate the effectiveness of AI -powered	-	52 (19.8%)	159 (60.5%)	52 (19.8%)		2.0	Disagreed

Key: SA=Strongly Agreed, A= Agreed, D=Disagree and SD=Strongly Disagree

Table 5 above shows that most of the challenges listed were strongly agreed and agreed such as; addressing digital divide(X=3.7), transparency and Accountability/ job displacement(X=3.4), equity and access/ partnership and collaborations X =3.3), data quality and integrity(X=3.2), resource allocation/ change management (X=3.0), privacy and security (X=2.5). while few respondents disagreed in their responses to the challenges face by artificial intelligence in library and information science service delivery in academic library like; keeping up with rapid technological change (X=2.2),user trust and acceptance(X=2.0) and evaluating effectiveness (X=2.0).

Discussion of Findings

The effects of artificial intelligence to the future of library and information service delivery is"Very High" and "High" from the responses of the library staff, as supported by the associated means, as shown in Table 4 above, is appreciably high.

This finding is supported by Ex Libris. (2019), research outcome that pointed out that the application of artificial intelligence by library staff in academic libraries for service delivery will enable the future of Library and Information Science profession. Also of interest to the study is the fact that Library Management (X=4.0), Research Assistance (X=3.2), Automated Cataloguing (X=3.1), Data Analysis (X=3.0), Recommendation System(X=3.0) were high. While Digital Preservation(X=2.6),Collection Analysis (X=2.0), Virtual Assistants(X=1.8), User Outreach (X=1.6) and Search Engine (X=1.2)were considered as low perceived significance.

Further findings from the study revealed that, addressing digital divide(X=3.7), transparency and Accountability/ job displacement(X=3.4), equity and access/ partnership and collaborations X=3.3), data quality and integrity (X=3.2), resource allocation/ change management (X=3.0), privacy and security (X=2.5) are the main challenges face by artificial intelligence in library and information science service delivery in academic library. This could, therefore, be substantiated by the findings of Coke (2016), who asserted that artificial intelligent systems (robots) will be an important technology in this century. But, the crux for applying artificial intelligent systems in libraries is the fact that they are less prone to errors unlike human beings; they can work for 24 hours/7 days without getting tired thereby freeing the librarians to do other jobs.

As supporting evidence, (Shohana, 2016) pointed out "evaluation effectiveness will be used as a strategy in place to correct the challenges that alter the workforce of artificial intelligence in library and information service delivery.

Conclusion and Recommendations

This study has critically explored the impact of artificial intelligence and the future of library and information service delivery in academic libraries in Nasarawa State, Nigeria.

The study also revealed the challenges that affect the performance of artificial intelligence. It is on this background that the following recommendations were put forward:

1. Academic libraries should totally embrace the utilization of artificial intelligence and developing it services towards their activities in exploring its benefits for the effective future of library and information science profession.
2. That AI-powered services should be designed in a manner that all users can access.
3. In addition to transparency and accountability, AI systems should be transparent and accountable wit clear decision making process and its data privacy and security should be well secured.

References

Abram, S. (2019). Robots in libraries: Technology trends that aren't out-there anymore! Retrieved from: https://lucidea.com/blog/robots-in-libraries/

Asemi, A., & Asemi, A. (2022). Artificial intelligence (AI) application in library systems in Iran: A taxonomy study. Library Philosophy and Practice (e-journal).Retrieved September 27, 2021 from: http://digitalcommons.unl.edu/libphilprac/1840/

Bailey, C. W., Jr. (1991). Intelligent library systems: artificial intelligence technology and library automation systems. Advances in Library Automation and Networking, 4. Retrieved May 17, 2017 from: http://eprints.rclis.org/4891/1/intlibs.pdf

Bourg, C. (2017). What happens to libraries and librarians when machines can read all books? Retrieved September 29, 2021 from: www.chrisbourg.wordpress.com

Corke, P. (2013). Robotics, vision and control: Fundamental algorithms in MATLAP. BeEx Libris. (2019). How AI can enhance the value of research libraries. Retrieved October 1, 2021 from: www.libraryjournal.com/?detailStory=how-ai-can-enhancetheHYPERLINK "http://www.libraryjournal.com/?detailStory=how-ai-can-enhance-the-value-of-"value-of- *research-libraries*

Garcia-Febo, L. (2019). Exploring AI: How libraries are starting to apply artificial intelligence in their work. American Libraries. Retrieved from https://americanlibrariesmagazine.org/2019/03/01/exploring-ai/

Guion, D. (2020). Artificial intelligence and libraries. Retrieved from: www.allpurposeguru.com/2019/04/artificial-intelligence -and-libraries/

Jacknis, N. (2017). The AI- enhanced library. Retrieved from: https://medium.com/@NormanJacknis/the-ai-enhanced-library-a34d96fffdfe

Romero, V. (2018). 4 ways libraries can improve with AI & big data. TechSoup Canada. Retrieved September 27, 2021 from: https://www.techsoupcanada.ca/en/community/blog/4-ways-libraries-can- *improve-with- ai-big-data*

Shohana. (2016). AI, Robot and Library: A new dimension in LIS. Retrieved September 29, 2021 from: https://shohanasite.wordpress.com/2016/12/04/ai-robot-and- *library-a-new- dimension-in-lis/*

Sridevi, P. C., & Shanmugam, A. P. (2017). Artificial intelligence and its applications in Libraries. In E- Resources Management. Retrieved from: https://www.researchgate.net/publication/327831852_ *Artificial_Intelligence_and_its_ap plications_in_Libraries*

Suthakorn, J., Lee, S., Zhou, Y., Choudhury, S., & Chirikjian, G. S. (2002). A robotic library system for an off-site shelving facility. Proceedings of ICRA '02 - IEEE International Conference on Robotics and Automation. 10.1109/ROBOT.2002.1014266

Udensi, J. N., & Akor, P. U. (2016). Fundamentals of library and information science. Zaria, Nigeria: Ahmadu Bello University Press.Unagha, A. O. (2010). Knowledge Organisation and Information Retrieval. Okigwe: Whyterm Publishers.

Vijayakumar, A., & Vijayan, S. S. (2011). Application of information technology in libraries: An overview. International Journal of Digital Library Services, 1(2). Retrieved from http://www.

Artificial Intelligence and the Future of Library and Information Service Delivery in the 5th Industrial Revolution in Nigeria

By
Odunlade, Racheal Opeyemi (PhD) CLN
University of Lagos, Akoka, Lagos
rodunlade@unilag.edu.ng
+234 8051226676
https://orcid.org/**0000-0003-1687-1743**

Ojo, Joshua, Onaade (PhD) CLN
University of Lagos, Akoka, Lagos
jojo@unilag.edu.ng
+234 8033007729
https://orcid.org/0000.0002-4601-5211
&
Ajayi, Taiwo Bosede, (PhD) CLN
Lagos State University of Science and Technology, Lagos.
ajayi.t@lasustech.edu.ng
+234 8023 364 171
https://orcid.org/0000.0001-7337-9419

Abstract
The advent of artificial intelligence has led to the fusion of advanced technologies which is reshaping various sectors including the library. This paper examined the transformative potential of Artificial Intelligence (AI) in the delivery of library and information services in Nigeria especially within the context of the 5th Industrial Revolution. The study examined the various AI technologies that are transforming library operations and services delivery. A mixed-method approach was employed using the combination of review of related literature on global AI trends in libraries and interview technique to gather data. In addition to an in-depth review of literature, a cross section of 25 librarians in Southwest Nigeria was selected regardless of their type of library. Simple random sampling technique was adopted to achieve this. Semi structured interview questions were posted to them via WhatsApp platform and responses were given through voice note audio recordings. Gathered data were synthesized accordingly. Findings revealed that majority of Librarians in Nigeria are aware of AI technologies. Also, many of the libraries have adopted AI in library operations though at the early stage. Librarians in Nigeria are receptive to AI and are willing to be trained. AI has impacted greatly on library operations and this has led to increased patronage, easy access and library efficiency amongst others. Despite these benefits, there are prevalent challenges such as inadequate budgetary allocation, lack of required AI infrastructures, lack of exposure and technical know-how of library professionals and users, and lack of management support. Suggestions were provided on the way forward.
Keywords: *Artificial Intelligence, Library, Service delivery, 5th Industrial revolution, Nigeria.*

Introduction

The rapid advancement of technology has significantly impacted various sectors, including library and information services. Technology has transitioned from various stages beginning with the invention stage - 1840s to 1900s (Mokyr,1990; Hobsbawm, 1968); through innovation -1900s to 1950s (Hughes,1983, Schumpeter, 1939); diffusion -1950s to 1980 (Freeman, 1987, Rogers, 1962); maturation -1980s to 2000s (Perez, 2002, Castells, 1996); convergence - 2000s to present (Schwab, 2016, Brynjolfsson & McAfee, 2014); and singularity (future) stage (Tegmark, 2017, Kurzweil, 2005). As the stages evolve, the world keeps experiencing significant impact that touch on global economies, industries, societies, and other human endeavours. Though these stages may overlap or occur concurrently, one thing is sacrosanct, and that that is the fact that technology has come to stay.

However, as the world recognizes the advent of the 5th Industrial revolution characterized by human-centric artificial intelligence (AI) integration (Kelly,2020; Xu, David & Kim, 2018), embracing this move may not be devoid of some opportunities and challenges. The 5th Industrial Revolution (5IR) which builds upon the digital advancements of the 4th Industrial Revolution fosters a synergy between humans and intelligent systems (Faggella, 2020). Unlike its predecessor, which emphasized automation and data-driven operations, 5IR focuses on human-AI collaboration, ethics, and sustainability.

According to Isiaka (2023), the application and use of Artificial Intelligence (AI) in library operations and services delivery has modernized traditional practices thereby making it easy for libraries to familiarize with the evolving information needs of their users. It is obvious that use of artificial intelligence in libraries is prevalent as AI does not only improve library operations and services, but can also upgrade and heighten the relevance of libraries in an ever-changing digital society (Omame and Alex-Nmecha, 2020). Library operations and services such as answering of directional and ready reference questions, cataloguing and

classification of information resources, self-check- out of books by users, library marketing, statistics evaluation and recommendations, charging and discharging of library materials, indexing, robotics referencing (Abba, 2024; Isiaka, 2023) are performed using AI. Some of the AI technologies used in performing the services mentioned include Chatbots and Virtual Assistants, ChatGPT, LibKey, robots, RFID technology and Grammarly.

In spite of this global development, it is not certain if libraries in Nigeria are part of the bandwagon. Therefore, **a**s the world transitions into the era of the 5th Industrial Revolution, there is a need to explore how AI will shape the future of library and information service delivery Nigeria. This study seeks to explore the level of preparedness of Nigerian libraries towards AI technologies adoption in the 5th industrial revolution.

Objectives of the study

The general objective of the study is to examine the role of AI in modernizing libraries in Nigeria. Specific objectives that would guide the study are to:

1. determine the level of preparedness of Nigerian libraries in embracing AI technologies in service delivery and operations.
2. determine the various services and operations that AI is used for in those libraries
3. determine the impact of AI technologies on service delivery and patronage
4. ascertain the challenges facing libraries in adopting AI
5. identify potential solutions for effective implementation of AI technologies

Review of Literature

Literature is replete on the concept of Artificial Intelligence and the attendant role it plays in delivering library and information services (Togia & Malliari, 2021; Faggella, 2020; **Jain & Kataria, 2019).** As the world gradually embraces the 5th industrial revolution, it is pertinent to explore the impact of AI on the future of information services delivery in the 5th industrial revolution especially in Nigeria. Existing literature on this concept would be reviewed under the following subject categories: the 5th Industrial Revolution and AI integration into library, AI in library operations in Nigeria, ethical and human-centered considerations**,** and challenges of AI adoption in Nigerian libraries.

The Fifth Industrial Revolution and AI Integration in Libraries

The Fifth Industrial Revolution (5IR) is widely described as a human-centric phase of technological development, prioritizing worker well-being and sustainability alongside advanced automation (mdpi.com) In this paradigm, libraries are reimagined as "intelligent" or human-centered organizations that strategically blend AI with core values of access, community, and equity (degruyter.commdpi.com). For example, Adigun, Ajani, and Enakrire (2024) note that 5IR-era libraries integrate technologies like IoT, cloud computing, biotechnology and especially AI to enhance user experiences and efficiency – while also confronting ethical issues of data privacy and inclusion (degruyter.com). Libraries thus embrace the 5IR goal of bridging divides: they bridge the digital divide by providing equitable access to technology and digital resources, advance research and innovation, and foster community engagement in digital society (degruyter.comjournal.ar-raniry.ac.id). In summary, 5IR encourages libraries to harness AI innovations without losing sight of people, emphasizing resilience, sustainability and human-centric services (mdpi.comdegruyter.com).

AI Applications and Innovations in Libraries

Libraries worldwide are deploying AI across virtually every service. Key innovations include:

i. **AI-powered virtual assistants and chatbots:** Many academic and public libraries use AI chatbots (including ChatGPT-style systems) to answer routine reference questions 24/7. These bots can generate human-like responses to user inquiries, offering convenience outside traditional hourssadil.ws. For instance, pilot projects report that chatbots provide "rapid and accurate responses to user inquiries, offering convenience and accessibility outside traditional library hours*"* (Rodríguez & Lozano, 2020) effectively acting as virtual reference assistants. By handling routine queries, bots free librarians to tackle complex tasks.

ii. **Automated cataloging and resource management:** Generative AI models are used to create and clean metadata, de-duplicate records, and identify collection gaps. As one report notes, AI can streamline workflows such as cataloging and interlibrary loan processing—dramatically improving efficiency (libraryjournal.comlibraryjournal.com). In practice, libraries use machine learning to analyze circulation patterns and recommend new purchases that match community needs, making acquisitions more "smart" and data-driven (libraryjournal.comlibraryjournal.com).

iii. **Personalized recommendation engines:** Similar to e-commerce, AI is used to suggest books, articles, or digital media based on a patron's history and preferences. These systems apply machine learning to usage data so that patrons see content tailored to their interests. As one industry expert observes, AI tools can "help librarians recommend appropriate resources to users" and even cut loan delivery times in half through better interlibrary loan routing (libraryjournal.com).

iv. **Robotics and smart infrastructure:** Physical robots and IoT devices are emerging in modern libraries. Examples include **autonomous book retrievers** and **shelf-scanning robots** that perform inventory collections. In South Africa, a university introduced an **AI-guided robot** in the library that helps students navigate to books and answers simple questions (news.nwu.ac.za). The robot proved especially "people-friendly": students interacted more comfortably with it than with human staff, allowing staff to focus on higher-value services (news.nwu.ac.za). Similarly, "smart" self-service kiosks with facial recognition and 24/7 access are being piloted (e.g. in China) so users can borrow books using only their face ID.

v. **Immersive experiences (VR/Metaverse)**: Libraries are experimenting with virtual and augmented reality to enhance services. Virtual library tours, AR-enhanced exhibits, and **metaverse library spaces** allow users to explore collections in 3D or attend virtual events. Industry data show VR/AR adoption is growing: for instance, 86% of top US academic libraries have implemented VR/AR programs. Immersive environments can make learning and outreach more engaging, fitting the 5IR theme of enriching human experience with technology.

vi. **Big Data analytics and AI-driven research support:** Academic and national libraries leverage AI to mine big data. Algorithms analyze vast digital archives to surface insights for researchers (e.g., text mining millions of documents). They also monitor user demographics and service usage in real time to identify underserved groups. For example, a study of Nigerian open-university libraries found 5IR technologies (like AI-driven data processing) enhance "service efficiency" and help create more inclusive, customized services (journal.ar-raniry.ac.id).

These innovations collectively transform library operations – from collections and workflows to user engagement – always aiming to keep the human user at the center (papers.ssrn.comjournal.ar-raniry.ac.id).

AI and Library Operations in Nigeria

Nigerian libraries, particularly academic libraries, are gradually embracing AI to improve service delivery despite infrastructural and policy-related challenges. Its application ranges from automated cataloguing and reference services to enhanced user engagement and resource management. AI tools being implemented in various aspects of library operations in Nigeria, though still at an emerging stage include:

i. **Automated Cataloguing and Metadata Management**: AI facilitates more efficient cataloguing, classification, and indexing of resources, which helps libraries maintain accurate and up-to-date records.

ii. **User Services and Chatbots**: Some Nigerian university libraries are experimenting with virtual assistants or chatbots to respond to user queries, improving access to information and reducing the burden on librarians (Edewor, Emeka & Aregbesola, 2021).

iii. **Information Retrieval and Recommender Systems**: AI enhances search capabilities and can personalize resource recommendations for users based on usage patterns.

Some of the benefits of AI integration into library operations are:

a. **Improved Efficiency**: AI can handle repetitive tasks such as cataloguing and answering FAQs, freeing librarians for higher-level responsibilities.

b. **Enhanced Access to Information**: Intelligent systems can provide 24/7 user support and faster information retrieval.

c. **Support for Distance Learning**: Especially important during the COVID-19 pandemic, AI-supported libraries enabled continued access to academic resources for remote learners (Eze & Eze, 2022).

Ethical and Human-Centered Considerations

Implementing AI in libraries raises important ethical and social issues, especially under a human-centered 5IR framework. Major considerations include:

i. **Privacy and data protection.** AI systems often require processing personal data (e.g. chat logs, borrowing records, biometric IDs). Libraries must ensure that user privacy—long a core library value—is not compromised by surveillance or data breaches. As Panda *et al.* (2024) emphasize, intelligent systems must uphold "core values such as intellectual freedom, privacy, and inclusivity"(papers.ssrn.com). Privacy guidelines, data minimization and anonymization are therefore critical.

ii. **Bias and fairness.** AI models can perpetuate existing biases in data, leading to skewed recommendations or exclusion of some groups. Libraries must audit AI tools to prevent unfair treatment of patrons. For example, an AI recommendation engine must not systematically favor books by majority authors or marginalize minority voices. Ethical guidelines (e.g. by library associations) are urging development of "trustworthy AI" that mitigates bias, promotes equity, and respects diverse perspectives (papers.ssrn.com).

iii. **Intellectual freedom and transparency.** Libraries champion free access to information; AI tools should not censor or filter content in opaque ways. There is a risk that AI-driven search or content curation might inadvertently suppress controversial viewpoints. Maintaining transparency about how AI systems select or rank information is key to preserving intellectual freedom (papers.ssrn.comsadil.ws).

iv. **Digital inclusion.** A human-centered approach demands equitable access. Libraries must use AI to bridge rather than widen divides. For instance, deploying AI-based literacy programs or device lending helps ensure vulnerable patrons benefit. One survey found that Nigerian librarians see 5IR tech as boosting "inclusive services" in open/distance learning, if supported by training and infrastructure (journal.ar-raniry.ac.id). Conversely, libraries must guard against leaving non-tech-savvy users behind.

v. **Accountability and oversight.** As Panda *et al.* (2024) argue, ongoing oversight and community engagement are essential. Libraries should involve staff and patrons in guiding AI adoption and maintain ethical review committees or policies for AI use (papers.ssrn.com). Educating both librarians and patrons about AI ("digital literacy") is also recommended, so that communities understand AI's limits and potentials (libraryjournal.compapers.ssrn.com).

In summary, libraries adopting AI are guided by the 5IR ethos of *"technology with the people,"* ensuring that innovations empower human users and align with library missions (papers.ssrn.commdpi.com).

Challenges of AI Adoption in Nigerian Libraries

Despite the promise of AI and 5IR, Nigerian libraries face several challenges in AI integration. These include infrastructural deficiencies such as erratic power supply, poor internet access, and limited hardware are common barriers (Adigun et al., 2024), lack of skilled personnel (Akinola & Olayemi, 2023), limited budgetary allocation, ethical concerns in the area of data privacy, user consent, and algorithmic bias. Also, librarians' perception and readiness for technology adoption is a challenge. Studies indicate that while librarians in Nigeria generally acknowledge AI's benefits, there is also anxiety about job displacement and a lack of clear policy frameworks for ethical AI use (Akinyemi, 2024). However, professional bodies like the Nigerian Library Association are beginning to advocate for structured AI literacy and digital transformation agenda.

Recommendations from the Literature

These recommendations are from reviewed literature:

a. Capacity Building: Training programmes and continuous professional development in AI and digital tools are necessary for librarians.
b. Policy Development: Institutions should develop clear guidelines for AI use, addressing privacy, data protection, and ethical use.
c. Public-Private Partnerships: Collaborations with tech firms and NGOs can help bridge funding and infrastructure gaps.

Future Directions and Librarian Roles

AI will play a central role in shaping the future of library and information service delivery within the 5IR framework. For Nigerian libraries to remain relevant and competitive, deliberate investments in AI infrastructure, policy, and education are crucial. A human-centered approach that integrates technology ethically and inclusively will ensure sustainable transformation in library services.The role of librarians is evolving to meet the demands of a digitized, AI-enhanced environment. To function properly in this clime, librarians must:

1. acquire skills in data science, digital curation, programming, and AI literacy (Ugwulebo & Okoro, 2023), and also understand the fact that,
2. embracing AI does not diminish the librarian's role; instead, it redefines it as a technology integrator, data analyst, and ethical steward.

Conclusion

AI holds significant promise for transforming library operations in Nigeria. While progress is visible in some academic institutions, broader adoption requires investment in infrastructure, training, and ethical frameworks. A human-centered approach aligned with the principles of the 5th Industrial Revolution could help Nigerian libraries transition effectively into the AI era.

Methodology

The research design adopted for the study is qualitative research method. Mixed-methods approach using a combination of literature review on global AI trends in libraries and semi structured interview of some librarians in Nigeria were used to carry out this study. Apart from reviewing relevant literature, 25 librarians regardless of the type of library they work were sampled for the study using simple random sampling technique. Interview questions were posted via WhatsApp platform to the participants and their answers were recorded using voice notes. Data was analyzed using content analysis of the audio recordings and document study of existing literature on the subject matter. Results are presented in a synthesized format.

Research Objective 1

Determining the level of preparedness of Nigerian libraries in embracing AI technologies in service delivery and operations

To determine the level of preparedness of Nigerian libraries towards embracing Artificial Intelligence technologies, the end users (librarians and library managers) were asked of their awareness of the existing AI technologies used for library operations and services. Majority of the participants 24 (96%) answered in the affirmative. This is in agreement with Edewor, Emeka, and Aregbesola (2021). They were further interrogated on whether their libraries have adopted any of AI technologies for their operations and services. Another 92% (23) also affirmed their libraries adoption of AI for some operations and services though still at their early stages. This is in tandem with existing literature (Oyeleye & Oyelude, 2021**; Eze and Eze 2021; Iwhiwhu and Eyekpimi 2020**) which stipulate that Nigerian librarians are aware of AI technologies and the various library operations they are used for.

Research Objective 2

Determining the various services and operations that AI is used for in those libraries?

Ninety-two percent (23) of participants affirmed that various AI technologies are being used to deploy library operations and services though at varying degrees. Technologies such as ChatGPT, Grammarly, Perplexity, Scite, Microsoft pilot, ChatPDF, Cobot, Canva and Chatbot are being adopted in Nigerian libraries though at varying degrees. Library operations such as classification, cataloguing, indexing and abstracting are made easy using ChatGPT. Peplexity is handy in answering users' reference questions and factual inquiries. Grammarly provides assistance to researchers by identifying and suggesting correction for grammar, spelling, punctuations and style. A few of the respondents 12 (48%) attested that they teach their researchers on how to use Grammarly in their research work. ChatGPT and ChatPDF also assist researchers in their work and some of the librarians refer their patrons to these. Only 5(20%) affirmed that their libraries use Canva to design for marketing of library services. This is very insignificant as libraries need to market their resources and services in other to attract users.

Some also claimed they use Scite to assist researchers in getting scientific literature and citations for their work. The duo of Cobot and Chatbot are also used to assist library patrons. These are in agreement with **Ogunniyi and Oladele (2022); Agboola and Adebayo (2021);** Olatunji and Salami (2020). Owing to the ongoing, it is obvious that Nigerian libraries are gradually embracing AI technologies in their operations and service delivery, but, it can be better.

Research Objective 3

Determining the impacts of AI technologies on service delivery and library patronage

To address this research objective, 3 questions were posed to the participants. These include: stating the significant contribution of AI technologies to ease and efficiency of library operations and service delivery thereby reducing library staff workload; encouraging library patronage; and enhancing library comfort of patrons. 20 (80%) affirmed that AI technologies actually engender ease and efficiency of library operations and service delivery. Another 22 (88%) attested that adoption of AI technologies has brought about increase in library patronage. This findings support **Adeyemi and Yusuf (2021) study which** claimed that AI tools, particularly intelligent retrieval systems and virtual assistants, have improved information accessibility, resulting in increased user satisfaction; and **Nwosu and Onuoha (2020)**, which established that AI tools provide real-time responses and suggest resources based on users' previous searches, thereby boosting patronage and satisfaction. According to the ongoing study, while AI cannot replace human librarians, it can certainly augment their work.

However, less than half 40% (10) of respondents affirmed enhanced library comfort as part of the impacts of AI adoption in libraries. This is below average and it implies that though library patronage is increased and there is ease of access to library resources as a result of the adoption of AI technologies, these has no bearing with patrons' comfort in Nigerian libraries. Issues bordering on lack of conducive environment may have a role to play in this.

Research Objective 4

Ascertaining the challenges facing libraries in adopting AI technologies

Questions bothering on challenges facing the full adoption of AI technologies in Nigerian libraries were raised with the participants. These include: the percentage of library services and operations aided by AI as well as number of staff members assigned to manage AI related tasks in their libraries. The findings indicated the value of 7.5% only for the two variables. This is worrisome that at this time and age when the world is warming up for the 5th industrial revolution, many libraries in Nigeria are yet to fully embrace digital technology. Some of the reasons advanced by respondents include lack of exposure and technical know-how of library professionals and users, lack of required infrastructures such as internet connectivity, increased bandwidth to accommodate the new services, inadequate budgetary allocation to libraries, and lack of management support. This is in consonance with Akinola & Olayemi (2023).These challenges are enormous and require urgent action.

Research Objective 5

Identifying the potential solutions for effective implementation of AI technologies in Nigerian Libraries

Interestingly, almost all respondents (24 - 96%) indicated that library professionals are receptive to AI technologies. This is a plus and an indication that given adequate infrastructure and opportunity for capacity building in digital technology, Nigerian library professionals will up their games. They will not only be

prepared but will also be relevant in the 5th industrial revolution. To achieve this feat, respondents suggested the following:

i. Support from stakeholders
ii. Training and retraining of library professionals
iii. Increased budgetary allocation for libraries
iv. Provision of alternative power supply such as solar energy in the library to ensure uninterrupted power supply.

This findings support Odigie (2024); Ibrahim and Okpala (2024); Oyeleye and Oyelude (2021). The study also affirmed that though AI technologies have come to stay, it cannot replace human efforts. The case in Nigerian libraries for now is that while the young ones (under 35 years old) prefer the use of AI for sourcing information and carrying out research, those who are 40 years and above prefer to hold their resources in their hands, thereby preferring the physical materials. Also, because AI is a manipulated machine, it is not error free. Therefore, it cannot be totally relied upon. Librarians still need to edit whatever operations and services are performed using AI technologies. This finding supports Zou & Schiebinger (2018) study which affirms that AI lacks human judgment, and may misinterpret nuanced or ambiguous information.

Discussion

Artificial Intelligence no doubt has come to say. Globally, libraries are deploying AI across virtually every service This study focused on Artificial Intelligence and the future of library and information service delivery in the 5IR in Nigeria. Five objectives guided the study. Mixed methods approach was employed in gathering data. This involved the use of literature review and structured interview of selected librarians in Southwest Nigerian. Since the study is qualitative in nature, 25 librarians were selected as sample in addition to the in-depth review of relevant literature on the topic. From the ongoing, it is obvious that Librarians in Nigeria are aware of existing AI technologies deplorable in libraries. Not just that, some of them have also been adopted which implies that Nigerian librarians are prepared for the 5IR. However, the rate of adoption calls for concern because while the use of AI for some operations and services are still at their early stages, some are yet to start. Also, it seems most of Nigerian libraries that have adopted AI so far are the academic libraries.

There's need for other types of libraries in Nigeria to embrace AI. Operations and services being deployed through AI as established in the study include cataloguing and classification, indexing and abstracting, reference service, research assistance, marketing of library services, scientific literature search, and so on. The study established that AI technologies actually engender ease and efficiency of library operations and service delivery. It has also brought about increase in library patronage. However, issues bothering on users' comfort in the library as a result of AI adoption are still a far cry. This may be linked to lack of conducive environment. This area could be considered by future research.

Despite the various benefits associated with the use of AI in library operations, there are challenges. Many libraries in Nigeria are yet to fully embrace AI technologies due to the following: lack of exposure and technical know-how of library professionals and users, lack of required infrastructures such as internet connectivity, increased bandwidth to accommodate the new services, inadequate budgetary allocation to libraries, and lack of management support. To overcome these challenges, training and retraining of library professionals, increased budgetary allocation for libraries are some of the suggestions proposed in the study.

Conclusion

The 5IR is around the corner. AI is at the center of it. Libraries worldwide are getting set to embrace it and Nigerian libraries cannot stay aloof if they must be relevant. This study has established that Librarians in Nigeria are not only aware of existing AI technologies deplorable in the library but have also adopted some. It has impacted library operations in the area of improved access, efficiency and remote login to mention a few. Despite these benefits, literature consistently highlights limitations such as poor funding, low technical capacity, and infrastructural challenges, which hinder full-scale adoption. This stance is also supported by the findings of this study. These prevalent challenges if not addressed are capable of undermining seamless integration into the 5IR.

Recommendations

In view of the findings, the study proposes the following recommendations:

1. Policy on ethical concerns in the area of data privacy, user consent, and algorithmic bias,
2. Support from stakeholders such as government and institutions,
3. Increased budgetary allocation for libraries to acquire AI infrastructures,
4. Training and retraining of librarians, and
5. Public private partnership with well-meaning individuals to support library needs.

Since the study averred that majority of library professionals in Nigeria are receptive to AI, it is believed that given the right atmosphere with the necessary provisions, Nigerian libraries will transit to the 5IR with less or no struggles.

References

Aina, L. O. (2022). Information policy development for libraries in Africa: Prospects and challenges. *Nigerian Libraries, 55*(2), 23–34.

Adeyemi, A., Bello, O., and Yusuf, T. (2021). AI and HCI: Challenges and future directions. *Nigerian Journal of Computer Science,* 19 (3), pp 78-79

Adigun, G. O., Ajani, Y. A., & Enakrire, R. T. (2024). *The intelligent libraries: Innovation for a sustainable knowledge system in the Fifth (5th) Industrial Revolution*. Libri, 74(3), 211–223. https://doi.org/10.1515/libri-2023-0111

Akinola, O. A., & Olayemi, O. O. (2023). Exploring the readiness of Nigerian academic libraries for artificial intelligence integration. *Library Philosophy and Practice (e-journal)*, 7456.

Akinyemi, O. E. (2024). *Enhancing academic library service delivery using artificial intelligence (AI)*. Library Philosophy and Practice (e-journal).

Alves, J., Lima, T. M., & Gaspar, P. D. (2023). *Is Industry 5.0 a human-centred approach? A systematic review*. Processes, 11(1), 193. https://doi.org/10.3390/pr11010193

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. W. W. Norton & Company

Castells, M. (1996). *The rise of the network society*. Blackwell.

Edewor, N., Emeka, O., & Aregbesola, A. (2021). Awareness and application of artificial intelligence by librarians in university libraries in Nigeria. *Library Progress (International), 41*(2), 251–259.

Ekwueme, L. O., Oluwaseun, B. O., Ajie, I. A., Ofodu, P. N., & Ambrose, S. E. (2024). *The impact of 5th Industrial Revolution technologies on academic libraries: Improving diversity and inclusive services in open and distance learning*. Indonesian Journal of Library and Information Science, 5(2). https://doi.org/10.22373/ijlis.v5i2.6048

Enis, M. (2024, January 8). *Next gen AI: Libraries work with ChatGPT and other emerging AI tools*. Library Journal.

Eze, B. U., & Eze, J. U. (2022). Artificial intelligence in Nigerian university libraries: Prospects and challenges in the post-COVID era. *African Journal of Library, Archives & Information Science, 32*(1), 45–58.

Faggella, D. (2020). *Artificial intelligence in libraries – Applications and trends*. Emerj Artificial Intelligence Research. https://emerj.com

Freeman, C. (1987). *Technology policy and economic performance: Lessons from Japan*. Pinter.

Hobsbawm, E. J. (1968). *Industry and empire: From 1750 to the present day*. Penguin.

Hughes, T. P. (1983). *Networks of power: Electrification in Western society, 1880–1930*. Johns Hopkins University Press.

Ibrahim, H., & Okpala, A. E. (2024). Exploring the Integration of Artificial Intelligence in Nigeria Library Services. *International Journal of Knowledge Dissemination (IJKD)*, *5*(1), 55–65. Retrieved from https://ijkd.uniabuja.edu.ng/index.php/ijkd/article/view/98

Ifijeh, G., & Yusuf, F. (2020). Impact of artificial intelligence on library and information science education in Nigeria. *Library Philosophy and Practice*, 1–10.

Jain, P., & Kataria, S. (2019). Artificial intelligence and libraries: A powerful combination. *Library Hi Tech News, 36*(5), 10–14.

Kelly, E. (2020). The 5th Industrial Revolution: Merging human creativity with artificial intelligence. *Forbes*. https://forbes.com

Kurzweil, R. (2005). The singularity is near: When humans transcend biology. Viking.

Mokyr, J. (1990). *The lever of riches: Technological creativity and economic progress*. Oxford University Press.

Motsamai, G. (2024, March 16). *AI library assistant robot enhances student experience*. NWU News.

Odigie , I. O. (2024). Exploring the awareness, use and challenges facing the integration of artificial intelligence in library services by librarians in university libraries in North-Central, Nigeria. *Communicate: Journal of Library and Information Science*, *26*(1), 222–229. Retrieved from https://www.cjolis.org/index.php/cjolis/article/view/90

Ogunsola, L. A., & Aboyade, M. A. (2022). Preparing academic libraries in Nigeria for artificial intelligence. *African Journal of Library, Archives and Information Science, 32*(1), 45–56.

Omame, I and Alex-Nmecha, J. (2020). Arificial intelligence in libraries. DOI: 10.4018/978-1-7998-1116-9.ch008. https://www.irma-international.org/chapter/artificial-intelligence-in-libraries/245111/

Oyeleye, A. A., & Oyelude, A. A. (2021). Readiness of Nigerian university libraries for artificial intelligence integration. *Library Philosophy and Practice*, 1–15

Panda, S., Sharma, V., Sati, P. P., & Kaur, N. (2024). *Ensuring ethical intelligence: Guiding the integration of AI in modern libraries*. SSRN. https://doi.org/10.2139/ssrn.4980190

Perez, C. (2002). *Technological revolutions and financial capital: The dynamics of bubbles and golden ages*. Edward Elgar.

Pierce, D. (2025, March 26). *AI: Helping librarians work smarter, not harder*. Library Journal.

Rodríguez, C. A., & Lozano, J. F. (2020). Chatbots in academic libraries: User perceptions and implementation challenges. *Journal of Academic Librarianship, 46*(5), 102167.

https://doi.org/10.1016/j.acalib.2020.102167
Rogers, E. M. (1962). *Diffusion of innovations*. Free Press
Schumpeter, J. A. (1939). *Business cycles: A theoretical, historical, and statistical analysis of the capitalist process*. McGraw-Hill.
Schwab, K. (2016). *The fourth industrial revolution*. World Economic Forum.
Subaveerapandiyan, A. (2023). *Application of artificial intelligence (AI) in libraries and its impact on Library operations: A review*. Library Philosophy and Practice, 7828.
Tegmark, M. (2017). Life 3.0: Being human in the age of artificial intelligence. Knopf.
Togia, A., & Malliari, A. (2021). Chatbots in academic libraries: Current practices and future directions. *The Journal of Academic Librarianship, 47*(5), 102371.
Ugwulebo, C. E., & Okoro, C. I. (2023). Re-skilling librarians for artificial intelligence adoption in Nigerian libraries. *International Journal of Information Science and Management, 21*(1), 13–24.
Xu, M., David, J. M., & Kim, S. H. (2018). The Fourth Industrial Revolution: Opportunities and challenges. *International Journal of Financial Research, 9*(2), 90–95.
Zhang, Q., & Wang, Y. (2021). Ethical considerations in using AI in library services. *Library Management, 42*(4/5), 270–284.
Zou, J. Y., & Schiebinger, L. (2018). AI can be sexist and racist — It's time to make it fair. *Nature, 559*(7714), 324–326. https://doi.org/10.1038/d41586-018-05707-8

Artificial Intelligence Competency and Ethical Considerations: Strategies for Sustainable Adoption Among Librarians in Nigeria

Yusuf Ayodeji **AJANI**
Department of Library and Information Science,
University of Abuja, Federal Capital Territory, Nigeria
trustusouph@gmail.com

Lawal **Umar**, PhD
Department of Library and Information Science
Umaru Musa Yar'adua University Katsina
lawal.umar@umyu.edu.ng
&
Adeyinka **Tella**
Department of Library and Information Science,
University of Ilorin in Nigeria & University of South Africa, Pretoria
tellayinkaedu@yahoo.com

Abstract

The emergence of the Fifth Industrial Revolution (5IR) emphasise the need for ethical, human-centric technological integration in knowledge institutions. As a result, this study investigates the competencies, usage patterns, ethical concerns, and contextual challenges influencing the sustainable adoption of Artificial Intelligence (AI) tools among librarians in Nigeria. Grounded in the Technology-Organization-Environment (TOE) framework and guided by AI ethics principles transparency, accountability, and fairness the study employed a mixed-methods descriptive research design. Using a snowball sampling technique, data were gathered from 1,244 librarians across Nigeria via a semi-structured online survey distributed through professional social media platforms (WhatsApp and Facebook). The survey combined closed-ended items and open-ended prompts to capture both quantitative and qualitative insights. Quantitative data were analyzed using descriptive statistics (means, frequencies, and percentages), while qualitative responses were subjected to narrative analysis. Findings reveal that librarians predominantly use language tools such as Grammarly and Quillbot, yet demonstrate lower competence and adoption of complex tools like speech-to-text and literature analysis applications. Ethical concerns ranging from data privacy to cultural insensitivity were prevalent, along with structural barriers including poor infrastructure, lack of policies, and limited training opportunities. In conclusion, the need for comprehensive strategies to promote sustainable AI adoption remain a gap. Therefore, the study proposes a holistic strategy for sustainable AI adoption encompassing institutional policy, inclusive training, infrastructural equity, ethical education, and the localization of AI tools. These measures are vital for aligning librarianship in Nigeria with global 5IR trends while remaining responsive to local realities.

Keywords: Artificial Intelligence, Librarianship, 5IR, AI Ethics, Competency, Nigeria, TOE Framework, Methodology, Sustainable Adoption

Introduction

The emergence of the Fifth Industrial Revolution (5IR) signifies a pivotal shift in the global innovation landscape, characterized by the purposeful convergence of Artificial Intelligence (AI) and human creativity to foster ethical, inclusive, and sustainable outcomes (George & Wooden, 2023). In the context of higher education, AI tools is increasingly recognized as a transformative force, with the capacity to revolutionize research, enhance academic service delivery, and streamline administrative workflows. Librarians, as key facilitators of knowledge access and research support, are increasingly adopting AI tools to optimize operations and contribute to scholarly productivity. Across the globe, academic institutions are demonstrating leadership in AI integration. Stanford University's Artificial Intelligence Laboratory (SAIL) supports interdisciplinary research across education and science (Lu, 2025), while the University of Cambridge's Centre for Human-Inspired Artificial Intelligence focuses on the ethical application of AI in academic environments (Centre for Human-Inspired Artificial Intelligence, 2025).

Similarly, Tsinghua University in China incorporates AI into STEM instruction and strategic planning, and the Massachusetts Institute of Technology (MIT) established the Schwarzman College of Computing to facilitate AI-driven innovation across disciplines (MIT, 2018; Tsinghua University, 2025). African institutions are also advancing in this domain. The University of Johannesburg, through its Institute for Intelligent Systems, offers specialized AI-focused programs, while the University of Pretoria integrates AI ethics into its digital humanities curricula (Bosworth, 2024; University of Pretoria, 2024). At Carnegie Mellon University Africa, training in AI tools prepares professionals for academic and industrial deployment (Carnegie Mellon University Africa, n.d.). These initiatives reflect growing global and continental recognition of AI's strategic value in higher education. In academic libraries, AI is increasingly deployed to support literature discovery (e.g., Semantic Scholar, Elicit), automate citation and referencing

(e.g., EndNote, Zotero), detect plagiarism (e.g., Turnitin), and aid research writing and presentation through tools like Scite Assistant and ChatGPT (Fu & Weng, 2024).

AI chatbots and cataloguing systems, such as OCLC WorldShare, are also being used to enhance service delivery and user engagement (Kubanek & Szymoniak, 2024). However, in Nigeria, the effective and widespread adoption of AI tools among librarians remains limited. While some librarians have begun to engage with AI tools to support research, manage institutional repositories, and assist with academic presentations, several barriers persist. These include infrastructural deficits, inconsistent access to technology, outdated professional training, and insufficient exposure to the ethical dimensions of AI use (Pedro et al., 2019; Ofem & Chukwujama, 2024). Furthermore, many librarians lack the foundational AI competencies necessary to fully harness these tools in ways that align with global standards and local needs. Compounding these issues is the absence of a national strategy or institutional framework to guide the ethical integration of AI in academic environments. As AI tools become increasingly embedded in research workflows and library services, unregulated adoption risks exposing institutions to ethical pitfalls such as data misuse, algorithmic bias, and reduced transparency in decision-making (Kubanek & Szymoniak, 2024).

Without structured guidance, librarians may remain underprepared to use AI tools responsibly and effectively. This study is therefore timely and necessary. It seeks to assess the current level of AI competency among librarians in Nigeria and examine the ethical considerations influencing AI adoption in information services. The goal is to develop a context-relevant, ethically grounded strategy for the sustainable integration of AI tools among librarians in the era of the 5IR. Such a strategies is essential to ensure that librarians are not only technically equipped to deploy AI tools, but also guided by ethical principles that safeguard academic integrity, protect user data, and promote equitable access to knowledge. In doing so, this study aims to support Nigeria's higher education sector in aligning with global digital transformation trends while remaining responsive to local institutional realities.

Objectives of the Study

The main objective of this study is to develop a strategic framework for the sustainable and ethically responsible adoption of AI tools among librarians in Nigeria. While the specific objectives are to:

1. Identify the types of AI tools mostly adopted by librarians
2. examine the extent to which librarians currently utilize AI tools.
3. assess the level of AI competency possessed by librarians
4. explore the ethical considerations guiding AI adoption among librarians.
5. identify the factors influencing the usage of AI tools by librarians.
6. propose a strategy for the sustainable usage of AI tools by librarians.

Literature Review

In recent years, the integration of AI into academic environments has rapidly advanced, transforming teaching, research, and information service delivery. As AI tools become increasingly prevalent, academic librarians key actors in knowledge facilitation are compelled to develop competencies that align with these technological advancements. Sequel to the above elucidation, Ajani et al. (2022) opined that the successful adoption of AI in academic libraries is deeply dependent on the competencies of library professionals. AI competency refers to the knowledge, skills, and attitudes required to effectively use and adapt to AI-based technologies in professional practice. Recent global literature highlights that academic librarians are increasingly expected to possess not only digital literacy but also advanced AI-specific skills. For instance, Okuonghae and Tunmibi (2024), applying the DIGCOMP framework, found that librarians in Edo and Delta States demonstrated commendable digital competence in areas such as information literacy, content creation, and communication. However, the study noted that digital skills alone were not sufficient; perceived usefulness and ease of use of AI tools were stronger predictors of actual adoption.

In the Nigerian context, competency levels remain inconsistent. Ibrahim's (2024) national survey of art faculty indicated that a significant proportion of academics, including librarians, had low to moderate familiarity with AI. This gap suggests the need for targeted capacity-building efforts, especially as AI tools grow more complex and diverse. Al-Zahrani's (2024) findings from Saudi Arabia provide a useful comparative lens: educators with higher AI proficiency experienced fewer difficulties and demonstrated greater confidence in integrating AI. These findings imply that without structured training and support systems, librarians in Nigeria may struggle to keep pace with AI's evolving demands. AI tools are increasingly embedded in academic workflows, particularly for tasks related to research, presentation, and service delivery. The literature highlights a growing range of generative AI applications, including ChatGPT, Grammarly, Zotero, and Copilot, that support writing, data analysis, and content generation (Dwivedi et al., 2023; Lund et al., 2023). Empirical evidence from EDUCAUSE (2023) shows that humanities and social science scholars frequently use generative AI for writing and editing, while STEM fields rely on more technical tools such as MATLAB and Python-based libraries.

In a quantitative study, Abdulah et al. (2024) reported that 70.68% of respondents actively used ChatGPT, while others employed tools like QuillBot and Grammarly for paraphrasing and grammar correction. These statistics affirm that writing assistance remains one of the most prominent AI functions in academia. Despite

high levels of awareness, however, utilisation patterns vary. Bakiri, Mbembati, and Tinabo (2024) found that although 68.3% of Tanzanian librarians were aware of AI technologies, only 23% had integrated them into their daily activities. In Nigeria, adoption rates remain modest. Ibrahim (2024) found that less than one-third of academic staff had incorporated AI into their teaching or research. Infrastructure issues, such as poor internet connectivity and erratic power supply, were key barriers. Coetzee's (2025) study further revealed that the frequency of AI use depended largely on institutional policies and individual perceptions of AI's relevance to discipline-specific tasks. These findings suggest that while the availability of AI tools is increasing, their consistent and meaningful integration into library workflows is still emerging.

The ethical dimension of AI use in academia is gaining increasing attention. As AI becomes more embedded in scholarly practices, concerns around privacy, intellectual property, algorithmic bias, and academic integrity are becoming more pronounced. Salman et al. (2024) found that while many researchers were enthusiastic about using generative AI, 58.96% expressed ethical concerns that could deter further adoption. In response to these issues, Zlotnikova et al. (2025) proposed a six-phase ethical roadmap for AI implementation in higher education. This includes raising awareness, establishing institutional policies, integrating AI into curricula, building infrastructure, monitoring implementation, and fostering collaboration among stakeholders. This roadmap highlights the importance of viewing ethical integration as a structured, ongoing process. From a governance perspective, Tarisayi (2024) argued that ethical AI use must be guided by strategic leadership and strong institutional frameworks. He emphasised the need to balance the opportunities AI offers such as personalised learning and predictive analytics with the risks of misuse or unintended consequences. In Nigeria, Ibrahim (2024) reported that many academics feared AI might compromise critical thinking and originality in student work, underscoring the urgency of formal ethical guidelines in higher education.

The integration of AI in academic libraries is shaped by a range of interrelated factors. Organisational support, access to infrastructure, leadership engagement, and training opportunities are some of the most frequently cited influences. Baig and Yadegaridehkordi (2025) identified ease of use, ethical clarity, and institutional backing as key determinants of long-term engagement with AI tools among university staff. Within the Nigerian context, infrastructural limitations remain a primary barrier. Ibrahim's (2024) study documented that librarians were often constrained by unreliable electricity, inconsistent internet access, and limited training resources. Participants also highlighted the inadequacy of current AI tools in capturing cultural and linguistic nuances, especially within humanities disciplines. Age and experience further mediate AI adoption. Older academic staff especially those aged 51 and above were less likely to engage with AI unless supported by specific professional development interventions (Ibrahim, 2024). These findings echo global trends and reinforce the need for inclusive, context-sensitive strategies that address both structural and personal barriers to AI integration.

The 5IR represents a shift towards human-centric technological development, placing ethics, inclusivity, and sustainability at the forefront of innovation. As such, AI integration in academic libraries must go beyond functional adoption to include value-driven design and use. Zlotnikova et al.'s (2025) ethical roadmap, along with Tarisayi's (2024) governance-focused model, offers valuable insights into the type of leadership and institutional alignment needed to support sustainable AI practices. Sanusi et al. (2022) also provide a foundation through their competency-based framework, which emphasises ethical reasoning, self-directed learning, and adaptability skills that align well with 5IR principles. These contributions point toward the need for a holistic framework that integrates technological proficiency, ethical literacy, and organisational readiness. Such a model would enable academic librarians in Nigeria to not only adopt AI but do so in a manner that is culturally aware, ethically grounded, and pedagogically effective. This study, therefore, builds upon existing literature to propose a context-sensitive, ethically guided framework for AI integration in academic libraries during the 5IR.

Literature Gap

The reviewed literature establish a growing body of knowledge concerning AI's transformative role in academic contexts. However, significant gaps remain in understanding how librarians in developing countries, particularly Nigeria, are navigating these changes. While international studies offer useful insights into competency levels, ethical considerations, and usage patterns, there is a need for more region-specific data to inform policy and practice. Furthermore, few studies provide integrated models that combine ethical governance with technical readiness and institutional support. This study seeks to fill these gaps by proposing a comprehensive framework for the sustainable and ethically sound adoption of AI in Nigerian libraries.

Theoretical Framework

Technology-Organisation-Environment (TOE) Framework

This study is grounded in the Technology-Organisation-Environment (TOE) Framework, originally developed by Tornatzky and Fleischer (1990) (Baker, 2012). The framework offers a general understanding of how institutions adopt and integrate new technologies by examining three interconnected dimensions: technology, organisation, and environment. It serves as a suitable lens for exploring the sustainable and ethically responsible integration of AI into academic librarianship particularly within the dynamic context of the 5IR. The technological context focuses on the characteristics of AI tools, including their perceived

usefulness, complexity, and compatibility with existing systems. For librarians, this relates to their ability to work with AI-powered applications such as Turnitin for plagiarism detection, ChatGPT for information curation and content generation, Zotero for automated referencing, and machine learning tools for cataloguing and metadata enhancement. These technologies are increasingly being used to support research activities, scholarly presentations, and core library operations. However, successful adoption depends on the librarians' technical competence and confidence in navigating these tools. This study considers how librarians in Nigerian libraries engage with such technologies, and how their level of competence shapes their readiness to adopt AI. The organisational context encompasses internal factors such as institutional support, digital infrastructure, access to training, leadership vision, and policy alignment. Many Nigerian libraries continue to face barriers including outdated curricula, limited investment in staff development, and inadequate administrative commitment to digital transformation. These organisational limitations can hinder the ability of librarians to innovate with AI. Through the TOE framework, this study investigates how internal dynamics such as resource availability, decision-making processes, and institutional culture impact the integration of AI within library settings. The environmental context involves external forces that influence institutional adoption, such as national policies, regulatory standards, technological trends, and ethical considerations. With the increasing emphasis on human-centred AI in the 5IR, there is a strong need for ethical awareness around data privacy, algorithmic transparency, intellectual property, and fairness. As academic librarians navigate these emerging technologies, they are also required to uphold professional and societal values. The TOE framework allows for an exploration of how librarians in Nigeria respond to these external pressures and ethical demands, and how this shapes their approach to AI adoption. TOE framework is well-positioned to develop a practical, context-sensitive model that supports the competent, ethical, and sustainable integration of AI among librarians. It also helps to illuminate the interconnectedness of technological capability, institutional preparedness, and ethical responsibility key elements that underpin AI adoption in academic environments, particularly within the evolving landscape of the 5IR.

Conceptual Framework



The conceptual framework for this study is anchored in the Technology-Organization-Environment (TOE) Framework and enriched by principles from AI Ethics Guidelines such as transparency, accountability, and fairness. The framework recognizes that sustainable AI adoption in librarianship is influenced by three interrelated dimensions:

1. Technological Context: includes AI competency, tool availability, and perceived usefulness of AI in information workflows (e.g., research support, presentation tools, catalogue automation).
2. Organizational Context: encompasses institutional readiness, strategic alignment, administrative support for librarians.
3. Ethical and Environmental Context: involves awareness of ethical risks, adherence to data protection protocols and algorithmic accountability of AI use.

This integrated framework supports a systematic approach to AI adoption that aligns with global standards while addressing local needs and constraints.

Methodology

This study employed a mixed-methods approach using a descriptive research design. Be that as it may, The Nigeria Library Association (NLA) formed the core of the study population of approximately 5,900 librarians spread across the country (Librarian Registration Council of Nigeria (LRCN), directory, 2024). Unfortunately, NLA does not have a holistic platform that accommodates its whole members. So, to ensure national adequate responses and representation of participants in the study, a snowball sampling technique was employed to target NLA social media platforms such as WhatsApp and Facebook to reach the participants across the nation, this process was aided by targeting various NLA Whatsapp Admin belonging to each state across the country, Federal Capital Territory inclusive. Data were collected through a semi-

structured online survey developed using Google Forms. The survey was designed to address the study's six objectives, combining both closed and open-ended questions to gather quantitative and qualitative insights. The survey distribution and monitoring was active for 16 weeks, running from November 31st 2024 to March 2nd, 2025 and yielded a total response of 1,244 participants. Before full deployment, the instrument underwent a rigorous validation process. A panel of three experts in AI, educational technology, and Librarianship reviewed the survey for relevance and clarity. A pilot test involving 30 librarians to refine the instrument and ensure reliability. Using an embedded design for analysis of data. Independently, the analysis combined both quantitative and qualitative methods to offer a comprehensive view of the findings. Descriptive statistics including frequency counts, percentages, and mean scores were used to summarize patterns in AI adoption. Open-ended responses were analyzed narratively, helping to uncover underlying perspectives and ethical concerns while generating practical suggestions for adoption. In line with standard research protocols, ethical approval was obtained from NLA Whatsapp Administrators before data collection commenced. Before the commencement of the survey distribution, participants were initially and fully informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time without penalty. To ensure privacy and build trust, all responses were anonymized and treated with strict confidentiality. Informed consent was obtained electronically before participants began the survey.

Results of analysis

1. Types of AI Tools Adopted by Librarians

Table 1: Types of AI tools adopted by librarians (N = 1,244)

Category	SA	A	D	SD	$\bar{x}$	RANK
General-Purpose Conversational AI						
ChatGPT	597 (48%)	398 (32%)	149 (12%)	100 (8%)	3.20	1st
Claude	224 (18%)	299 (24%)	423 (34%)	299 (24%)	2.36	3rd
Microsoft Copilot	274 (22%)	361 (29%)	348 (28%)	261 (21%)	2.52	2nd
Gemini (Google)	174 (14%)	249 (20%)	448 (36%)	373 (30%)	2.18	4th
Deepseek	75 (6%)	174 (14%)	522 (42%)	473 (38%)	1.88	5th
Weighted mean: 2.43			**Criterion mean: 2.50**			
Plagiarism Detection AI						
Turnitin	647 (52%)	373 (30%)	124 (10%)	100 (8%)	3.26	1st
PlagScan	348 (28%)	423 (34%)	299 (24%)	174 (14%)	2.76	2nd
Unicheck	249 (20%)	361 (29%)	348 (28%)	286 (23%)	2.46	3rd
Copyleaks	174 (14%)	299 (24%)	448 (36%)	323 (26%)	2.26	4th
Originality	149 (12%)	274 (22%)	423 (34%)	398 (32%)	2.14	5th
Weighted mean: 2.58			**Criterion mean: 2.50**			
Literature Analysis AI						
Elicit	299 (24%)	373 (30%)	348 (28%)	224 (18%)	2.6	2nd
Consensus.app	224 (18%)	323 (26%)	398 (32%)	299 (24%)	2.38	3rd
Scite	199 (16%)	348 (28%)	373 (30%)	323 (26%)	2.34	4th
ExplainPaper	149 (12%)	274 (22%)	448 (36%)	373 (30%)	2.16	5th
Perplexity	323 (26%)	423 (34%)	274 (22%)	224 (18%)	2.68	1st
Weighted mean: 2.43			**Criterion mean: 2.50**			
Language Tools						
Grammarly	771 (62%)	299 (24%)	124 (10%)	50 (4%)	3.44	1st
Quillbot	597 (48%)	398 (32%)	174 (14%)	75 (6%)	3.22	2nd
Jenni	274 (22%)	323 (26%)	348 (28%)	299 (24%)	2.46	3rd
Wordtune	224 (18%)	299 (24%)	398 (32%)	323 (26%)	2.34	4th
Scribbr	174 (14%)	249 (20%)	448 (36%)	373 (30%)	2.18	5th
Weighted mean: 2.73			**Criterion mean: 2.50**			
Reference Management Tools						
Zotero	448 (36%)	373 (30%)	249 (20%)	174 (14%)	2.88	2nd
Mendeley	498 (40%)	398 (32%)	224 (18%)	124 (10%)	3.02	1st
EndNote	323 (26%)	348 (28%)	323 (26%)	249 (20%)	2.6	3rd
Citavi	174 (14%)	249 (20%)	423 (34%)	398 (32%)	2.16	4th
BibGuru	149 (12%)	224 (18%)	448 (36%)	423 (34%)	2.08	5th
Weighted mean: 2.55			**Criterion mean: 2.50**			

Creative & Design AI						
Microsoft Copilot for PowerPoint	348 (28%)	423 (34%)	299 (24%)	174 (14%)	2.76	2nd
Gamma	274 (22%)	323 (26%)	373 (30%)	274 (22%)	2.48	3rd
Canva	547 (44%)	373 (30%)	199 (16%)	124 (10%)	3.08	1st
Adobe Firefly	224 (18%)	299 (24%)	423 (34%)	299 (24%)	2.36	5th
SlidesAI	249 (20%)	348 (28%)	373 (30%)	274 (22%)	2.46	4th
Weighted mean: 2.63			**Criterion mean: 2.50**			
Speech-to-Text & Transcription AI						
Otter.ai	299 (24%)	373 (30%)	323 (26%)	249 (20%)	2.58	1st
Whisper (OpenAI)	224 (18%)	323 (26%)	398 (32%)	299 (24%)	2.38	2nd
Rev AI	174 (14%)	274 (22%)	423 (34%)	373 (30%)	2.2	4th
Descript	199 (16%)	299 (24%)	373 (30%)	373 (30%)	2.26	3rd
Sonix	124 (10%)	224 (18%)	448 (36%)	448 (36%)	2.02	5th
Weighted mean: 2.29			**Criterion mean: 2.50**			
Translation tool						
Google Translate	672 (54%)	348 (28%)	124 (10%)	100 (8%)	3.28	1st
DeepL Translator	373 (30%)	423 (34%)	274 (22%)	174 (14%)	2.8	2nd
Wordly AI	149 (12%)	274 (22%)	423 (34%)	398 (32%)	2.14	3rd
OpenL Translate	124 (10%)	249 (20%)	448 (36%)	423 (34%)	2.06	4th
Wordvice AI Translator	100 (8%)	224 (18%)	423 (34%)	498 (40%)	1.94	5th
Weighted mean: 2.44			**Criterion mean: 2.50**			

Table 1 presents an overview of the types of AI tools utilized by librarians in Nigeria. Among the categories analyzed, language tools emerge as the most widely used, with a weighted mean score of 2.73. Grammarly ($\bar{x}$= 3.44) and Quillbot ($\bar{x}$= 3.22) are particularly popular within this category. Following closely behind are Creative & Design AI tools, which have a weighted mean score of 2.63. Conversely, Speech-to-Text & Transcription AI tools exhibit lower overall usage ($\bar{x}$= 2.29). However, Otter.ai stands out within this category, recording a mean score of 2.58. Similarly, within the General-Purpose Conversational AI category, ChatGPT is widely adopted, with a high mean score of 3.20, whereas other tools like Deepseek have significantly lower adoption rates. Generally, language tools, Creative & Design AI, Plagiarism Detection AI, and Reference Management Tools are the most frequently used AI by librarians in Nigeria.

1. Frequency of AI Tools Used by Librarians

Table 2: Frequency of AI tools used by librarians (N = 1,244)

Category	Daily	2-3 days/week	Weekly	Monthly	Never	$\bar{x}$	RANK
General-Purpose Conversational AI							
ChatGPT	498 (40%)	348 (28%)	199 (16%)	124 (10%)	75 (6%)	3.86	1st
Claude	149 (12%)	224 (18%)	274 (22%)	299 (24%)	299 (24%)	2.7	3rd
Microsoft Copilot	224 (18%)	299 (24%)	249 (20%)	274 (22%)	199 (16%)	3.06	2nd
Gemini (Google)	124 (10%)	199 (16%)	249 (20%)	299 (24%)	373 (30%)	2.52	4th
Deepseek	50 (4%)	124 (10%)	224 (18%)	348 (28%)	498 (40%)	2.1	5th
Weighted mean: 2.85				**Criterion mean: 3.00**			
Plagiarism Detection AI							
Turnitin	473 (38%)	373 (30%)	224 (18%)	124 (10%)	50 (4%)	3.88	1st
PlagScan	249 (20%)	348 (28%)	299 (24%)	199 (16%)	149 (12%)	3.28	2nd
Unicheck	174 (14%)	249 (20%)	323 (26%)	299 (24%)	199 (16%)	2.92	3rd
Copyleaks	124 (10%)	199 (16%)	274 (22%)	323 (26%)	323 (26%)	2.58	4th
Originality	100 (8%)	174 (14%)	249 (20%)	348 (28%)	373 (30%)	2.42	5th
Weighted mean: 3.02				**Criterion mean: 3.00**			
Literature Analysis AI							
Elicit	199 (16%)	299 (24%)	323 (26%)	249 (20%)	174 (14%)	3.08	2nd
Cousensus.app	149 (12%)	249 (20%)	299 (24%)	274 (22%)	274 (22%)	2.78	3rd
Scite	124 (10%)	224 (18%)	274 (22%)	323 (26%)	299 (24%)	2.64	4th
ExplainPaper	100 (8%)	174 (14%)	249 (20%)	348 (28%)	373 (30%)	2.42	5th
Perplexity	249 (20%)	323 (26%)	299 (24%)	224 (18%)	149 (12%)	3.24	1st
Weighted mean: 2.83				**Criterion mean: 3.00**			
Language Tools							
Grammarly	647 (52%)	323 (26%)	149 (12%)	75 (6%)	50 (4%)	4.16	1st
Quillbot	498 (40%)	373 (30%)	199 (16%)	100 (8%)	75 (6%)	3.9	2nd
Jenni	249 (20%)	323 (26%)	299 (24%)	224 (18%)	149 (12%)	3.24	3rd
Wordtune	199 (16%)	274 (22%)	323 (26%)	274 (22%)	174 (14%)	3.04	4th
Scribbr	124 (10%)	224 (18%)	249 (20%)	299 (24%)	348 (28%)	2.58	5th
Weighted mean: 3.38				**Criterion mean: 3.00**			

Reference Management Tools							
Zotero	299 (24%)	348 (28%)	323 (26%)	174 (14%)	100 (8%)	3.46	2nd
Mendeley	348 (28%)	373 (30%)	274 (22%)	149 (12%)	100 (8%)	3.58	1st
EndNote	249 (20%)	323 (26%)	299 (24%)	224 (18%)	149 (12%)	3.24	3rd
Citavi	149 (12%)	224 (18%)	249 (20%)	299 (24%)	323 (26%)	2.66	4th
BibGuru	124 (10%)	199 (16%)	274 (22%)	323 (26%)	323 (26%)	2.58	5th
Weighted mean: 3.10 Criterion mean: 3.00							
Creative & Design AI							
Microsoft Copilot for PowerPoint	224 (18%)	299 (24%)	323 (26%)	249 (20%)	149 (12%)	3.16	2nd
Gamma	149 (12%)	249 (20%)	323 (26%)	274 (22%)	249 (20%)	2.82	5th
Canva	448 (36%)	373 (30%)	249 (20%)	100 (8%)	75 (6%)	3.82	1st
Adobe Firefly	174 (14%)	274 (22%)	323 (26%)	249 (20%)	224 (18%)	2.94	4th
SlidesAI	199 (16%)	299 (24%)	299 (24%)	249 (20%)	199 (16%)	3.04	3rd
Weighted mean: 3.16 Criterion mean: 3.00							
Speech-to-Text & Transcription AI							
Otter.ai	249 (20%)	348 (28%)	299 (24%)	199 (16%)	149 (12%)	3.28	1st
Whisper (OpenAI)	199 (16%)	274 (22%)	299 (24%)	249 (20%)	224 (18%)	2.98	2nd
Rev AI	149 (12%)	224 (18%)	274 (22%)	299 (24%)	299 (24%)	2.7	4th
Descript	174 (14%)	249 (20%)	274 (22%)	274 (22%)	274 (22%)	2.82	3rd
Sonix	100 (8%)	174 (14%)	224 (18%)	323 (26%)	423 (34%)	2.36	5th
Weighted mean: 2.83 Criterion mean:3.00							
Translation tool							
Google Translate	572 (46%)	373 (30%)	174 (14%)	75 (6%)	50 (4%)	4.08	1st
DeepL Translator	348 (28%)	423 (34%)	224 (18%)	124 (10%)	124 (10%)	3.6	2nd
Wordly AI	124 (10%)	224 (18%)	274 (22%)	299 (24%)	323 (26%)	2.62	3rd
OpenL Translate	100 (8%)	174 (14%)	249 (20%)	323 (26%)	398 (32%)	2.4	4th
Wordvice AI Translator	75 (6%)	149 (12%)	224 (18%)	348 (28%)	448 (36%)	2.24	5th

Table 2 provides insights into the frequency of AI usage by librarians. The findings reveal that language tools are the most frequently used, with a weighted mean score of 3.38. Within this category, Grammarly stands out as the most frequently used tool, with 52% of participants reporting daily usage. The Creative & Design AI category ranks second in terms of usage frequency, with a weighted mean score of 3.16. Canva ($\bar{x}$= 3.82) is the dominant tool in this group, used daily by 36% of participants. Although the Translation Tools category has a weighted mean score of 2.99, slightly below the threshold of 3.00, it still includes tools that enjoy frequent usage. Notably, Google Translate is used daily by 46% of participants. Similarly, in the General-Purpose Conversational AI category, ChatGPT emerges as the most frequently used tool, with 40% of participants using it daily. These findings highlight the prominence of language-related AI tool librarians in Nigeria.

1. Competence level of AI Tools Used by librarians

Table 3: Competence level of AI use by librarians (N = 1,244)

	Items	SA	A	D	SD	$\bar{x}$	RANK
1	I am proficient in using general-purpose conversational AI tools (e.g., ChatGPT, DeepSeek) for academic writing and data analysis.	356 (28.6%)	488 (39.2%)	273 (21.9%)	127 (10.2%)	3.00	4th
2	I can effectively utilize plagiarism detection tools (e.g., Turnitin, Originality) to identify and address instances of plagiarized content.	421 (33.8%)	523 (42.0%)	206 (16.6%)	94 (7.6%)	3.02	2nd
3	I am capable of using literature analysis AI tools (e.g., Elicit, Scite) for conducting literature reviews and mapping scholarly work.	194 (15.6%)	336 (27.0%)	422 (33.9%)	292 (23.5%)	2.51	7th
4	I can comfortably use language enhancement tools (e.g., Grammarly, QuillBot) for paraphrasing and improving text clarity.	487 (39.2%)	528 (42.4%)	154 (12.4%)	75 (6.0%)	3.15	1st
5	I am skilled in using reference management tools (e.g., Zotero, Mendeley) to organize and manage academic references.	364 (29.3%)	455 (36.6%)	283 (22.7%)	142 (11.4%)	2.91	5th
6	I can apply creative and design AI tools (e.g., Gamma, Canva) to develop professional presentation slides.	338 (27.2%)	409 (32.9%)	315 (25.3%)	182 (14.6%)	2.83	6th
7	I can utilize speech-to-text and transcription tools (e.g., Otter.ai, Whisper) to convert audio recordings into written text.	197 (15.8%)	308 (24.8%)	404 (32.5%)	335 (26.9%)	2.45	8th
8	I can use translation tools (e.g., Google Translate, DeepL) to accurately translate content between languages.	434 (34.9%)	497 (39.9%)	191 (15.4%)	122 (9.8%)	3.01	3rd
Weighted mean: 2.86 Criterion mean: 2.50							

Table 3 highlights the competence level of AI usage librarians in Nigeria. The results indicate a weighted mean score of 2.86, which is slightly above the criterion mean score of 2.50, signifying a moderately high level of AI proficiency among librarians. Librarians demonstrate the highest competence in using language enhancement tools such as Grammarly and QuillBot for paraphrasing and improving text clarity ($\bar{x}$= 3.15). Other areas of proficiency include the effective use of plagiarism detection tools (e.g., Turnitin, Originality) to identify and address instances of plagiarized content ($\bar{x}$= 3.02), as well as the ability to utilize translation tools (e.g., Google Translate, DeepL) for accurate language conversion ($\bar{x}$= 3.01). Additionally, academics show competence in leveraging general-purpose conversational AI tools (e.g., ChatGPT, DeepSeek) for academic writing and data analysis. However, the lowest area of competence among librarian is the ability to use speech-to-text and transcription tools (e.g., Otter.ai, Whisper) for converting audio recordings into written texts.

1. Ethical considerations guiding AI adoption by librarians.

An analysis of responses from 1,244 librarians revealed five dominant ethical concerns influencing the adoption of AI: data privacy, academic integrity, cultural-contextual appropriateness, lack of transparency, and the erosion of critical thinking and professional judgment. Participant quotes are included to reflect real perspectives. A recurring concern among librarians was the risk of data breaches and weak data governance when using AI platforms, especially cloud-based and third-party tools. Many emphasized that, in the absence of clear institutional policies, they felt vulnerable to ethical violations. A Reference Librarian remarked, *"We use AI tools that ask for user data, but our institution has no guidelines on what's acceptable. It's dangerous to work in this kind of vacuum."* Similarly, a Systems Librarian commented, *"Until we know how tools like Grammarly or ChatGPT handle our inputs, we shouldn't be using them for sensitive tasks like student theses or institutional documents."* Another Systems Librarian added, *"Data privacy is not just a legal issue; it's an ethical one. Librarians are supposed to protect user trust, not outsource it to invisible algorithms."* These concerns highlight the urgent need for universities to develop institutional AI ethics policies, particularly around user data protection and tool vetting. Many librarians also raised alarms about the blurred lines between academic assistance and dishonesty, particularly with the growing use of generative AI tools. While acknowledging their usefulness, participants expressed deep concern over students and even faculty relying on AI without ethical guidance. For instance, an Instruction Librarian, stated, *"AI tools like Quillbot are now go-to platforms for students, but are they learning anything? We're seeing over-reliance that borders on plagiarism."* A Senior Librarian, noted, "It's hard to tell who wrote what anymore. If a researcher uses ChatGPT for 40% of their paper, where is the line between support and misrepresentation?" Similarly, a Collection Development Librarian, stressed, *"Academic llbraries should be the first to define what constitutes ethical use. We can't just adopt tools; we must also redefine originality."* Another major concern was the cultural insensitivity and algorithmic bias present in many AI systems developed outside the African context. Librarians pointed out that these tools often failed to recognize local languages, academic structures, and cultural references. A Metadata Librarian, observed, *"When I type Yoruba names into some tools, they get flagged or mispronounced. That's more than a glitch it's a kind of bias."* Likewise, a Faculty Librarian, commented, *"Most AI tools reflect Euro-American academic norms. They don't understand our citation styles, our educational values, or how we structure arguments."* These responses underscore the need for culturally responsive AI tools, ideally developed through partnerships between local developers, academic libraries, and regulatory bodies. A number of participants also raised concerns about the lack of transparency in how AI tools generate responses, store data, or make recommendations. They emphasized the ethical necessity of disclosing AI involvement in academic work, particularly in research and instructional content. A Research Librarian, asked, *"We ask for ethical clearance for human subjects, why not for AI-generated content? Using AI without declaring it is deceptive, especially in academic publishing."* A professor added, *"Faculty members submit papers partly generated with AI, and there's no requirement to state that. It's a form of ghostwriting, ethically speaking."* Similarly, a Reference Librarian, stated, *"Even we librarians use tools like Scite and Elicit to generate summaries. We need to start being open about the role AI plays in our work."* These concerns call for institutions to implement AI usage disclosure standards for teaching, research, and publishing, similar to conflict-of-interest declarations. Finally, a growing concern among participants was the potential decline in critical thinking, evaluative judgment, and research rigour due to over-reliance on AI tools. While AI was recognized as a time-saver, many feared it could inadvertently weaken the academic process. A User Services Librarian, noted, *"When students use AI to summarize or write, they lose the chance to engage deeply with ideas. We're encouraging laziness without meaning to."* An Academic Librarian, warned, *"We are becoming answer consumers rather than problem solvers. AI doesn't teach you how to think, it gives you what to think."* In the same vein, an Assistant Librarian, stated, *"Library work requires judgment what to recommend, what to cite, how to guide. AI can assist, but it cannot replace human discernment."* These sentiments highlight the ethical responsibility of training librarians and users to treat AI as a complement not a substitute for critical intellectual engagement.

2. Factors Influencing the Adoption of AI by Librarians

Table 4: Factors Influencing the Adoption of AI by Librarians (N = 1,244)

	Factor	SA (%)	A (%)	D (%)	SD (%)	$\bar{x}$	Rank
1	Absence of institutional AI policies or usage guidelines	433 (34.8%)	412 (33.1%)	246 (19.8%)	153 (12.3%)	2.91	4th
2	Inadequate digital skills to use AI tools effectively	311 (25.0%)	392 (31.5%)	348 (28.0%)	193 (15.5%)	2.66	1st
3	Low trust in the accuracy/reliability of AI-generated outputs	276 (22.2%)	398 (32.0%)	342 (27.5%)	228 (18.3%)	2.58	10th
4	Limited institutional funding/support for AI tools and training	479 (38.5%)	413 (33.2%)	215 (17.3%)	137 (11.0%)	2.99	2nd
5	Lack of awareness of AI tools relevant to academic work	388 (31.2%)	411 (33.0%)	279 (22.4%)	166 (13.3%)	2.82	6th
6	Poor digital infrastructure	482 (38.7%)	426 (34.2%)	216 (17.4%)	120 (9.6%)	3.02	8th
7	Ethical concerns (e.g., plagiarism, misuse, over-reliance)	422 (33.9%)	384 (30.9%)	273 (21.9%)	165 (13.3%)	2.85	5th
8	Data privacy and security concerns with AI tools	354 (28.5%)	401 (32.2%)	302 (24.3%)	187 (15.0%)	2.74	7th
9	Subscription or licensing barriers to AI platforms	446 (35.8%)	407 (32.7%)	239 (19.2%)	152 (12.2%)	2.92	3rd
10	Difficulty transitioning from traditional to AI-enhanced workflows	297 (23.9%)	386 (31.0%)	352 (28.3%)	209 (16.8%)	2.62	9th
Weighted mean: 2.81 Criterion mean: 2.50							

Table 4 outlines the factors influencing the adoption of AI by librarians in Nigeria. The findings show a weighted mean score of 2.81, which exceeds the criterion mean score of 2.50, indicating that there are significant barriers to AI adoption among librarians. The most prominent factors include poor digital infrastructure ($\bar{x}$ = 3.02), limited institutional funding and support for AI tools and training ($\bar{x}$ = 2.99), and subscription or licensing barriers to accessing AI platforms ($\bar{x}$ = 2.92). Other notable factors include the absence of institutional AI policies or usage guidelines ($\bar{x}$ = 2.91) and ethical concerns such as plagiarism, misuse, or over-reliance on AI ($\bar{x}$ = 2.85). Interestingly, inadequate digital skills to use AI tools effectively, although ranked first, has a relatively moderate mean score ($\bar{x}$ = 2.66), suggesting that while it is a significant concern, it is somewhat less pressing than infrastructure and funding challenges. The least influential factor hindering AI adoption is low trust in the accuracy or reliability of AI-generated outputs ($\bar{x}$ = 2.58), followed by difficulties in transitioning from traditional workflows to AI-enhanced ones ($\bar{x}$ = 2.62).

6. Strategies for the sustainable and ethically guided adoption of AI technologies by librarians in the era of 5IR

This section presents a narrative strategy for the ethical adoption of AI by librarians in Nigeria, drawing from the lived experiences and insights of 1,244 librarians across Nigeria. A foundational recommendation by participants was the urgent need for clear, enforceable institutional policies on the ethical use of AI. A majority (72%) of librarians expressed concern that the current lack of defined protocols allows for inconsistent and, at times, inappropriate usage of AI tools. For example, One participant, a senior lecturer, emphasised: *"Right now, we're operating in a grey area. There's no formal document that tells us whether using ChatGPT for developing lecture slides or helping students with essays is okay or not. We need clear, context-sensitive policies."* A consistent theme among 81% of participants was the need for intensive training to build digital competence and AI literacy among librarians. Participants particularly stressed that professional development should be ongoing and inclusive of librarians across all ranks. A professor remarked: *"Many of our older colleagues still shy away from using AI tools, not because they don't want to, but because they haven't been taught how. Training should not be restricted to tech-savvy departments. Everyone should be carried along."* The participants noted that there are some institutions in Africa that offer regular AI competency workshops for faculty, which were suggested as a model worth replicating locally. These programs help demystify AI, improve usage confidence, and mitigate unethical practices stemming from ignorance. However, more than half (58%) of the participants advocated for the integration

of AI education including ethical use into the mainstream curriculum. Participants noted that embedding AI instruction into course content across faculties would demystify its role and normalize ethical use. According to a Senior lecturer: *"If we expect librarians to use AI responsibly, we need to teach them what responsible use looks like. AI education shouldn't be an optional seminar, it should be part of the training."* Ethical adoption of AI is unattainable without addressing basic infrastructural challenges. Approximately 66% of participants highlighted the unequal distribution of AI-enabling infrastructure such as high-speed internet, reliable electricity, and institutional licenses as a significant barrier. For instance, One librarian commented: *"It's not just about knowing the tools; it's about being able to access them consistently. We share one Turnitin account with our entire institution. How do we enforce ethical AI use under such conditions?"* Participants suggested that institutions and regulatory bodies like the NUC and TETFund invest in university-wide licenses for essential tools like Grammarly, Turnitin, Mendeley, and Copilot, ensuring fairness and reducing ethical dilemmas rooted in access inequality. Over half of the participants (54%) emphasised the critical role of leadership in fostering an ethical AI culture. Many called for the establishment of AI Ethics Committees or Technology Governance Boards at departmental and faculty levels. Another professor stated: *"This isn't just a tech issue it's a governance issue. We need leadership that's informed, proactive, and inclusive. Heads of department and deans should be trained on AI ethics, not just ICT officers."* Around 45% of participants advocated for establishing mechanisms to monitor and report AI usage in academic work. Suggestions included requiring researchers to declare the extent of AI tool usage in their publications and integrating AI disclosures into thesis submissions. For instance, another professor explained*: "Just as we declare conflicts of interest and ethical approval, we should declare if AI tools were used in writing or reviewing. It adds a layer of transparency and encourages self-regulation."* Finally, 43% of participants stressed the importance of ensuring that AI platforms used in Nigerian universities are culturally and ethically appropriate. They noted that many imported AI tools lack sensitivity to linguistic nuances, religious values, and contextual realities of Nigerian academia. As one participant stated: *"AI platforms are often built in the West. Their understanding of what's ethical doesn't always translate here. For instance, their idea of acceptable student help might contradict our policies."* To address this, participants called for collaboration with local developers and researchers to customize AI platforms for Nigerian linguistic, pedagogical, and cultural settings, similar to efforts seen in other advanced countries of the world.

Discussion of Findings

As indicated in the study findings, Nigerian librarians predominantly adopt language enhancement tools such as Grammarly and Quillbot, followed by creative design platforms like Canva and reference management tools. This pattern reflects an emphasis on writing support within academic workflows and aligns with Abdulah et al. (2024), who reported high adoption rates of language-centric tools like ChatGPT and Grammarly among scholars. Similarly, Dwivedi et al. (2023) and Lund et al. (2023) highlighted the widespread use of generative AI tools in academic and professional contexts, particularly for content creation and data processing. The dominance of Grammarly and Canva echoes EDUCAUSE (2023), which suggests that disciplinary preferences significantly influence tool adoption especially in the humanities and social sciences, where writing and editing tools are central. However, the relatively low uptake of speech-to-text tools such as Whisper and Otter.ai reflects persistent challenges related to technical complexity and infrastructure, as also emphasized by Bakiri, Mbembati, and Tinabo (2024), and Ibrahim (2024). The findings further reveal that librarians not only adopt these tools but use them frequently. Language tools, particularly Grammarly, are used daily by over half of the respondents, indicating strong user confidence and perceived utility. This supports Okuonghae and Tunmibi's (2024) view that digital competence must be complemented by perceived usefulness and ease of use to drive adoption. The regular use of Canva and Google Translate reinforces Coetzee's (2025) observation that frequency of use is closely tied to relevance and convenience within institutional workflows. Daily engagement with ChatGPT further affirms its global relevance, particularly in enhancing interactive learning, content development, and virtual assistance (Dwivedi et al., 2023). The normalization of these tools in daily library operations suggests a positive shift toward technology-enhanced librarianship, despite ongoing challenges related to resources and training. Nigerian librarians also demonstrated moderately high competence with AI tools, particularly for grammar correction, paraphrasing, plagiarism detection, and translation. These competencies affirm the practical, skill-based integration approach advocated by Ajani et al. (2022). Similarly, the digital literacy framework by Okuonghae and Tunmibi (2024) underscores the value of targeted competencies in fostering meaningful AI engagement. Al-Zahrani (2024) also found that higher competence correlates with increased user confidence. However, proficiency with more complex tools, especially speech-to-text applications, remains limited. Ibrahim (2024) attributes this to unintuitive design and minimal training support. These disparities underscore the need for structured, continuous professional development a strategy also emphasized by Sanusi et al. (2022), who advocate for self-directed learning and adaptability as critical in the 5IR landscape. Qualitative responses highlighted significant ethical concerns surrounding AI adoption. Participants cited issues such as data privacy, algorithmic bias, absence of institutional guidelines, cultural insensitivity, and the potential erosion of academic integrity. These concerns align with Salman et al. (2024) and Zlotnikova et al. (2025), who stressed the lack of governance frameworks as a key vulnerability in emerging AI ecosystems. Testimonies regarding the lack of transparency and cultural mismatch in global tools echo Zlotnikova et al.'s (2025) call for contextually grounded and ethically responsible AI practices.

Fears about over-reliance on AI, particularly in academic writing, support Ibrahim's (2024) argument that AI's benefits must be balanced with human creativity and intellectual rigor. These concerns reinforce the need for institutional AI policies, user education, and ethical oversight mechanisms to guide sustainable adoption. The study also identified significant barriers hindering AI adoption, including inadequate infrastructure, limited funding, and restricted access to licensed tools. These challenges mirror those identified by Yakubu et al. (2023), who underscored the importance of institutional readiness, especially in infrastructure and policy development. Agboke and Oladokun (2024) similarly noted that outdated infrastructure and funding shortfalls impede AI implementation in Nigerian libraries. Interestingly, concerns about insufficient digital skills were less prominent, suggesting that while training gaps exist, systemic and structural limitations are more significant. This supports Suleiman et al.'s (2024) argument that digital skill development must be accompanied by broader institutional reforms. Ethical issues such as plagiarism and vague usage guidelines were also highlighted, reinforcing Akinola's (2023) call for governance and oversight in AI deployment. Participants proposed pragmatic strategies for responsible AI adoption, including the development of clear institutional policies, ethical guidelines, and culturally grounded frameworks. These recommendations align with those of Yakubu et al. (2023) and Akinola (2023), who emphasized the strategic importance of policy in guiding ethical AI use. Respondents also called for ongoing training, AI literacy programs, and curriculum integration recommendations that resonate with Suleiman et al. (2024). Infrastructure remains a foundational concern. As Agboke and Oladokun (2024) argued, equitable access to digital tools is a prerequisite for meaningful technological transformation. Respondents also advocated for leadership-driven ethical governance structures, such as the establishment of AI Ethics Committees a suggestion echoed by Suleiman et al. (2024). Notably, participants emphasized the need for culturally relevant AI platforms that reflect Nigerian linguistic and contextual realities, challenging the universality of imported technologies. This supports broader African scholarship calling for localized digital solutions that ensure relevance, fairness, and ethical alignment.

Conclusion

This study has provided a detailed assessment of the adoption, competency, ethical considerations, and strategic integration of AI tools among librarians in Nigeria, with a focus on the emerging dynamics of the Fifth Industrial Revolution (5IR). The findings revealed that AI tools such as Grammarly, ChatGPT, Quillbot, and Canva are among the most frequently used, particularly for language enhancement, plagiarism detection, and creative design. While there is a moderate level of AI competence among librarians, significant disparities persist regarding complex tool usage, such as literature analysis and speech-to-text applications. Furthermore, ethical concerns surrounding data privacy, cultural bias, and academic integrity have surfaced prominently, alongside structural challenges such as poor infrastructure and limited institutional support. In conclusion, the study highlights the urgent need for a well-rounded strategy that addresses technical training, ethical orientation, infrastructural investment, and policy development to ensure that AI adoption in Nigerian libraries is both sustainable and ethically guided.

Recommendations

Based on the findings, the following recommendations are proposed to guide the ethical, competent, and sustainable use of AI tools among librarians in Nigeria within the context of the 5IR.

1. Universities should formulate policies that define acceptable AI use and embed ethical principles related to academic integrity, user data protection, and intellectual property.
2. Regular and inclusive training sessions should be organised to build librarian capacity in the effective and responsible use of AI tools, targeting both advanced and underutilised applications.
3. Librarians should be sensitised on the ethical implications of AI use, including data privacy, plagiarism risks, and transparency. Ethical training should be mandatory as part of professional development.
4. Institutions should prioritise investment in reliable internet, electricity, and AI software licenses to enhance equitable access and facilitate consistent AI tool usage among librarians.
5. Collaborate with local developers to customise AI tools that reflect indigenous languages, citation styles, and educational norms, thereby reducing algorithmic bias and increasing usability.
6. Incorporate AI competency and ethical use into the core library and information science curriculum to prepare future professionals for the realities of AI-enhanced librarianship.

Limitations of the Study

1. Due to the absence of a centralised database for Nigerian librarians, the study relied on snowball sampling via social media platforms. This non-probability sampling technique may not fully capture a representative demographic.
2. Although open-ended survey questions provided valuable narratives, the study's reliance on survey methodology limited deeper exploration of participants' lived experiences with AI in institutional settings.
3. The study was limited to Librarians in Nigeria and does not account for regional variations within Africa or across the world. Consequently, the findings may not be generalisable beyond the Nigerian context.

Suggestions for Further Studies

1. Future research should explore cross-national comparisons within Africa or other developing regions to identify commonalities and context-specific differences in AI adoption among librarians.
2. In-depth case studies of selected universities can provide richer insights into organisational practices, policy implementation, and librarian experiences with AI.
3. Tracking changes in AI competency, ethical awareness, and adoption over time will provide a dynamic understanding of trends and impacts.
4. Further research could investigate how librarians support students' use of AI tools, including ethical guidance and information literacy interventions.
5. Research should investigate the development and adoption of AI tools that are specifically designed for the Nigerian academic context, considering cultural, linguistic, and pedagogical peculiarities.

References

Abdulah, D. M., Zaman, B. A., Mustafa, Z. R., & Hassan, L. H. (2024). *Artificial intelligence integration in academic writing: Insights from the University of Duhok*. ARO-The Scientific Journal of Koya University, 12(2).

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullahi, F. (2022). Perspectives of librarians on awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services in Nigeria. Internet Reference Services Quarterly, 26(4), 213-230.

Al-Zahrani, A. M. (2024). From traditionalism to algorithms: Embracing artificial intelligence for effective university teaching and learning. IgMin Research, 2(2), 102–112. https://doi.org/10.61927/igmin151

Baig, M.I., Yadegaridehkordi, E. (2025). Factors influencing academic staff satisfaction and continuous usage of generative artificial intelligence (GenAI) in higher education. *Int J Educ Technol High Educ* **22**, 5 https://doi.org/10.1186/s41239-025-00506-4

Baker, J. (2012). The Technology–Organization–Environment Framework. In: Dwivedi, Y., Wade, M., Schneberger, S. (eds) Information Systems Theory. Integrated Series in Information Systems, vol 28. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-6108-2_12

Bakiri, H., Mbembati, H., & Tinabo, R. (2023). Artificial intelligence services at academic libraries in Tanzania: Awareness, adoption, and prospects. *University of Dar es Salaam Library Journal*, 18(2), 19–35. ISSN 0856-1818.

Bosworth, B. (2024, August 25). *Learning about AI (for free) with the University of Johannesburg*. Human Element Communications. https://www.humanelementcommunications.com/insights/learning-about-ai-for-free-with-the-university-of-johannesburg

Carnegie Mellon University Africa. (n.d.). *Academics - CMU-Africa*. https://www.africa.engineering.cmu.edu/academics/index.html

Centre for Human-Inspired Artificial Intelligence. (2025). *About us*. University of Cambridge. https://www.chia.cam.ac.uk/about/

Coetzee, D. (2025). *Navigating the Use of Publicly Available Artificial Intelligence in Tertiary Education* (Doctoral dissertation summary). Retrieved from https://www.academia.edu/126939737/Navigating_the_use_of_Publicly_Available_Artificial_Intelligence_in_Tertiary_Education

Dwivedi, Y. K., Hughes, L., Ismagilova, E., et al. (2023). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management, 68*. https://doi.org/10.1016/j.ijinfomgt.2021.102525

Fu, Y., & Weng, Z. (2024). Navigating the ethical terrain of AI in education: A systematic review on framing responsible human-centered AI practices. Computers and Education: Artificial Intelligence, 100, 306.

George, B., & Wooden, O. (2023). Managing the strategic transformation of higher education through artificial intelligence. Administrative Sciences, 13(9), 196.

Gwagwa, A., Kraemer-Mbula, E., Rizk, N., Rutenberg, I., & De Beer, J. (2020). Artificial intelligence (AI) deployments in Africa: benefits, challenges and policy dimensions. *The African Journal of Information and Communication*, *26*, 1-28.

Ibrahim, A. B. (2024). Assessing the knowledge and perception of artificial intelligence for teaching and research among lecturers in the faculties of arts in Nigeria. Journal of Global Research in Education and Social Science, 18(2), 25–33. https://doi.org/10.56557/JOGRESS/2024/v18i28671

Kathe Pelletier, J., 2023. *2023 EDUCAUSE Horizon Report: Teaching and Learning Edition - Key Trends and Technologies*, Educause. United States of America. Retrieved from https://coilink.org/20.500.12592/p17m5t on 22 May 2025. COI: 20.500.12592/p17m5t.

Kubanek, M., & Szymoniak, S. (2024). Ethical challenges in AI integration: A comprehensive review of bias, privacy, and accountability issues. In The Leading Role of Smart Ethics in the Digital World

(pp. 75–85). Springer.

Lu, C. A. (2025). Tracing the evolution of artificial intelligence education at Stanford University. *TechTrends, 69*(4), 447–453. https://doi.org/10.1007/s11528-025-01046-4

Lund, B. D., Wang, T., Mann, B. J., & Neymotin, F. (2023). Student perceptions of ChatGPT in higher education: An exploratory study. *Journal of Academic Librarianship, 49*(3). https://doi.org/10.1016/j.acalib.2023.102615

Massachusetts Institute of Technology**.** (2018, December 19). *The Institute launches a college*. *MIT Technology Review*. https://www.technologyreview.com/2018/12/19/138376/the-institute-launches-a-college/

Ofem, U. J., & Chukwujama, G. (2024). Sustainable artificial intelligence-driven classroom assessment in higher institutions: Lessons from Estonia, China, the USA, and Australia for Nigeria. European Journal of Interactive Multimedia and Education, 5(2), e02403.

Okuonghae, N., & Tunmibi, S. (2024). Digital competence as predictor for the motivation to use artificial intelligence technologies among librarians in Edo and Delta States, Nigeria. Journal of Technology Innovations and Energy, 3(1). https://doi.org/10.56556/jtie.v3i1.728

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development. UNESCO.

Salman, H.A., Aliif, M., Ibrahim, R., & Mahmood, J. (2024). Technology Readiness for Generative AI Among Academic Researchers. *2024 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT)*, 329-336.

Sanusi, I. T., Olaleye, S. A., Oyelere, S. S., & Dixon, R. A. (2022). Investigating learners' competencies for artificial intelligence education in an African K-12 setting. Computers and Education Open, 3, 100083. https://doi.org/10.1016/j.caeo.2022.100083

Tsinghua University. (2025, January 1). *Artificial intelligence*. School of Information Science and Technology, Tsinghua University. https://www.sigs.tsinghua.edu.cn/en/2024/1230/c7587a99302/page.htm

University of Pretoria. (2024, September 16). *Responsible use of AI for postgraduate students in the Faculty of Health Sciences*. https://www.up.ac.za/faculty-of-health-sciences-research/news/post_3259711-responsible-use-of-ai-for-postgraduate-students-in-the-faculty-of-health-sciences

Artificial Intelligence-Driven Innovations in Open-Access Book Publishing: The Federal University of Technology Minna BookHub Initiative

By

Dr. Fatimah Jibril Abduldayan & Prof. Kovo Abdulsalami Sanni
Academic Publishing Centre,
Federal University of Technology, Minna, Niger State
fj.dayan@futminna.edu.ng
07068155501

Abstract

The study was carried out to investigate the perception of authors on Artificial Intelligence-Driven Innovations in Open-Access Book Publishing using the Federal University of Technology (FUT) Minna BookHub Initiative. Specifically, the study seeks to determine authors' perception on open access book publishing in FUT Minna; their perception in the use of AI-driven innovations for open access book publishing using the BookHub Initiativ; and the challenges faced in the use of AI-Driven innovations in open access book publishing. Descriptive survey research was adopted for the study. The population for the study were 30 authors from the university. Data was collected using a structured questionnaire. The collected data was analysed using simple frequency and percentages as well as mean and standard deviation to answer the research questions. Findings of the study revealed that, authors perceived that open access books generate higher citations, and it was rated above the benchmark indicating a general acceptance. The authors were also of the opinion that the use of AI to generate entire content for open access book publishing takes away the originality of the work, even though the use of AI hastens book production. These perceptions were rated 2.93 and 2.90 respectively which indicates a general positive perception among the authors. Ethical use of AI technologies in publishing gave a mean score of $\bar{x}$ = 3.40; SD=0.90, inadequate training programmes gave $\bar{x}$= 3.33; SD=0.83, lack of fund $\bar{x}$=3.33; SD=0.83, and lack of ICT skills $\bar{x}$= 3.13; SD=0.63, which were all rated above 2.50 benchmark. This indicates a significant acceptance that they all constituted part of the challenges in using AI-driven innovations in open access book publishing. The study concluded that the ongoing AI application in publishing using the BookHub Initiative will further drive innovations, promote better authoring collaboration and democratise access to scholarly knowledge, thus shaping the future of scholarly communication. The study recommended that academic institutions and publishers should prioritise promoting the ethical use of AI technologies in open access book publishing, organise continuous training programs for authors, editors, and peer reviewers focusing on AI literacy, and encourage collaboration across disciplines to improve access and visibility to scholarly books emanating from institutions.

Keywords: AI-driven innovation, BookHub, FUT Minna, open access publishing.

Introduction

In recent years, the realm of academic publishing has experienced a profound transformation propelled by advancements in artificial intelligence (AI). Open-access publishing, which enables free, unrestricted access to scholarly work, is at the forefront of this change, facilitating knowledge dissemination in an increasingly digital landscape. As researchers face the challenge of navigating vast repositories of academic literature, tools powered by AI, such as chatbots and recommendation systems, have emerged to enhance the efficiency of literature searches and improve access to academic resources.

The FUT Minna Open Access Book Publishing Initiative, in collaboration with Datasphir BookHub and powered by Coko with a funding support from the Open Book Collective (OBC), aim to harness these AI technologies to create a sustainable model for open-access book publishing. This initiative seeks to address both the challenges of traditional publishing and the economic barriers that often inhibit academic contributions, especially from researchers in low- and middle-income countries. By integrating AI-driven solutions into the open-access framework, the FUT Minna Initiative presents a promising pathway for creating a more equitable academic environment, fostering collaboration, and promoting inclusive access to knowledge. This paper reviews the role of AI in open-access publishing**.** AI-driven innovation refers to the process of using artificial intelligence (AI) technologies to generate new ideas, improve decision-making, and drive advancements in various fields by leveraging AI's ability to analyse large data sets and identify patterns, effectively pushing the boundaries of innovation within a various sector (Kaggwa, S., Eleogu, T. F., Okonkwo, F., Farayola, O. A., Uwaoma, P. U., & Akinoso, A., 2024).). According to Lahti (2023), AI-driven innovation is the application of artificial intelligence (AI) technologies that involves leveraging AI algorithms, natural language processing, and other AI techniques to generate new ideas, develop them further, and improve decision-making. The push for open-access (OA) publishing aligns with global movements toward increasing the accessibility of academic work, particularly in regions underserved by traditional publishing models. AI-driven tools facilitate this shift by streamlining manuscript submission, peer review, and publication processes. For instance, preliminary reviews of manuscripts can now be automated, allowing for faster turnaround times and potentially higher-quality outputs.

Langham-Putrow, A., Bakker, C., & Riegelman, A. (2021) discuss the utility of AI tools in performing initial quality control of submitted manuscripts, which includes plagiarism detection and transparency checks. These features are particularly valuable for open-access initiatives, where the goal is to maintain high academic standards while ensuring rapid dissemination of research findings. The partnership between the Federal University of Technology Minna and BookHub epitomizes this approach. Open access (OA) publishing has gained traction to democratise knowledge and eliminate paywalls that restrict access to academic work. It has become crucial for researchers who publish in high-volume areas such as engineering, technology, health sciences and social sciences. The transition to open access is seen not only as beneficial for distributing knowledge but also to enhance citation impact, as studies indicate that OA articles tend to receive more citations compared to their subscription-based counterparts (Langham-Putrow, A., Bakker, C., & Riegelman, A, 2021). This growing recognition has led to significant discussions around the need for sustainable open-access models that do not impede scholarly contributions.

The incorporation of AI in open-access initiatives enhances the discovery process. AI-powered systems can assist in narrowing down research fields, suggesting relevant literature, and even providing summaries of complex academic texts. Methnani, J., Latiri, I., Dergaa, I., Chamari, K., & Saad, H.B. (2023) highlight the benefits of AI tools like ChatGPT in improving user engagement and search precision, thus catering to the diverse needs of the academic community. However, while these advancements facilitate easier access to open resources, they also raise important questions about the comprehensiveness of the literature reviewed. AI tools tend to prioritize open-access journals, potentially overlooking critical contributions from subscription-based publications, which can skew the research outputs presented to users. Thus, addressing this bias is imperative to ensure that AI-driven solutions enrich rather than limit the scholarly exchange.

The economic dynamics of transitioning to open-access publishing are complex. As discussed by Yun, J.J., Liu, Z., Jeong, E., Kim, S., & Kim, K. (2022), the shift to OA often entails authors facing publication fees, especially in high-quality journals, which can become a barrier for researchers from low- and middle-income countries. The FUT Minna Initiative looks to address these issues by promoting equitable financial models that reduce such barriers, thus enhancing access to publication opportunities for underrepresented researchers.

The FUT Minna Initiative, in collaboration with the Datashpir BookHub, represents a strategic effort to leverage AI for advancing open-access book publishing. By focusing on creating a platform that merges AI capabilities with open-access principles, the initiative aims to provide a user-friendly interface that simplifies the process of publishing and accessing academic resources. Researchers and academics can benefit from features such as AI-assisted recommendations, comprehensive analytics on readership, and streamlined submission processes that reduce bureaucratic overheads. A transformative approach to book publishing through AI can help to enhance the distribution and visibility of scholarly work, thus fostering a more collaborative academic environment. Moreover, as the initiative seeks to connect authors from diverse geographical backgrounds, it ensures that voices from traditionally marginalized communities are amplified.

Artificial intelligence (AI) is fundamentally transforming traditional academic publishing paradigms, including chatbots, systems like the Chat Generative Pre-trained Transformer (ChatGPT), machine learning algorithms for data analysis, and AI-powered reference managers have significantly improved literature search and retrieval processes. According to Dergaa and Saad (2023), these innovations allow researchers to process vast amounts of data quickly, improving the efficiency of identifying relevant academic papers. AI's capacity to understand and contextualize user queries enables these tools to filter out irrelevant results, saving researchers valuable time and ensuring that no critical literature is overlooked. In addition, AI-powered writing assistants and plagiarism detection systems support the drafting and revision of scholarly work, further enhancing the quality and integrity of academic outputs.

The application of AI in academic publishing spans a variety of functions, ranging from content generation to automated recommendation systems. A report by Frontier Economics Ltd. (2020) highlights that AI is being applied across the entire value chain of publishing. These applications include routine tasks such as conducting searches, summarizing content, and generating strategic insights. By automating these administrative burdens, AI enables researchers, authors, and publishers to concentrate on more value-added tasks, such as ideation, creativity, and critical analysis, which are often overshadowed by the logistical aspects of the publishing process.

AI technologies, particularly machine learning (ML) and natural language processing (NLP), are especially influential in transforming academic publishing. For instance, ML algorithms can analyse existing literature to recommend relevant content to authors, helping them navigate vast academic resources with ease. NLP, on the other hand, facilitates content summarization, enabling readers to quickly extract essential information from lengthy academic texts without needing to read them in full. These

advancements significantly enhance the efficiency of both writing and reading in academic circles. Despite these advancements, the use of AI in academic research and publishing raises important ethical and practical concerns. Shevlane (2019) highlights both the potential for misuse and the need for protective measures in AI research, stressing the importance of maintaining a balanced approach to ensure AI's responsible use. Upshall (2019) discusses how AI can improve scholarly publishing by, for example, streamlining the process of identifying suitable peer reviewers, helping match reviewers with the necessary expertise. However, Thelwall (2019) raises significant concerns about the potential biases introduced by AI systems in the peer review process, particularly regarding the favouritism toward authors from high-impact countries. Such biases may compromise the fairness and transparency of the review process, perpetuating existing inequalities in academic publishing.

Furthermore, the capabilities of generative AI have profound implications for academic writing and publishing. Langham-Putrow, A., Bakker, C., & Riegelman, A., (2021) argue that generative AI's ability to produce text that rivals or even exceeds human authors raises critical questions surrounding authorship, originality, and academic integrity. As these technologies continue to evolve, academic institutions are increasingly exploring ways to harness AI for both improving the quality and expanding the accessibility of academic literature. For example, the Federal University of Technology Minna has identified opportunities to leverage AI to enhance the efficiency and effectiveness of its academic publishing processes, further illustrating the growing role of AI in the academic world. The project employed several advanced AI technologies to enhance the publishing process. These technologies include:

Natural Language Processing (NLP) is an exciting and fast-evolving field that lies at the convergence of computer science, artificial intelligence, and linguistics. Its primary goal is to bridge the gap between human language and machine understanding, enabling computers to comprehend, interpret, and respond to human communication in a way that feels natural and intuitive (Geetha et.al., 2023). In the context of the FUT Minna Initiative, NLP was used to automate content analysis, such as detecting plagiarism, evaluating readability, and summarizing large bodies of text. NLP algorithms can also be used for language translation, helping to make scholarly works accessible to a broader audience by breaking down language barriers.

Through NLP, machines can engage in meaningful interactions with humans using everyday language. Natural Language Processing (NLP) has a wide range of practical applications across various sectors thereby enhancing efficiency and enabling deeper insights (Geetha *et.al.,* 2023). This includes:

i. **Search Engines:** NLP improves search engine functionality by enabling better comprehension of user queries and web content, leading to more relevant and accurate search results.
ii. **Virtual Assistants:** Voice-activated virtual assistants, such as Siri and Google Assistant, leverage NLP to process spoken commands and provide contextually relevant responses.
iii. **Sentiment Analysis:** NLP is used by businesses to analyze customer reviews and social media content, allowing them to gauge public sentiment and make data-driven decisions about their products or services.
iv. **Machine Translation:** Tools like Google Translate utilize NLP to automatically translate text between languages, making communication across different languages easier.
v. **Healthcare:** NLP plays a crucial role in extracting valuable insights from medical records and research papers, supporting clinical decision-making and advancing medical research.
vi. **Chatbots and Virtual Agents:** NLP-driven chatbots provide automated customer support, assisting with information retrieval and answering common inquiries.
vii. **Text Summarization:** NLP techniques enable the automatic summarization of lengthy texts and documents, making it easier to extract key information quickly.
viii. **Content Recommendation:** Platforms like Netflix and Amazon use NLP to analyze user preferences and viewing history, offering personalized content recommendations.
ix. **Legal and Compliance:** NLP is instrumental in automating the analysis of contracts, legal documents, and ensuring compliance with regulatory standards by flagging potential issues.
x. **News and Media:** NLP is used for automating content generation and conducting sentiment analysis in journalism, enabling faster content production and insights into public opinion.

By harnessing the power of NLP, these sectors can automate processes, improve decision-making, and provide personalized experiences for users. Machine learning (ML), a subfield of artificial intelligence (AI), automates the development of statistical and analytical models that enable systems to learn from data, recognize patterns, and make predictions with minimal human intervention (Theng and Theng, 2020). This technology has been applied in various domains, including academic publishing, where machine learning algorithms have been utilized to forecast the potential success of manuscripts. By analyzing factors such as citation potential, relevance to contemporary research trends, and author credibility, these algorithms can predict which manuscripts are most likely to succeed. The automation of this predictive process allows publishers to make more informed decisions regarding manuscript acceptance, thereby enhancing editorial workflows.

Predictive analytics is a widely used method for analyzing both current and historical data to forecast future events or anticipate unforeseen circumstances with a high degree of accuracy. This process involves a variety of analytical techniques, such as data mining, statistical analysis, and machine learning (Theng and Theng, 2020). According to Kumar and Garg (2018), several machine learning algorithms are commonly applied in predictive analytics, including logistic regression, K-nearest neighbors (KNN), support vector machines (SVM), decision trees, random forests, and Naive Bayes. Kumar and Garg (2018) also outline the typical steps involved in the predictive analytics process, which help data analysts forecast future events based on historical and current data. These steps include:

i. Requirement Collection
ii. Data Collection
iii. Data Analysis and Cleaning
iv. Application of Statistical and Machine Learning Techniques
v. Predictive Modeling
vi. Prediction and Monitoring

These stages collectively support the development of accurate predictive models, enabling organizations to make data-driven decisions and anticipate future trends. Recommendation systems are widely used in e-commerce, social media, and entertainment platforms, but their application in academic publishing is relatively new. The AI-driven recommendation system integrated into BookHub analyses user behavior, reading history, and preferences to suggest relevant books or research articles to readers. This personalized approach to content discovery helps increase the visibility of open-access publications, leading to a more engaged readership and greater academic impact.

Statement of the problem

Despite the critical role that Artificial Intelligence (AI) play in supporting open-access book publishing in academic achievement and intellectual growth in universities, there is a significant gap in understanding how book authors, researchers, librarians, and publishers utilise these AI-Driven innovations at the FUT Minna Using BookHub Initiative. The FUT Minna Initiative, in collaboration Using BookHub Initiative, aims to harness these AI technologies to create a sustainable model for open-access book publishing. This initiative seeks to address both the challenges of traditional publishing and the economic barriers that often inhibit academic contributions, especially from researchers in low- and middle-income countries. By integrating AI-driven solutions into the open-access framework, the FUT Minna Initiative presents a promising pathway for creating a more equitable academic environment, fostering collaboration, and promoting inclusive access to knowledge. By identifying and exploring these gaps, the study aims to provide insights that will inform the enhancement of academic publishing to better support the BookHub collaborative authoring.

Objectives of the Study

This research aimed to understand how AI-driven innovations has impacted open-access book publishing in Federal University of Technology Minna using the BookHub Initiative. Specifically, the research addressed the following objectives:

1. Determine authors' perception of open access book publishing in Federal University of Technology Minna.
2. Examine the perception of authors in the use of AI-driven innovations for open access book publishing in Federal University of Technology Minna using BookHub Initiative.
3. To identify the key challenges faced in the use of AI-Driven innovations in open access book publishing in Federal University of Technology Minna Using BookHub Initiative.

Research Questions

Based on the objectives of the study, the following research questions were formulated:

1. What is the perception of authors on open access book publishing in Federal University of Technology Minna?
2. What is the perception of authors in the use of AI-driven innovations for open access book publishing in Federal University of Technology Minna using BookHub Initiative?
3. What are the challenges faced in the use of AI-Driven innovations in open access book publishing in Federal University of Technology Minna Using BookHub Initiative?

Research Methodology

This study employs a survey research design to assess AI-Driven Innovations in Open-Access Book Publishing in Federal University of Technology Minna Using BookHub Initiative with three objectives and three research questions. The population for the study is 30 authors from FUT Minna. The entire population was used for the study because of its small size. Data was collected using questionnaire. The questionnaire

was designed to gather comprehensive information on the perception of open access book publishing, use of AI-Driven innovations in open access book publishing using the BookHub, and the challenges faced in the use of AI-Driven innovations in open access book publishing. To facilitate a clear and organized visualization of the responses, data was presented using tables. It was analysed using simple frequency and percentages to determine the response rate and respondents' demographic information. Frequency counts, percentages, mean and standard deviation were used to answer the research questions.

Analysis/Discussion of Results

Table 1

Questionnaire Response Rate

Number of Questionnaires Administered	Numbered Retrieved	Percent (%) Number Retrieved
30	30	100

A total of 30 copies of questionnaire were administered to the authors to assess their perception on the AI-Driven Innovations in Open-Access Book Publishing in Federal University of Technology Minna using BookHub Initiative. All the 30 copies of questionnaire were successfully retrieved, representing a 100% response rate. This complete retrieval of questionnaires ensures that the data collected is comprehensive and fully representative of the targeted population, enhancing the reliability of the study's findings.

Table 2

Demographic Distribution of Authors

Gender	Frequency (f)	Percent (%)
Male	25	83
Female	5	17
Total	**30**	**100**
Age		
31 - 40 years	10	33
41 - 50 years	12	40
Above 50 years	8	27
Total	**30**	**100**

The demographic data as presented in Table 2 shows that the respondents were split by gender, with 83% male and 17% female. The largest age group was 41-50 years (40%), followed by 31-40 years (33%). A smaller portion of respondents were aged 50 years and above (27%),

Table 3

Perception of authors on open access book publishing in Federal University of Technology Minna

S/N	Items	SA	A	D	SD	Mean	SD
1	Publishers of open access books have lower standards	0 (0%)	8 (27%)	12 (40%)	10 (33%)	1.93	0.57
2	Publishers of open access books have questionable reputation	0 (0%)	4 (13%)	15 (50%)	11 (37%)	1.77	0.73
3	Open access books are not suitable to use for research purposes	0 (0%)	6 (20%)	10 (33%)	14 (47%)	1.73	0.77

4	The publication speed of open access books affects the rigor and quality of the work	0 (0%)	11 (37%)	13 (43%)	6 (20%)	2.17	0.33
5	Open access books encourage plagiarism because it allows copyright infringement	0 (0%)	2 (7%)	19 (63%)	9 (30%)	1.77	0.73
6	Open access books encourage the commercial re-use of work	0 (0%)	14 (47%)	13 (43%)	3 (10%)	2.37	0.13
7	Open access books are only published online	3 (10%)	8 (27%)	15 (50%)	4 (13%)	2.33	0.17
8	Open access books are not widely read	0 (0%)	4 (13%)	17 (57%)	9 (30%)	1.83	0.67
9	Open access books generate higher citations	10 (33%)	18 (60%)	2 (7%)	0 (0%)	3.27	0.77
10	Open access books are not easily accessible	0 (0%)	3 (10%)	14 (47%)	13 (43%)	1.67	0.83
11	All publishers of open access books require authors to compulsorily pay book processing charges	0 (0%)	7 (23%)	21 (70%)	2 (7%)	2.17	0.33
12	The book processing charges for open access books is too high compared to non-open access books	2 (7%)	8 (27%)	16 (53%)	4 (13%)	2.27	0.23
	Weighted mean					**2.11**	

Source: Field survey, 2025

Table 3 shows the perception of researchers on open access book publishing in Federal University of Technology Minna. Only item 9 produced high mean scores which was above the average benchmark of 2.50; the item is 'Open access books generate higher citations ($\bar{x}$=3.27; SD=0.77)'. The other items produced low mean scores which were above the average benchmark of 2.50. The decision mean of 2.50 and above is considered as the positive perception on open access book publishing, while the decision mean of below 2.50 have negative perception on open access book publishing. Consequently, the weighted mean of 2.11 indicates that respondents were indifferent regarding their perception of open access book publishing in Federal University of Technology Minna.

Table 4
Perception of authors on the use of AI-driven innovations for open access book publishing in Federal University of Technology Minna using the BookHub Initiative

S/N	Items	SA	A	D	SD	Mean	SD
1	The use of AI to generate content in open access book publishing diminishes the quality of the work	3 (10%)	6 (20%)	17 (57%)	4 (13%)	2.27	0.23
2	The use of AI to generate content in open access book publishing amounts to plagiarism	2 (7%)	7 (23%)	19 (63%)	2 (7%)	2.30	0.20

3	The use of AI to generate content in open access book publishing diminishes author creativity	1 (3%)	12 (40%)	16 (50%)	1 (3%)	2.43	0.07
4	The use of AI to generate content in open access book publishing takes away the originality of the work	7 (7%)	6 (20%)	20 (67%)	2 (7%)	2.93	0.43
5	The use of AI to generate content in open access book publishing breeds distrust among readers of the work	2 (7%)	5 (17%)	19 (63%)	4 (13%)	2.17	0.33
6	The use of AI to generate content in open access book publishing diminishes the integrity of the authors	3 (10%)	4 (13%)	21 (70%)	2 (7%)	2.27	0.23
7	The use of AI to generate content in open access book publishing diminishes the integrity of the publishers	1 (3%)	4 (13%)	20 (67%)	5 (17%)	2.03	0.47
8	The use of AI to generate content in open access book publishing diminishes the integrity of the work	2 (7%)	6 (20%)	19 (63%)	3 (10%)	2.23	0.27
9	The use of AI for reviewing content in open access book publishing makes editing and proofreading difficult	2 (7%)	0 (0%)	23 (77%)	5 (17%)	1.97	0.53
10	The use of AI in open access book publishing hikes the cost of production	0 (0%)	0 (0%)	22 (73%)	8 (27%)	1.73	0.77
11	The use of AI in open access book publishing makes it difficult to produce books in varying format such as audiobooks	0 (0%)	0 (0%)	23 (77%)	7 (23%)	1.77	0.73

Source: Field survey, 2025

Table 4 shows the perception of researchers in the use of AI-driven innovations for open access book publishing in Federal University of Technology Minna using the BookHub Initiative. Two items listed produced high mean scores which was above the average benchmark of 2.50. These items include item 4; the use of AI to generate content in open access book publishing takes away the originality of the work ($\bar{x}$=2.93; SD=0.43) and item 14: The use of AI in open access book publishing hastens book production ($\bar{x}$=2.90; SD=0.40). On the other hand, twelve items produced low mean scores which were below the average benchmark of 2.50. The decision mean of 2.50 and above is considered as the positive perception in the use of AI-driven innovations for open access book publishing using the Bookhub platform. Consequently, the weighted mean of 2.18 indicates that researchers differ on their Perception in the use of AI-driven innovations for open access book publishing in Federal University of Technology Minna using BookHub Initiative.

Table 5
Challenges faced in the use of AI-Driven innovations in open access book publishing in Federal University of Technology Minna

S/N	Items	SA	A	D	SD	Mean	SD
1	Ethical use of AI technologies in publishing	13 (43%)	16 (53%)	1 (3%)	0 (0%)	3.40	0.90
2	Inadequately Training Programmes	11 (37%)	18 (60%)	1 (3%)	0 (0%)	3.33	0.83
3	Lack of fund	10 (33%)	20 (67%)	0 (0%)	0 (0%)	3.33	0.83
4	Lack of ICT skills	9 (30%)	16 (53%)	5 (2%)	0 (0%)	3.13	0.63
	Weighted mean					**3.30**	

Source: Field survey, 2025

Table 5 presents data on challenges faced in the use of AI-Driven innovations in open access book publishing in Federal University of Technology Minna. All the items listed produced high mean scores which was above the average benchmark of 2.50. This indicates a unanimous agreement on the challenges faced in the use of AI-Driven innovations in open access book publishing in Federal University of Technology Minna.

Conclusion

The integration of AI in open-access book publishing, as demonstrated by FUT Minna Using BookHub Initiative, is poised to revolutionise academic communication by addressing access barriers and enhancing research efficiency. This initiative, which incorporates AI technologies such as natural language processing (NLP), machine learning, and recommendation systems into the editorial workflow, has successfully reduced review times, increased discoverability, and improved user satisfaction. The project highlights the transformative potential of AI in the academic publishing landscape, emphasizing its role in fostering a more inclusive and accessible academic environment. As AI continues to evolve, its ongoing application in publishing will likely drive further innovations, promoting greater collaboration and democratising access to scholarly knowledge, thus shaping the future of scholarly communication.

Recommendations

This study recommends that:

1. Academic institutions and publishers should prioritize the ethical use of AI technologies in publishing, ensuring that tools are deployed responsibly to mitigate biases and promote fairness in the peer review process.
2. Universities should develop training programs for researchers, editors, and peer reviewers that focus on AI literacy. Understanding the capabilities and limitations of AI tools will empower stakeholders to leverage these technologies effectively while maintaining academic integrity.
3. Universities should encourage collaboration across disciplines to foster innovations in AI applications within academic publishing, drawing insights from fields such as computer science, linguistics, and ethics to enhance the effectiveness of publishing processes.
4. The need for involving a diverse range of stakeholders- including researchers, publishers, librarians, and policymakers- in the development of strategies to integrate AI in open access publishing. This collaborative approach can ensure that various perspectives are considered, ultimately leading to more comprehensive and widely accepted solutions.
5. Universities should continue to seek funding and partnerships that support research into AI applications in publishing. Investments in technology infrastructure can lead to advancements that benefit the entire academic community.
6. There is also the need for academic institutions to regularly assess the impact of AI on academic publishing practices, citation rates, and reader engagement. This evaluation will inform future strategies and adjustments necessary to enhance the effectiveness of AI integration.

By implementing these recommendations, the academic publishing community can better harness the potential of AI technologies while fostering a more equitable and effective landscape for scholarly communication in FUT Minna and across other institutions in Nigeria.

References

Dergaa, I., & Saad, H. B. (2023). Artificial Intelligence and Promoting Open Access in Academic Publishing. *La Tunisie Médicale*, 101(06), 533-536. https://www.researchgate.net/publication/374701644_Artificial_Intelligence_and_Promoting_Open_Access_in_Academic_Publishing

Geetha, V., Gomathy, C. K., Vallab Yaratha Yagn, D.Sri. & Praneesh, Sai (2023) The Role of Natural Language Processing. *Interantional Journal of Scientific Research in Engineering and Management*, (7) 11, 1-11. DOI: 10.55041/IJSREM27094 https://ijsrem.com/download/the-role-of-natural-language-processing/

Kaggwa, S., Eleogu, T. F., Okonkwo, F., Farayola, O. A., Uwaoma, P. U., & Akinoso, A. (2024). AI in decision making: transforming business strategies. *International Journal of Research and Scientific Innovation*, 10(12), 423-444. DOI: https://doi.org/10.51244/IJRSI.2023.1012032

Kumar, V., & Garg, M. L. (2018). Predictive analytics: a review of trends and techniques. *International Journal of Computer Applications*, 182(1), 31-37. DOI:10.5120/ijca2018917434

Lahti, E. (2023). What is AI driven innovation? Role of AI in innovation. [Blog post] retrieved from https://info.orchidea.dev/innovation-blog/what-is-ai-driven-innovation-role-of-ai-in-innovation#:~:text=AI%2Ddriven%20innovation%20means%20the,%2C%20and%20improve%20decision%2Dmaking.

Langham-Putrow, A., Bakker, C., & Riegelman, A. (2021). Is the open access citation advantage real? A systematic review of the citation of open access and subscription-based articles. *PLoS ONE*, 16(6), e0253129. https://doi.org/10.1371/journal.pone.0253129

Methnani, J., Latiri, I., Dergaa, I., Chamari, K., & Saad, H.B. (2023). ChatGPT for sample-size calculation in sports medicine and exercise sciences: A cautionary note. *International Journal of Sports Physiology and Performance*. 18(10) , 1219-1223

Shevlane, T. & Allan, D. (2020). The Offense-Defense Balance of Scientific Knowledge: Does Publishing AI Research Reduce Misuse? In: *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*, pp. 173-179. 2020.

Thelwall, M.(2019) "Artificial intelligence, automation and peer review." *Bristol JISC.* Retrieved fom https://repository.jisc.ac.uk/7614/1/AI_and_peer_review_briefing_paper.pdf

Theng, D., & Theng, M. (2020, July). Machine learning algorithms for predictive analytics: A review and new perspectives. In Conf. High Technol. Lett (Vol. 26, No. 6, pp. 536-545). DOI:10.37896/HTL26.06/1159

Upshall, Michael (2019). Using AI to solve business problems in scholarly publishing. *Insights,* (32),113. DOI: 10.1629/uksg.460

Yun, J.J., Liu, Z., Jeong, E., Kim, S., & Kim, K. (2022). The difference in open innovation between open access and closed access, according to the change of collective intelligence and knowledge amount. *Sustainability*, 14(5), 2574.

ACKNOWLEDGEMENT

The authors thank the Open Book Collective (OBC), United Kingdom, for funding open access book publishing with the Datasphir BookHub platform at FUT Minna. This pilot project is ongoing in Nigerian universities, particularly those with TETFund Academic Publishing Centres (APC).

Assessment of the Availability of Innovative Technologies for Information Service Delivery: A Study of Unity Schools' Libraries in Rivers State

Chidaka Okachukwu NYMEZU
Department of Library and Information Science
Faculty of Education
River State University, Nkpolu Oro-worukwo Port Harcourt, Rivers State. PMB 5080.
chidaka.nyemezu@ust.edu.ng, 07032154657
&
Juliet C. ALEX-NMECHA
Rivers State University Central Library, Nkpolu Oro-worukwo Port Harcourt, Rivers State. PMB 5080.
Juliet.anmecha@rsu.edu.ng,08035442363

Abstract
The study assessed the Availability of Innovative Technologies for Information Service Delivery in Unity School Libraries in Rivers. Two objectives and research questions guided the study: Descriptive research design was used to investigate the availability of innovative technologies in information service delivery across Unity Schools' libraries in Rivers State. Three School Librarians formed the population of the study. Census approach was adopted, since the population was considered manageable. Observation checklist was used to elicit data and Simple percentages were used for the analysis of the data. On the aspect of availability of multimedia Resources for information service delivery, the study found out that platform such as YouTube EDU was available in all the libraries surveyed. While there was a similarly mixed picture regarding the availability of virtual reference services in all the libraries surveyed. In conclusion, the study indicated that there was a fractional and not smooth integration of these technologies which implied that although Unity School libraries were beginning to grip digital tools, the integration remained inadequate in scope and depth. The study, therefore, recommends that libraries,

Keywords*: Innovative technologies, information service delivery, Unity Schools, Rivers State, digital resources*

Introduction
In recent years, the rapid advancement of technology has profoundly transformed the landscape of library services, particularly in educational settings. Innovative technologies in information service delivery refer to the application of modern tools, systems, and platforms that enhance access to, organization of, and interaction with information resources. These technologies include but are not limited to automated library systems, digital repositories, online public access catalogs (OPAC), mobile applications, cloud computing, artificial intelligence (AI), and interactive learning platforms (Okwu, Okwu & Oladokun, 2024). According to eSehar (2019), innovation in technology is disruptive when it transforms existing markets or creates new ones by offering simplicity, convenience, accessibility, and affordability. Similarly, García-Avilés (2020) defines it as the process through which new ideas and tools are communicated and adopted within a social system over time. The concept of innovative technology in the context of library services encompasses any innovative digital tools or systems that enhance user interaction and promote access to information. These technologies empower libraries to surpass physical limitations, advocate for instantaneous information dissemination, and ensure effective information service provision. Library service delivery refers to the systematic and strategic means by which libraries provide access to information resources, user support, and related services to meet the needs of their patrons. It encompasses all interactions and processes aimed at ensuring that library users can discover, access, and effectively utilize the information resources they need. According to Aina (2018), library service delivery is the provision of library and information resources and services to users at the right time, in the right format, and in an efficient and effective manner to support learning, teaching, and research. This definition emphasizes timeliness, appropriateness, and user-centeredness. Nzang and Awandia (2024) further assert that library service delivery includes both physical and virtual methods of guiding users to resources, providing reference support, and enhancing information literacy skills, especially in either academic, public or school library settings. Some of these services include but not limited to Circulation Services**, Reference and Information Services,** User Education and Information Literacy Services, Current Awareness Services (CAS), Selective Dissemination of Information (SDI), Reprographic and Document Delivery Services, Digital and Electronic Information Services and Recreational and Leisure Services.

However, in the context of School libraries, service delivery plays a crucial role in supporting curriculum delivery, encouraging reading culture, enhancing academic performance, improve access to quality information resources, prepare students for an increasingly digital world and generally improve information service provision and user engagement (Ernst, 2023). The integration of innovative technologies in library service delivery is not merely a trend but a necessary evolution in response to the growing demands for fast, reliable, and user-centered information services.

Statement of the Problem

Despite global advancements in educational technology, many school libraries in developing regions, including Nigeria, still operate under traditional models of service delivery that are no longer adequate to meet the dynamic information needs of students and teachers. The role of the library as a hub for learning and inquiry is threatened by outdated practices, limited access to digital tools, and underutilization of innovative technologies. While technology has transformed access to knowledge in many parts of the world, students in these schools often rely solely on physical books and face-to-face interactions for information, limiting their exposure to a broader spectrum of resources that support digital literacy and academic excellence.

Emerging technologies such as cloud-based library systems, digital catalogues, virtual reference services, and online repositories have proven effective in enhancing library services globally. These innovations enable personalized, accessible, and interactive learning experiences, yet their application in Unity Schools remains unclear. Although federal support for these schools suggests a potential for leadership in educational reform, there is scant evidence of structured efforts to integrate and sustain innovative technologies within their library systems. Furthermore, there is a significant gap in scholarly literature that critically examines how such technologies are adopted, implemented, and evaluated in the context of school libraries in Nigeria.

The absence of comprehensive empirical studies on the assessment of the of innovative technologies in information service delivery in Unity Schools' libraries underscores a pressing need for research in this area. Without such evidence, policy decisions and educational investments may continue to overlook the transformative potential of technology in fostering inclusive, efficient, and future-ready library services. This study, therefore, seeks to investigate the extent to which innovative technologies are utilized in information service delivery in Unity Schools in Rivers State.

Objectives of the Study

The study investigated the use of innovative technologies in information service delivery in unity schools' libraries in Rivers State. Specifically, the study aims to:

1. **To assess the availability of Multimedia Resources for Information Service Delivery in Unity Schools' Libraries in Rivers State.**
2. **To examine the availability of Virtual Reference Services for information service delivery in Unity Schools' libraries in Rivers State.**

Research Questions

The following research questions were formulated to guide the study.

1. **What is the extent of availability of Multimedia Resources for Information Service Delivery in Unity Schools' Libraries in Rivers State?**
2. **What is the extent of availability of Virtual Reference Services for Information Service Delivery in Unity Schools' Libraries in Rivers State?**

Literature Reviews

Innovative Technologies

Innovative technologies encompass groundbreaking instruments, methodologies, and frameworks that improve operational processes, address challenges, and generate new avenues for advancement across diverse domains, such as education and library service provision. Within the context of libraries, innovative technologies have fundamentally transformed the modalities of information retrieval, organization, preservation, and distribution, resulting in services that are increasingly centered on user needs. According to Agbo and Eyindah (2023), innovative technologies in libraries encompass the use of digital platforms, mobile technologies, artificial intelligence (AI), virtual libraries, and cloud computing, all aimed at providing efficient information services. These technologies enable libraries to meet users' expectations in an era characterized by rapid technological change and a demand for instant information.

Onunka et al, (2023) argue that the integration of innovative technologies, such as integrated library systems (ILS), online public access catalogs (OPACs), and digital repositories, has significantly improved library operations by automating manual processes and expanding access beyond physical walls. This shift is vital in supporting remote learning, research, and information retrieval. Similarly, Baro, Onyenania, and Osaheni (2019) highlight those mobile technologies, such as smartphones and tablets, have enabled libraries to develop mobile-friendly resources, ensuring that users can access services on-the-go, thus enhancing service convenience and flexibility. Furthermore, AI applications, including chatbots and recommendation systems, are being utilized to personalize user experiences in modern libraries. Despite the numerous benefits, the adoption of innovative technologies also presents challenges, such as high implementation costs, the need for continuous staff training, digital divide issues, and concerns about information security (Nnadozie & Jude-Iwuoha 2020). Libraries, therefore, must strategically plan and invest in technology infrastructure to maximize the potentials while mitigating the risks.

Libraries have long been recognized as essential institutions in society, serving as repositories of

knowledge, facilitators of learning, and promoters of literacy and information dissemination. As society evolves, so too does the role of the library, adapting to technological advancements, changing user needs, and broader social transformations. The integration of innovative technologies into library operations has significantly transformed the landscape of information service delivery, enhancing the capacity of libraries to meet the evolving needs of users. The introduction of Information and Communication Technologies (ICTs) into libraries has not only streamlined traditional services but has also expanded the scope, accessibility, and efficiency of information provision. According to Aina (2018), technological innovations have led to the redefinition of library functions, from passive repositories of books to dynamic knowledge centers facilitating information retrieval, access, and dissemination through digital means.

One of the major impacts of technology in libraries is the facilitation of quick and remote access to vast information resources. With the advent of online public access catalogues (OPACs), digital repositories, e-books, and electronic databases, users are no longer restricted by geography or time in accessing information (Ogwo, et al , 2023).

Concept of Libraries

Traditionally, libraries were perceived mainly as physical spaces housing collections of books and other print materials. According to Aina (2018), a library is "an institution charged with the responsibility of acquiring, organizing, preserving, and providing access to knowledge and information." This fundamental definition highlights both the collection-based and service-oriented nature of libraries. The evolution of library services has shifted the perception of libraries from mere book depositories to dynamic centers for information access and knowledge creation. As Lankes (2016) asserts, modern libraries are spaces where communities come together to create, share, and preserve knowledge, emphasizing the participatory nature of contemporary library services. Libraries serve multiple critical functions, they are pivotal in education, providing resources and services to support learning at all levels (Rubin, 2020).

Libraries serve as hubs for information access and knowledge dissemination. In today's digital age, school libraries are increasingly providing access to digital information through electronic resources, internet services, and online learning platforms. Ejikeme and Okpala (2017), note that modern libraries facilitate the acquisition of 21st-century skills by exposing students to digital tools that promote creativity, collaboration, and innovation.

Concept of School Library

The school library is universally acknowledged as a cornerstone of effective education. It plays a vital role in supporting teaching and learning by providing access to a wide range of information resources, both print and digital, tailored to students' curricular and extracurricular needs. The importance of the school library has grown even more pronounced with the increasing demand for information literacy and lifelong learning skills in today's knowledge-driven society. School libraries serve as learning laboratories where students can access, evaluate, and use information effectively, a skill that is increasingly critical in the digital era (Bamigbola & Onifade 2024).

Nwankwo, et al (2022) argues that a functional school library provides equitable access to information, enabling students to bridge educational gaps regardless of socio-economic background. This aligns with the United Nations Sustainable Development Goal 4, which emphasizes inclusive and equitable quality education. School libraries also play a fundamental role in cultivating reading habits and promoting literacy. According to Merga (2020), the availability of a well-resourced school library significantly influences students' reading culture, particularly in environments where personal ownership of books is limited. The presence of a school library has been associated with improved academic performance, enhanced vocabulary, and better comprehension skills. These outcomes are especially relevant in Unity Schools, where students are prepared for national and international academic competitions. Another crucial dimension of the school library is its role in fostering information literacy and digital competence. As digital technologies reshape education, school libraries have evolved from being mere repositories of books to becoming dynamic information and technology centers. Boyer and Kelly (2014) notes that school libraries now integrate online databases, e-books, multimedia resources, and internet access to provide 21st-century learning experiences. The integration of technology into library services is not only essential for information retrieval but also for equipping students with skills to navigate an increasingly digital world. The advent of information and communication technologies (ICT) has profoundly transformed library operations and services. Libraries now integrate digital collections, online databases, electronic books (e-books), and virtual reference services into their offerings.

Concept of Information Service Delivery

Information Service Delivery (ISD) forms the backbone of effective library and information center operations. It entails the organized provision of information resources, services, and technologies to meet the knowledge needs of users efficiently and satisfactorily. As knowledge societies evolve, ISD increasingly incorporates innovative strategies and technological integration to enhance user access, usability, and satisfaction (Nzang & Awandia, 2024). Information Service Delivery is generally defined as the set of activities aimed at making information accessible, usable, and relevant to intended audiences. It

involves sourcing, organizing, disseminating, and evaluating information services to satisfy user needs. According to Aina (2018), ISD is "the systematic effort to identify and meet information needs with appropriate resources through suitable channels at the right time." The emphasis is on timely, accurate, and relevant information provision that aids in decision-making, learning, research, and development. Information Service Delivery encompasses several interrelated dimensions: Reference Services, Current Awareness Services (CAS) and Selective Dissemination of Information (SDI), User Education and Information Literacy, Electronic Information Services (EIS) among others. Information service delivery remains a critical component of library operations, serving as the foundation upon which knowledge acquisition, learning support, and intellectual development are built.

In educational settings, particularly school libraries, information services support the teaching and learning processes by offering guided access to resources, reference services, and research assistance. These services help students develop the ability to locate, evaluate, and effectively use information, thus promoting information literacy, a key competency in the 21st century (Emezie & Nwaohiri 2013). This function is especially relevant to Unity Schools in Rivers State, where students are expected to excel academically and compete at national levels. Without structured and efficient information service delivery, the potential of school libraries to contribute to holistic education is significantly diminished. Moreover, the importance of information services in libraries extends to the personalization of learning experiences. The integration of ICT in information services such as online catalogues, virtual reference services, and digital resource access has significantly expanded the scope and impact of library services.

Research Method

The study adopted a descriptive research design to investigate the availability of innovative technologies in information service delivery across Unity Schools' libraries in Rivers State. The population of this study was 3 Librarians. Given the relatively small number of Unity Schools in Rivers State, the entire population of library staff within these schools was considered manageable and relevant, thereby warranting a census approach. Observation checklist was used to elicit data and Simple percentages were used for the analysis of the data.

Results

Table 1: Availability of Multimedia resources for information service delivery in Unity School libraries

S/N	Items	Available	Not Available	% Available
1	YouTube EDU	3	0	100%
2	National Geography Kids	2	1	66.7%
3	Discovery Education	1	2	33.3%
4	Edpuzzle	1	2	33.3%
5	Audible (Audio books)	2	1	66.7%
6	LibriVox (Free Audiobooks)	0	3	0%

6LibriVox (Free Audiobooks)030% Table 1 assessed the availability of Multimedia resources for information service delivery in Unity School libraries. The analysis shows that the use of multimedia resources in Unity School libraries is moderately implemented. Out of the six multimedia tools assessed YouTube EDU recorded 100% availability, indicating that all the libraries have embraced these platforms. National Geographic Kids and Audible (Audiobooks) recorded 66.7% availability, reflecting a moderate level of adoption. In contrast, Discovery Education and Edpuzzle each recorded only 33.3% availability, revealing low adoption rates. LibriVox (Free Audiobooks) also revealed 0%, which means not available.

Table 2: Availability of virtual reference service for information service delivery in Unity School libraries

S/N	Item	Available	Not Available	% Available
1	WhatsApp	3	0	100%
2	Email	2	1	66.7%
3	Google chat	0	3	0%
4	Facebook Messenger	2	1	66.7%
5	Zoom	2	1	66.7%
6	Google meet	2	1	66.7%
7	Microsoft Teams	0	3	0%
8	Telegram	2	1	66.7%
9	LibAnswers	0	3	0%

Table 2 assessed the availability of virtual reference service for information service delivery in Unity School libraries. This table revealed that WhatsApp had 100% availability, making it the most consistently used virtual communication platform among the libraries. Tools like Email, Facebook Messenger, Zoom, Google Meet, and Telegram each recorded 66.7% availability, pointing to a moderate level of implementation. However, Google Chat, Microsoft Teams, and LibAnswers each recorded 0% availability, showing they are not in use at all.

Discussion of Findings

The first objectives of the findings revealed that platform such as YouTube EDU is reported to be available in all the libraries surveyed, suggesting a foundational level of digital resource utilization. However, more advanced and interactive multimedia platforms like Discovery Education, Edpuzzle and LibriVox showed low availability, indicating limited integration of curriculum-aligned digital tools that enhance student engagement and learning outcomes.

These findings align with the assertions of Agbo and Eyindah (2023), who emphasized the potential of innovative technologies such as digital platforms and multimedia tools in improving the efficiency of library services. The consistent availability of YouTube EDU suggests that school libraries are leveraging open-access platforms to provide flexible, audio-visual learning opportunities. This development supports the view of Ejikeme and Okpala (2017) that libraries now serve as instructional partners, providing resources that complement classroom instruction and promote independent learning.

However, the limited adoption of platforms like Discovery Education, Edpuzzle and LibriVox also underscores the challenges associated with implementing advanced technologies in Nigerian school libraries. Nnadozie and Jude-Iwuoha, (2020) highlighted several barriers to the effective integration of innovative technologies, including high implementation costs, lack of training, and infrastructural deficits. The current findings reflect these concerns and reveal that while Unity Schools are embracing basic technologies, more structured efforts are required to integrate advanced, pedagogically rich tools that support student-centered learning.

The second objectives of the findings revealed a similarly mixed picture regarding the availability of virtual reference services. WhatsApp was available in all libraries, indicating a strong preference for informal, real-time communication tools. Other platforms such as Email, Facebook Messenger, Zoom, Google Meet, and Telegram reflects a moderate level of digital communication adoption. In contrast, structured platforms like Google Chat, Microsoft Teams, and Lib Answers were completely pointing to a lack of formalized virtual reference systems.

The widespread use of WhatsApp supports the perspective of Okwu, Okwu, and Oladokun, (2024) who emphasized the role of responsive communication technologies in bridging the gap between users and information services. The use of familiar, user-friendly platforms like WhatsApp and Telegram reflects an attempt by school libraries to provide real-time support in a resource-constrained environment. However, the absence of professional virtual reference platforms such as LibAnswers and Microsoft Teams raises concerns about the depth and quality of digital service provision. According to Nzang and Awandia (2024), effective library service delivery should incorporate both physical and virtual methods that guide users, provide reference support, and promote information literacy. The lack of structured systems in Unity School libraries suggests a gap in delivering professional, standardized digital services that are essential in supporting research, inquiry, and academic excellence.

Conclusion

This study assessed the availability of innovative technologies, specifically multimedia resources and virtual reference services in Unity Schools' libraries in Rivers State. The findings revealed a partial and uneven integration of these technologies. These results suggest that although Unity School libraries are beginning to embrace digital tools, the integration remains limited in scope and depth. This constrains their ability to deliver comprehensive, user-centered information services. The disparity in technology availability points to underlying challenges such as lack of funding, inadequate infrastructure, and limited digital literacy among staff and students. Addressing these gaps is essential to transforming school libraries into dynamic centers for 21st-century learning, capable of supporting the academic and informational needs of students in a digital era.

Recommendations

1. Unity schools should expand their advanced and interactive multimedia platforms like Discovery Education, Edpuzzle and LibriVox which showed low availability.
2. Unity Schools should as a matter of urgency improve on the aspect of formalized virtual reference systems.

References

Aina, L. O. (2018). An analysis of quality reference services delivery as perceived by undergraduates in selected university libraries in South-West, Nigeria. *Library philosophy and practice*, 0_1.

Agbo, D.A., & Eyinnah, U.A. (2023). Effectiveness of Information Service Delivery through Marketing of Library Resources and Services. Information Impact Journal of Information and Knowledge Management, 13(2), 88-97 https://doi.org/10.4314/iijikm.v13i2.7

Bamigbola, A. A., & Onifade, C. O. (2024). Future Unlocked: School libraries Role in Promoting Future-ready skills for Learners. *National Secretariat*, 118.

Baro, E. E., Onyenania, G. O., & Osaheni, O. W. (2019). Internet use among academic librarians in a Nigerian University Library. *The Electronic Library*, *37*(4), 611-622.

Ejikeme, A. N., & Okpala, H. N. (2017). Promoting Children's learning through technology literacy: challenges to school librarians in the 21st century. *Education and Information Technologies*, *22*, 1163-1177.

Emezie, N. A., & Nwaohiri, N. M. (2013). 21st century librarians and effective information service delivery. *Information impact: Journal of information and knowledge management*, *4*(1), 30-43.

Ernst, M. I. (2023). The Crucial Role of School Libraries in Influencing Children's Literacy and Learning. *Journal of Childhood Literacy and Societal Issues*, *2*(1), 32-39.

eSehar, N. (2019). Innovation and development of information communication technology (ICT) in libraries: a new dimension in librarianship. *International Journal of Approximate Reasoning*, *7*(4), 1536–1542. https://doi.org/10.21474/IJAR01/8980

García-Avilés, J. A. (2020). Diffusion of innovation. *The international Encyclopedia of media psychology*, *1*(8), 1-8.

Lankes, R. D. (2016). Expect more: Demanding better libraries for today's complex world.

Merga, M. (2020). How can school libraries support student wellbeing? Evidence and implications for further research. *Journal of Library Administration*, *60*(6), 660-673.

Nnadozie, C. D., & Jude-Iwuoha, A. (2024). Comparative Study of School Libraries' Resources and Services in Public and Private Secondary Schools in Imo State, Nigeria. *A Journal of Nigerian Library Association Rivers State Chapter*, *7*(1).

Nwankwo, F. A., Akanwa, P. C., & Okorie, O. N. (2022). Management of School Libraries and Utilization of Library Resources by Secondary School Students in Rivers State. *Library Philosophy & Practice*.

Nzang, D. N., & Awandia, J. T. (2024). Information service delivery and its impact on students' academic achievement in tertiary institution libraries within the BuEa Municipality. *Greener Journal of Social Sciences*, *14*(2), 117-128.

Ogwo, U., Ibegbulem, F., & Ezema, I. J. (2023). Prospects and challenges of cloud computing for effective information service delivery in academic libraries in Nigeria.

Okwu, E., Okwu, N. E., & Oladokun, B. D. (2024). New Technological trends and application in libraries: An overview. In *Seminars in Medical Writing and Education* (Vol. 3, pp. 64-64).

Onunka, O., Onunka, T., Fawole, A. A., Adeleke, I. J., & Daraojimba, C. (2023). Library and information services in the digital age: Opportunities and challenges. *Acta Informatica Malaysia*, *7*(1), 113-121.

Rubin, R. E., & Rubin, R. G. (2020). *Foundations of library and information science*. American Library Association.

Availability and Use of Technology Devices for Service Delivery in Federal University Libraries in North Central of Nigeria

By

Mercy Enefu Okwoli (PhD, CLN)
mokwoli@noun.edu.ng
08033173383/09026008086
University Library
National Open University of Nigeria
University Village, Plot 91,
Cadastral zone, Nnamdi
Azikiwe Express Way, Jabi, Abuja

Solomon Obotu Akor (CLN)
Department of Library and Information Technology,
Federal University of Technology Ikot Abasi Akwa Ibom State
Akorsolomon11@gmail.com
08035927051
&
Mr. Babarotimi Opeyemi Oluwaseun
National Open University of Nigeria
University Village, Plot 91,
Cadastral zone, Nnamdi
Azikiwe Express Way, Jabi, Abuja
boluwaseun@noun.edu.ng +2348179594943

Abstract

This study investigates the availability and use of technology devices for service delivery in federal university libraries in North central of Nigeria. The objectives of the study were to examine the current state of technology devices available for use in federal university libraries in Nigeria, to identify the digital skills and competencies required by librarians to effectively use in federal university libraries in Nigeria, to assess the impact of technology devices for service delivery in federal university libraries in Nigeria and to determine the challenges associated with the availability and use of technology devices for services federal university libraries in Nigeria. This study adopted descriptive survey research design to investigate the availability and use of technology devices for service delivery in federal university libraries within Nigeria's North Central region. A sample of 243 respondents were selected for the study. And since the population is not large, the researchers decided to use proportional sampling techniques for all the population. Data was gathered through a structured questionnaire. The findings revealed that libraries are facing significant challenges in technology integration, particularly in terms of funding and technical skills. The high cost of advanced technologies and lack of adequate funding hinder libraries' ability to provide effective services. Additionally, limited technical skills among library staff pose a challenge. Conclusion and recommendations were made that Federal University Libraries in North Central should seek additional funding or alternative financing options to support cutting-edge technologies, and university administrations should advocate for larger library budgets. Federal University Libraries in North Central should invest in upgrading technology infrastructure, including digital storage, ICT hardware, and internet connection, and explore low-cost, scalable solutions.

Keywords: *Availability and Use, Technology Device, Service Delivery, Federal University Libraries and North Central Nigeria.*

Introduction

Technology has fundamentally transformed the way information is produced, shared, and accessed. This digital revolution has reshaped the field of Library and Information Science (LIS), requiring librarians to adopt a more dynamic, innovative, and tech-savvy approach in their service delivery. The traditional role of librarians as gatekeepers of information is rapidly shifting toward that of facilitators and collaborators, assisting users in navigating an increasingly complex information landscape (Abdulrahman, 2018). The integration of technology into librarianship offers numerous advantages. These include enhanced user experiences through personalized and interactive services, improved operational efficiency, and greater accessibility through remote access to digital collections (Islam &Islam, 2020). Libraries also benefit from cost savings associated with reduced physical storage requirements, better resource management, and improved preservation of digital resources. Additionally, technology provides librarians with opportunities for professional growth, job satisfaction, and leadership development. It fosters collaboration between librarians, researchers, faculty, and community leaders while strengthening research support services and improving users' digital literacy skills.

Information Communication Technology (ICT) has revolutionized the field of librarianship, bringing about significant advancements and opportunities. This article explores the benefits that ICT offers to librarians, empowering them to provide enhanced services, streamline operations, and adapt to the evolving information landscape. Information Communication Technology (ICT) has significantly transformed various industries and sectors, and librarianship is no exception. The integration of ICT in libraries has revolutionized the way information is accessed, managed, and shared. This chapter provides an overview of the background and context of the study, highlighting the increasing importance of ICT in the field of librarianship (Adedoyin, 2020).

ICT has transformed the way librarians provide access to information. Digital libraries, online databases, and electronic resources have expanded the scope of available materials, allowing librarians to offer a vast array of resources to their users. This enables users to access information remotely, breaking down barriers of time and location. ICT tools such as search engines, metadata management systems, and advanced indexing techniques have revolutionized information retrieval in libraries. Librarians can efficiently organize and categorize resources, making them easily discoverable for users. Advanced search capabilities enable users to find specific information quickly, enhancing the research process (Adigun, 2021).

ICT offers opportunities for librarians to personalize and enhance the user experience. Online Catalogs, recommendation systems, and user profiles enable librarians to provide tailored recommendations based on users' preferences and interests. As Mohammed and Otobo (2021) noted that virtual reference services and interactive platforms facilitate convenient and timely assistance, improving user satisfaction. ICT automates routine tasks and streamlines library operations. Integrated Library Systems (ILS) and library management software simplify processes such as cataloguing, circulation, and inventory management. This automation reduces manual errors, improves efficiency, and frees up librarians' time for more valuable user services.

Statement of the Problem

The integration of technology to improve information service delivery presents a significant challenge for federal university libraries in Nigeria's North Central region. Despite the potential benefits of technological advancement, including enhanced accessibility, operational efficiency, and enriched user experiences, many libraries struggle to maximize these opportunities due to persistent limitations in resources, infrastructure, and expertise. Key issues facing these libraries include inadequate technological infrastructure, such as insufficient computers, poor internet access, and a lack of digital repositories. Consequently, many libraries lack the modern tools necessary to offer advanced, technology-driven services to their users. Additionally, librarians frequently do not possess the essential digital skills and competencies required to effectively manage and leverage emerging technologies for service delivery (Adetimirin, 2019).

Financial constraints exacerbate these challenges, with many federal university libraries operating under limited budgets that hinder investments in technological upgrades and staff development. This situation results in a growing disparity between user expectations and the services libraries can provide, undermining their relevance in supporting academic activities. The implications of these challenges are significant for teaching, learning, and research across institutions such as the Federal University of Lafia, the University of Ilorin, and the University of Abuja, where the inability to meet evolving information needs can negatively impact the academic performance of both students and faculty.

This study aims to investigate the transformative impact of technology on librarianship and information service delivery in these libraries, assessing the current state of technology adoption, identifying necessary skills for librarians, exploring the challenges and opportunities of technological integration, and recommending strategies for sustainable technological development in the region.

Research Objectives

1. To examine the current state of technology devices available for use in federal university libraries in North Central, Nigeria.
2. To identify the digital skills and competencies required by librarians to effectively use in federal university libraries in North Central, Nigeria.
3. To assess the impact of technology devices for service delivery in federal university libraries in North Central, Nigeria.
4. To determine the challenges associated with the availability and use of technology devices for services federal university libraries in North Central, Nigeria.

Research Questions

1. What is the current state of technology devices available for use in federal university libraries in North Central, Nigeria?
2. What are the digital skills and competencies required by librarians to effectively use in federal university libraries in North Central, Nigeria?
3. What is the impact of technology devices for service delivery in federal university libraries in North Central, Nigeria?
4. What are the challenges associated with the availability and use of technology devices for services federal university libraries in North Central, Nigeria?

Significance of Study
This study offers crucial insights into the **transformative role of technology** in federal university libraries across Nigeria's North Central region. It will benefit librarians by identifying **essential skills and competencies** for effective technology adoption and highlighting professional development opportunities to meet evolving user needs. University management will gain a clearer understanding of **technological infrastructure's critical role** in supporting teaching, learning, and research. For policymakers, the findings will guide **funding and implementation strategies** for technological advancements, encouraging investment in infrastructure and capacity building. The study also contributes to existing literature on **digital transformation in libraries,** providing a foundation for future research. Ultimately, library users will benefit from **enhanced access to information, improved research support, and better overall experiences.**

Literature Review
Current State of Availability and Use of Technology Devices for Service Delivery Libraries
The global library landscape has undergone significant transformation due to technological advancements. Digital platforms, electronic databases, cloud storage, and automated cataloguing systems have redefined library operations (Islam & Islam, 2020). However, in developing countries like Nigeria, many university libraries still face limited adoption of these technologies. Mohammed and Otobo (2021) noted that technological infrastructure in many Nigerian federal university libraries remains inadequate, with insufficient internet access, limited digital collections, and outdated computer systems. This situation hampers their ability to meet users' information needs effectively. In the North Central region, institutions such as the University of Ilorin and the Federal University of Lafia face challenges in keeping up with modern library technologies. Factors such as poor funding and lack of technical support have been identified as major barriers to technological adoption (Nupal & Oleja, 2017).

Skills and Competencies Required by Librarians
As the role of librarians evolves, new skills are required to manage and utilize technological tools effectively. Essien, Abredu and Zotool (2022) emphasized the need for librarians to possess digital literacy skills, including knowledge of electronic resource management, data analytics, and digital preservation techniques. The ability to guide users in navigating complex digital resources is also essential. Furthermore, continuous professional development is critical. Adamu (2017) highlighted the importance of training programs and workshops to keep librarians updated on emerging trends and technologies. Without these competencies, librarians may struggle to remain relevant in a digitally driven environment.

Impact of Technology Devices for Service Delivery
Technology has revolutionized how information services are delivered in academic libraries. Key benefits include enhanced access to information through digital collections, improved operational efficiency, and personalized services for library users (Ariole, 2017). Remote access to resources has also enabled greater flexibility and convenience for users, fostering a culture of independent research and learning. However, Mohummed and Muhummed (2021) observed that in many Nigerian university libraries, the potential of technology remains underutilized. This has limited the capacity of libraries to fully support teaching, learning, and research activities. Successful integration of technology can bridge this gap by providing robust digital services and resources.

Challenges Associated with Technology Devices for Service Delivery
Several challenges hinder the effective adoption of technology in Nigerian university libraries. Funding constraints, inadequate infrastructure, and a lack of technical expertise are persistent issues (Essien et al., 2021). Additionally, there are concerns about data security, digital preservation, and user privacy when adopting certain technologies. Despite these challenges, numerous opportunities exist. Technological advancements provide avenues for collaboration between libraries, researchers, and academic departments. Digital repositories can also increase the visibility of research outputs, enhancing the reputation of universities (Adigun, 2021). Moreover, partnerships with technology vendors and government agencies can help address funding and infrastructure challenges.

Methodology
This study adopts a descriptive survey research design to investigate the availability and use of technology devices for service delivery in federal university libraries within Nigeria's North Central region. The target population comprises 243 library staff, including professional librarians and paraprofessionals staff from federal university libraries from the North Central Geo- Political Zones.
A sample of 243 respondents was selected for the study. And since the population is not large, the researchers decided to use proportional sampling techniques for all the population. Data was gathered through a structured questionnaire. The questionnaire covers demographic information availability information availability and use of technology devices for services in federal university libraries in North Central, Nigeria.
To ensure validity, research instruments were reviewed by experts and pilot-tested with 15 respondents outside the study population. Reliability was determined using Cronbach's alpha, with a minimum

acceptable threshold of 0.70. Data collection was conducted in person to facilitate a high response rate and provide clarification where needed. Quantitative data were analysed using descriptive statistics, including frequencies, percentages, means, and standard deviations.

Federal University Libraries in North Central Nigeria Sample Size

S/No	University Libraries	State	No of Librarians
1.	University of Ilorin, Ilorin	Kwara	32
2.	University of Abuja, Gwagwalada	FCT	30
3.	Federal University, Lokoja	Kogi	22
4.	University of Agriculture, Markudi	Benue	24
5.	Federal University of Health Sciences	Otukpo	10
6.	University of Jos, Jos	Plateau	35
7.	Federal University, Lafia	Nasarawa	30
8.	Federal University of Technology, Minna	Niger	35
9.	National Open University of Nigeria.	FCT	25
	Total		243

Discussions of Findings

Response Rate

Table 4.1: Distribution of Response Rate of Respondents According to their University Libraries.

S/No	University	No. of Questionnaire Administered	No of Librarians	Percentage
1	University of Ilorin, Ilorin	32	30	98
2	University of Abuja, Gwagwalada	30	30	FCT 90
3	Federal University, Lokoja	22	22	Kogi 90
4	University of Agriculture, Markudi	24	22	Benue
5	Federal University of Health Sciences	10	10	100
6	University of Jos, Jos	35	35	100
7	Federal University, Lafia	30	28	98
8	Federal University of Technology, Minna	35	32	96
9	National Open University of Nigeria.	25	25	100
	Total	**243**	**234**	**98.89**

This table presents data on the number of questionnaires administered and the number of librarians who responded from various university libraries. A total of 243 questionnaires were administered across 9 university libraries. The number of librarians who responded was 234, resulting in an overall response rate of 98.89%. Most university libraries had a high response rate, with 5 out of 8 universities achieving a 100% response rate. The University of Jos and University of Abuja had a perfect response rate with 35 and 30 librarians responding respectively out of the questionnaires administered. The Federal University of Technology, Minna had the lowest response rate at 96%, with 32 librarians responding out of 35 questionnaires administered. The high overall response rate of 98.89% suggests that the survey results are likely to be representative of the views of librarians in these universities.

Results

Table 1: Analysis of the Current State of Technology Adoption in Federal University Libraries (North Central Region)

SN	Item	SD 1	D 2	A 3	SA 4	Mean	SD
1	Internet Access	95 (28.4)	36 (10.6)	115 (34.7)	36 (26.4)	2.76	0.96
2	Automated Cataloguing System	72 (21.5)	60 (17.8)	86 (25.8)	116 (34.9)	2.60	1.02
3	Digital Repositories	70 (20.9)	60 (18)	80 (24)	124 (37.1)	2.67	1.03
4	Electronic Databases	63 (18.7)	141 (42.1)	71 (21.2)	60 (18)	2.62	0.99
5	Library Management Software	30 (8.9)	47 (14.1)	154 (46)	104 (31)	2.01	0.90
6	ICT Hardware Availability	66 (19.6)	172 (51.2)	41 (12.1)	3 (17.1)	2.97	0.77

Findings

The findings revealed that Internet Access has the most respondents agreed (34.7% agreed, 26.4% strongly agreed) that they have internet access, with a mean score of 2.76. Automated Cataloguing System: Respondents were generally positive (25.8% agreed, 34.9% strongly agreed) about the automated cataloguing system, with a mean score of 2.60. Digital Repositories: Most respondents (24% agreed, 37.1% strongly agreed) were positive about digital repositories, with a mean score of 2.67. Electronic Databases: Opinions were mixed, with 42.1% disagreeing and 21.2% agreeing, resulting in a mean score of 2.62. Library Management Software: Respondents were generally dissatisfied (46% neutral, but mean score of 2.01 suggests overall dissatisfaction). ICT Hardware Availability: The results show a strong disagreement (51.2% disagreed), with a mean score of 2.97 being skewed by the high number of disagreements, suggesting that ICT hardware availability is a significant issue. The mean scores and standard deviations provide insight into the respondents' attitudes with a mean score around 2.5-3 indicate a generally positive attitude. Lower mean scores (e.g., 2.01 for Library Management Software) indicate dissatisfaction or negative attitudes. Standard deviations around 1 or lower suggest relatively consistent responses, while higher standard deviations indicate more variability in opinions.

Table 2: Analysis of Digital Skills and Competencies required by Librarians to Leverage Technology for Enhanced Service Delivery

SN	Item	SD 1	D 2	A 3	SA 4	Mean	SD
1	Knowledge of Digital Resource Management	95 (28.4 %)	36 (10.6 %)	115 (34.7 %)	90 (26.4 %)	2.76	0.96

2	**Familiarity with Library Management Software**	**72 (21.5 %)**	**60 (17.8 %)**	**86 (25.8 %)**	**116 (34.9 %)**	**2.60**	**1.02**
3	Data Analytics and Use of Statistical Tools	70 (20.9 %)	60 (18%)	80 (24%)	124 (37.1 %)	2.67	1.03
4	**Knowledge of Digital Preservation Techniques**	**25 (12.7 %)**	**35 (15.8 %)**	**71 (32%)**	**102 (69.5 %)**	**2.62**	**0.99**
5	Ability to Provide Research Support via Digital Platforms	10 (8.9%)	28 (14.1 %)	92 (39.3 %)	104 (71.5 %)	2.01	0.90
6	**Web-based Information Retrieval and Search Techniques**	**12 (4.94.)**	**18 (7.41)**	**92 (39.3 2.)**	**112 (74.67)**	**2.97**	**0.77**

Findings

The survey results indicate that librarians have moderate to good knowledge in digital areas, with strengths in data analytics and library management software. However, they struggle with digital preservation techniques and web-based information retrieval. The findings suggest that librarians are generally confident in their skills, but there may be inconsistencies in scoring or interpretation. Overall, the study highlights the need for training and development in specific areas, particularly digital preservation techniques and web-based information retrieval. Librarians would benefit from continued development in digital resource management, data analytics, and library management software. By focusing on these areas, librarians can improve their skills and knowledge, ultimately enhancing their support for researchers and users. The study's findings provide valuable insights for libraries seeking to optimize their digital initiatives and staff training programs. Training programs can be tailored to address the identified gaps and improve librarians' digital skills.

Table 3: Impact of Technology Devices for Service Delivery in Federal University Libraries in the North Central Region.

SN	Impact Areas	SD 1	D 2	A 3	SA 4	Mean	SD
1	Improved Access to Information (Digital Resources)	36 (10.4 %)	36 (10.4 %)	115 (50.9 %)	95 (28.4 %)	2.76	0.96
2	**Enhanced User Experience (Personalized Services)**	**72 (21.5 %)**	**60 (17.8 %)**	**86 (25.8 %)**	**116 (34.9 %)**	**2.60**	**1.02**
3	Increased Efficiency in Library Operations	70 (20.9 %)	60 (18%)	80 (24%)	124 (37.1 %)	2.67	1.03

4	Remote Access to Library Services	63 (18.7 %)	60 (18%)	71 (21.2 %)	141 (42.1 %)	2.62	0.99
5	Improved Collaboration with Academic Departments	30 (8.9%)	47 (14.1 %)	154 (46%)	104 (31%)	2.01	0.90
6	Streamlined Library Management and Automation	3 (9.6%)	41 (12.2 %)	172 (51.1 %)	66 (19.9 %)	2.97	0.77
7	Enhancement of Research Support and Assistance	36 (10.4 %)	37 (10.6 %)	118 (35%)	94 (28.4 %)	2.98	0.97
8	Increased Visibility of Research Outputs	9 (4.4%)	34 (10.6 %)	105 (38%)	156 (48%)	3.00	0.98
9	Improved Preservation of Library Collections	10 (5.0%)	37 (10.8 %)	107 (39%)	154 (47%)		
10	Increased User Digital Literacy and Self-Service Skills.						

Findings

The study's findings indicate that digital initiatives have had a significant impact on libraries. Libraries are successfully promoting research outputs, providing effective support for researchers, and improving operational efficiency. However, areas like collaboration with academic departments and personalized services require improvement. The study suggests that libraries need to develop more effective strategies for working with academic departments to better support research initiatives. The findings indicate a positive perception of digital initiatives in libraries, with a high percentage of respondents agreeing that these initiatives have had a positive impact. The standard deviations range from 0.77 to 1.03, indicating some variation in responses, but the low standard deviation for streamlined library management and automation suggests strong agreement among respondents.

Overall, the study highlights the potential of digital initiatives to enhance library services and support for users. By addressing areas that need improvement, libraries can further leverage technology to promote research outputs, support researchers, and improve operational efficiency. The study's findings provide valuable insights for libraries seeking to optimize their digital initiatives and better meet the needs of their users.

Table 4: Challenges Associated with the Adoption of Technology in Federal University Libraries in the North Central Region

S/N	Challenges	SD 1	D 2	A 3	SA 4	Mean	SD
1	Lack of Adequate Funding for Technology Integration	0,(0%)	15 (9.9%)	55 (36.2%)	82 (53.9%)	3.90	0.70

2.	Limited Technical Skills and Training for Library Staff	0(0%)	23(15.1 %)	61(40.1 %)	68(44.7 %)	3.80	0.75
3	Insufficient Technological Infrastructure (e.g., Internet)	8 (5.3%)	30(19.7 %)	64 (42.1%)	50 (32.9%)	3.60	0.80
4	Resistance to Change from Library Staff	15 (9.9%)	35 (23%)	62 (40.8%)	40 (26.3%)	3.40	0.85
5	High Cost of Advanced Technologies (Software/Hardware)	0(0%)	10 (6.6%)	50 (32.9%)	92 (60.5%)	4.00	0.68
6	Opportunities for Collaboration with External Tech Partners	0 (0%)	10 (6.6%)	50 (32.9%)	52 (34.2%)	3.50	0.88
7	Improved Access to Educational Resources (e.g., Databases)	0 (0%)	5 (3.3%)	40 (26.3%)	107 (70.4%)	4.20	0.60
8	Enhancement of User Experience and Engagement	0(0%)	15 (9.9%)	55 (36.2%)	82 (53.9%)	3.90	0.70
9	Development of Innovative Library Services (e.g., Virtual)	5 (3.3%)	25 (16.4%)	62 (40.8%)	60 (39.5%)	3.70	0.77
10	Potential for Improved Research Support and Collaboration	0 (0%)	20 (13.2%)	55 (36.2%)	77 (50.7%)	3.80	0.72

Findings

The findings revealed challenges Associated with the Adoption of Technology in libraries. High cost of advanced technologies has the most significant challenge, with 60.5% of respondents strongly agreeing that it's a challenge. Lack of Adequate Funding has 53.9% of respondents strongly agree that lack of funding is a challenge. Limited technical skills have 44.7% of respondents strongly agree that limited technical skills are a challenge. Insufficient technological infrastructure 42.1% agree, and 32.9% strongly agree that this is a challenge. 40.8% agree, and 26.3% strongly agree that this is a challenge. Opportunities for Collaboration: 39.5% agree, and 34.2% strongly agree that this is an opportunity and development of Innovative Services: 40.8% agree, and 39.5% strongly agree that this is an opportunity. The table highlights the challenges and opportunities faced by libraries in technology integration. The top challenges are related to funding, cost, and technical skills, while the top opportunities are related to improving access to resources, user experience, and research support.

Discussion of Findings

The study revealed that libraries are facing significant challenges in technology integration, particularly in terms of funding and technical skills. The high cost of advanced technologies and lack of adequate funding hinder libraries' ability to provide effective services. Additionally, limited technical skills among library staff pose a challenge. These findings agree with Muhmmad and Otobo (2022) who ascertained that despite

these challenges, libraries have opportunities for growth and improvement. Technology integration can improve access to educational resources, enhance user experience, and support research and collaboration. Libraries can leverage technology to provide greater access to educational resources, improve user engagement, and facilitate research and collaboration (Essien et al. (2022).

These findings suggest that libraries need to prioritize funding for technology initiatives and invest in staff training and development. This is in confirmation with the findings of Adedoyin (2020) who noted that libraries can effectively utilize technology to support their mission and goals. Overall, the study highlights the importance of technology integration in libraries and the need for libraries to address the challenges and seize the opportunities presented by technology.

Conclusion

This study revealed that library staff have varying levels of digital literacy and library management skills. While they demonstrate strengths in certain areas, such as web-based information retrieval and search techniques, they also show room for improvement in areas like data analytics and library management software. The study highlights the positive impact of digital initiatives in libraries, particularly in areas like increased visibility of research outputs, enhancement of research support, and streamlined library management. However, there is room for improvement in areas like collaboration with academic departments and personalized services. The study identified significant challenges facing libraries, including high costs of advanced technologies, lack of adequate funding, and limited technical skills. Despite these challenges, libraries have opportunities for growth and improvement, particularly in areas like improved access to educational resources, enhancement of user experience, and potential for improved research support. Overall, the study suggests that libraries are making progress in digital initiatives, but there is still work to be done to address challenges and seize opportunities.

Recommendations Based on the Findings

Based on the findings of the study regarding the current state of technology adoption in federal university libraries in Nigeria's North Central region, the following recommendations are proposed:

1. Federal University Libraries in North Central should seek additional funding or alternative financing options to support cutting-edge technologies, and university administrations should advocate for larger library budgets.

2. Federal University Libraries in North Central should invest in upgrading technology infrastructure, including digital storage, ICT hardware, and internet connection, and explore low-cost, scalable solutions.

3. Library staff resistance to reform can be addressed by fostering an innovative culture, providing training and support, and encouraging open communication about technology's benefits, to ensure a smooth transition in Federal University Libraries in North Central of Nigeria.

4. To facilitate seamless technology integration and expanded service delivery, libraries must prioritize upgrading their core technology infrastructure, including digital storage, ICT hardware, and reliable internet connectivity. Additionally, exploring affordable, scalable solutions will enable libraries to gradually transition to comprehensive technology adoption while maximizing value with limited resources in federal university libraries in North Central, Nigeria.

References

Abdulrahman, A. R. (2018). Corporate Social Responsibility in Higher Education: A study of the institutionalization of CSR IN Malaysian Public Universities. *Corporate Social Responsibility and Environmental Management*, 26(4), Accessed at https://dio.org/10.1002/csr.1731https://dio.org/10.1002/csr.1731.

Adedoyin, A. T. (2020). Information and Communication Technologies and Information professionals in the information Age. The Nigerian prospective. In compendium of papers presented at the Annual National conference and AGM of Nigerian library Association, Owerri. 72-82.

Adetimirin, A. E. (2019) Availability, accessibility and use of information and communication technologies by undergraduates in Nigerian universities: What role for university library? (Unpublished). A paper presented at the 45th National conference of Nigerian Library Association, Uyo on 9th - 14th September 2019.

Adigun, T.A. (2021). Adoption and use of Information and communication technologies in Nigerian libraries: opportunities and challenges. *Ebonyi Journal of Library and Information Science,* 2(1), 58-69.

Adamu, R. (2017). Assessment of Library Service Quality and User Satisfaction among undergraduate students of Yusuf Maitama Sule University (YMSU) Library. *Library Philosophy and Practice (ejournal)*. Retrieved 18th March 2025 from

http://digitalcomons.unl.ed./libphilprac/1675.81. Retrieved 18th March 2025 from http://digitalcomons.unl.ed./libphilprac/1675.81

Ariole, I. A. (2017). Utilization and Users' satisfaction with ICT Services in Provided in Public Libraries in Nigeria. *International Journal of Applied Technologies in Library and Information Management*,3(3). Available at http://www.jatlim.org.

Essien, F. K, Lu, Z.P., Abredu, P. & ZotooI. (2022). Effect of ICT Use on Library Service Delivery: A Comparative Approach from Two Universities. *Open Access Library Journal*, 9: Accessed at https://dio.org/10.4236/Oalib.110865

Ezewanfor, J. J., Mins, F. and Gbande, M. (2018). Adequacy and Utilization of ICT Resources for Quality Instructional Delivery in Business Education in Universities in South-West Nigeria. *International Journal of Innovative Information Systems and Technology Research,* 6(11).212-120.

Islam, S. & Islam, N. (2020). Information and Communication Technology (IC) in libraries: A new dimension in librarianship. *Asian Journal of information and communication technology*,5(8):809- 817.https://www.mbjlisonline.org/.

Muhammad, K. S, & Otobo, E. E (2021). Academic Libraries and Challenges of Services Delivery in Nigerian Universities in the Digital Era. Information Impact: Journal of Information and Knowledge Management, 12(2). Accessed at https://dx.doi.org/10.4314/iijikm.V12 Accessed at https://dx.doi.org/10.4314/iijikm.V12 i2.4.

Nupal, A.Y & Oleja, C.N. (2017). Selection of Sustainable Sanitation of technologies for Urban Slums – A case of Braise III in Kampala, Uganda. The Science of Total Environment 409 (1) 52-62.

Awareness and Utilization of Artificial Intelligence Tools for Research Productivity by Masters Students of Distance Learning Center, Ahmadu Bello University, Zaria

WHONG, Fidelia Mbowheing[1]; Esew Michael[1] Adedokun Aderonke Olubukola, PhD1 & AVAJAH, Ngozika
[1]Kashim Ibrahim Library, Ahmadu Bello University, Zaria
fideliawhong@gmail.com **+234 8035 9276 24**
yaw4mi@gmail.com **+ 234 802 572 6783**
[2]Department of Library and Information Science, Ahmadu Bello University, Zaria
ngozikeeaberea@gmail.com

Abstract
This study discusses the Role of Artificial Intelligence (AI) tools in enhancing academic research productivity and innovation by students of master's in information management a comparative study of Ahmadu Bello University Zaria Distance Learning Center (ABU DLC). The specific objectives were to determine the types of Artificial intelligence tools the students of MIM at ABU DLC are aware of for their innovation and productivity in academic research; determine the types of AI tools that students of MIM at ABU DLC use for productivity and innovation in their academic research; as well as Identify the challenges encountered by students of MIM at DLC in the utilization of AI tools for academic research, productivity, and innovation. Using a quantitative approach, data were collected from 140 students via an online questionnaire. Findings revealed high awareness and usage of AI tools such as Google Scholar, semantic scholar and Scite with score of 111 (84.1%), and Plagiarism checking like Turnitin and Plagscan with score of 93 (70.5%). However, students reported limited awareness of Data analysis and Visualization AI tools like SPSS AI Extensions and Tableau among others with score below the benchmark of 11(8.3%) and reference management AI tools of Mendeley and Zotero with frequency of 16 (12.1%). The challenges among others were limited access to advanced AI tools 100(75%), lack of technical skills and training 96 (72.7%) and Data privacy and security concern with the frequency of 89(67.4%) all above the threshold for significant decision of 50%. The study concludes that the underscores the needs for enhance training and awareness on AI tools to foster 7innovation and productivity in academic research and recommend an increased in institutional support through training and workshops on research AI tools to enhance data analysis and visualization and reference management such as IBM Watson, Mendeley, and EndNote to boost research innovation and productivity.

Keywords: *Artificial Intelligence, Academic Research, Productivity, Innovation, Distance Learning, master's in information management, Ahmadu Bello University*

Introduction
Artificial Intelligence (AI) has become a transformative force across numerous sectors, including education, where it is reshaping how academic research is conducted. AI comprises technologies like machine learning, natural language processing, and computer vision that mimic human intelligence to perform complex tasks such as pattern recognition, decision-making, and language understanding. In academia, these capabilities are being leveraged to boost research productivity, enhance writing quality, and foster innovation. AI's role in academic writing is increasingly recognized. Studies by Abdalkader (2022) and Alharbi (2023) highlight how AI-powered tools can improve students' writing skills by offering real-time feedback and personalized suggestions. These tools not only support language acquisition but also elevate the standard of academic writing, making them valuable assets for both students and researchers. However, the integration of AI in scientific writing also raises concerns. Altmäe, Sola-Leyva, and Salumets (2023) discuss the dual role of AI, noting its ability to enhance clarity and precision, while also cautioning against over-reliance, which may undermine critical thinking skills. This underscores the need for a balanced and ethical approach to AI use in academia.

Ahmadu Bello University (ABU) Distance Learning Center (DLC), established in 2004 in Zaria, Nigeria, represents a strategic initiative to extend quality education to learners beyond traditional classroom settings. Designed to accommodate working professionals and geographically distant students, the DLC utilizes modern Information and Communication Technologies (ICT), including Learning Management Systems (LMS), digital libraries, and online platforms for content delivery and interaction. This ICT-driven approach reflects ABU's commitment to flexible, accessible, and technologically enhanced education, making it an ideal setting to study the impact of AI tools on academic research and innovation. Despite its successes, the Distance Learning Center faces challenges such as maintaining robust technical support and ensuring equitable access to digital resources among students (Eze & Onyekuru, 2021). Nonetheless, its establishment marks a pivotal step towards modernizing education delivery in Nigeria and demonstrates ABU's role in advancing educational opportunities through innovative methods.

Statement of Problem
Artificial Intelligence (AI) has become a transformative force, profoundly influencing various sectors, including academia. Its integration into academic research offers opportunities to enhance productivity and

foster innovation. It has been observed by other authors that many students lack awareness and understanding of the different types of AI tools available for academic use (Abdulkader, 2022; Burkhard, 2022 and Altmae, Sola-Leyva and Salpumets 2023). Even when some awareness exists, the actual use of these tools is often sporadic and inconsistent. Many students either do not utilize these technologies to their full potential or avoid them altogether due to various challenges, such as inadequate training, limited access to resources, or reluctance to adopt new technologies (Jacso 2005; and Adamu and Umar, 2023). Consequently, the potential benefits of AI in enhancing students' academic productivity and innovation are not fully realized.

Based on literatures, researchers work with students as tutors and project supervisors, there is a pressing need to identify the AI tools that students at Ahmadu Bello University Zaria Distance Learning Center are aware of and currently use for their academic research. This research aims to explore these issues in depth, offering insights and recommendations to bridge the gap and maximize the potential of AI in academic pursuits at Ahmadu Bello University Zaria Distance Learning Center. The specific objectives are to:

1. Identify the types of Artificial intelligence tools the students of MIM, ABU DLC are aware of for their innovation and productivity in academic research.
2. Find out the type of Artificial intelligence tools utilized by students of MIM, ABU DLC for productivity and innovation in their academic research.
3. Determine the extent to which students of MIM, ABU DLC make use of Artificial intelligence tools for academic research and activities research enhancing productivity and innovation.
4. Identify the challenges encountered by students of MIM, ABU DLC in the utilization of Artificial intelligence tools for academic research, productivity, and innovation.

Literature Review

The researchers reviewed literatures based on the objectives of the study.

Concept of Artificial Intelligence in Academic Research

Artificial Intelligence (AI) is reshaping the landscape of academic research by applying advanced technologies such as algorithms, machine learning, and data analytics to tasks that traditionally required human intellect. Far beyond simple automation, AI fundamentally transforms how scholars conduct research enhancing data analysis, improving decision-making processes, and streamlining literature reviews. As Russell and Norvig (2020) observed, AI systems can analyze vast datasets efficiently, delivering insights and solutions that would otherwise demand extensive human time and effort. A key advantage of AI in academia is its ability to process and interpret large volumes of data, overcoming the limitations of traditional research methods. In fields inundated with complex data like healthcare and the social sciences AI tools identify patterns, detect anomalies, and reveal correlations often missed by conventional techniques. For example, in healthcare research, AI can be used to track disease progression through patient data, contributing to improved outcomes (Baker & Inventado, 2021). Similarly, in social science research, AI analyzes data from platforms such as social media to uncover trends in public opinion and behavior.

Study by Gonzalez and Weigel (2023) classified research and innovation Artificial intelligence tools which students can utilized to enhance their research processing include: *Research and literature review AI tools* which are not limited to; google scholar, sematic scholar, connected paper, research Rabbit and Scite. Hope et al., (2022) added that A variety of AI-powered tools have been developed to assist researchers in conducting comprehensive literature reviews. These tools include, but are not limited to, Google Scholar, Semantic Scholar, Connected Papers, Research Rabbit, and Scite. They utilized machine learning and natural language processing to identify relevant publications, visualize citation networks, and suggest related works, thereby streamlining the research discovery process. *Writing and Grammer assistance:* Recent advancements in artificial intelligence have led to the development of numerous writing and grammar assistance tools designed to support academic and professional writing Tools such as Grammarly, QuillBot, ChatGPT, Scribbr AI, and Writefull are increasingly used to enhance the quality, clarity, and grammatical accuracy of written content. Kumar, and Bharti (2023) in their study noted that Grammarly offers real-time grammar, punctuation, and style suggestions, helping users refine their writing and QuillBot is known for its paraphrasing capabilities, aiding users in rephrasing sentences to improve clarity and avoid plagiarism. Similarly, Osakwe, Nwafor and Okeke (2022) noted that ChatGPT, developed by OpenAI, provides AI-driven conversational support, including content generation, brainstorming, and revision guidance, making it a versatile tool for writers and Scribbr AI focuses on academic writing, offering citation generators and plagiarism detection tools that are especially useful for students and researchers. Zhao, wu and Chen 2020 added that Writefull utilizes natural language processing to help with academic writing by suggesting discipline-specific language and checking the coherence of scientific texts. These tools collectively contribute to improving writing efficiency and accuracy, and their integration into academic workflows reflects a growing reliance on AI to support the writing process such as Grammarly, quill Bot, ChatGPT, scriber AI and writefull Data.

Study by Shafiq and Yousaf (2023) identified, Data Analysis and Visualization like IBM Watson studio, Orange, RapidMiner, Tableau and SPSS AI extension; Reference management such as Mendeley, Zotero,

EndNote, and CiteThisForMe; Plagiarism checking like Turnitin, unicheck, and PlagScan and Note-taking and Organization AI tools such as Notion AI, Evernote and Obsidian "Beyond data analysis as some of the AI tools researchers can use to enhance their research activities. AI also plays a pivotal role in fostering collaboration among researchers. AI-enabled collaborative platforms support real-time communication, information synthesis, and the aggregation of inputs from diverse contributors, thereby expediting the research process (Stienmetz, 2023). This shift introduces new methodological paradigms, particularly in areas like literature reviews and data synthesis. Instead of manually reviewing large numbers of articles, researchers can now use AI tools to automate these tasks, freeing time for deeper interpretation and critical analysis. This transformation enhances both the efficiency and the intellectual quality of research outputs (Ali & Hossain, 2024). However, as AI becomes increasingly integrated into academic practice, there is a growing emphasis on the ethical and responsible use of these tools. Patel and Sinha (2023) highlight the importance of addressing issues such as data privacy, algorithmic bias, and research integrity to ensure that AI contributes positively and equitably to academic advancement.

Awareness of Artificial Intelligence Tools Among Students

Awareness of Artificial Intelligence (AI) tools among higher education students is crucial for enhancing their research capabilities. Despite recognizing AI's transformative potential, many students have limited understanding of specific tools and their applications, which can hinder their research outcomes (Khan et al., 2021). A study by Abubakar et al. (2022) found that many students in Information management programs were unfamiliar with key AI tools like machine learning and data visualization software, which are essential for modern research practices. Factors such as limited exposure to AI technologies in academic curricula (Gonzalez & Weigel, 2023) and insufficient access to training resources contribute to this gap in awareness. To address this issue, educational institutions should integrate AI literacy into their curricula, offering both theoretical knowledge and hands-on experience with AI tools. Collaborations with industry partners could ensure content stays current. Creating a culture of collaboration, where students and faculty share knowledge and engage in interdisciplinary projects, can also enhance AI awareness (Verma & Singh, 2023). Additionally, leveraging online resources like courses, tutorials, and webinars could provide students with flexible learning opportunities. By bridging these awareness gaps, institutions can empower students to utilize AI tools in their research, ensuring they are prepared for a technology-driven future and contributing to research and innovation in higher education

Utilization of Artificial Intelligence Tools by Students

The use of Artificial Intelligence (AI) tools in academic research is an emerging trend that is reshaping education, with students increasingly adopting technologies like chatbots, data analytics platforms, and plagiarism detection software (Osakwe et al., 2022). While AI tools are enhancing research productivity, their utilization varies among students, with some hesitant to adopt these technologies due to a lack of technical skills or familiarity (Abubakar et al., 2022). This highlights the need for universities to offer more comprehensive training and resources (Adamu & Umar, 2023). The disparity in AI tool usage also raises concerns about equity and accessibility, as students without adequate training or resources may miss out on the benefits AI offers. AI tools not only improve research capabilities but also foster innovation by enabling new methodologies and more robust data analysis (Ali & Hossain, 2024). AI can assist students in analyzing large datasets, identifying patterns, and enhancing the efficiency and accuracy of their research. Additionally, AI facilitates collaboration, allowing students from various disciplines to work together and generate interdisciplinary solutions.

However, successful integration of AI tools faces challenges, primarily the need for digital literacy and technical competence (Adamu & Umar, 2023). Many students may lack the necessary training, leading to frustration and hesitation in using these tools. Collaboration between students, faculty, and industry professionals can enhance understanding and inspire innovation, with guest lectures and mentorship programs offering valuable insights. To optimize AI tool utilization, institutions should assess the effectiveness of their training programs and gather student feedback to improve initiatives. By investing in training, promoting collaboration, and addressing ethical issues, universities can help students navigate AI tools effectively. As AI's role in academia expands, equipping students with the necessary skills will be vital for their success, leading to higher-quality research outcomes benefiting students, researchers, and society.

Extent of Artificial Intelligence tools used for enhancing productivity and innovation in Academic Research

Artificial Intelligence (AI) tools are significantly enhancing productivity and innovation in academic research by automating tasks like data collection, analysis, and interpretation, thus transforming research methodologies (Zhao et al., 2020). AI tools, particularly in literature reviews, expedite the process by scanning vast databases and identifying relevant studies, saving researchers considerable time (Raza et al., 2021). This allows for more focus on critical phases like analysis and interpretation, improving research efficiency.

A study by Shafiq and Yousaf (2023) found a 30% increase in efficiency for students using AI-based data analysis tools compared to traditional methods. AI's ability to handle large datasets and uncover patterns

quickly enables researchers to draw conclusions faster and more effectively. Moreover, AI facilitates innovative research approaches, enabling students to integrate diverse data sources for interdisciplinary studies (Eisenberg et al., 2022). In the study by Adamu and Umar (2023) who stated that AI also enhances collaboration by allowing real-time communication and data sharing among researchers, leading to interdisciplinary projects and innovative solutions. However, challenges such as varying digital literacy levels among students and ethical concerns regarding data privacy, algorithmic bias, and misrepresentation of findings need to be addressed. Institutions should not only focus on AI tool usage but also emphasize responsible usage, offering workshops and discussions on ethical considerations. To maximize AI's potential usage, Osakwe, Nwafor and Okeke (2022) stated that universities must invest in training programs that build digital literacy and technical skills, including workshops, tutorials, and peer-led sessions. Continuously assessing and improving these programs based on student feedback will ensure their relevance and effectiveness. Properly integrating AI tools into academic research can lead to improved productivity, innovative methodologies, and higher-quality outcomes, benefiting both students and the broader academic community which may reduce the challenges encounter by students.

Challenges Faced by Students in Using Artificial Intelligence Tools for Academic Research

Despite the significant advantages AI tools offer for academic research, students face multiple challenges that hinder their effective utilization. These barriers need to be addressed to maximize the benefits of AI in enhancing research productivity and innovation. A study by Khan et al (2023) stated that the primary challenge is the lack of technical proficiency among students. Many feel inadequate when using complex AI tools, which can lead to frustration and underutilization of available technologies. Similarly, Kumar and Bharti (2023) added that the skills gap prevents students from fully benefiting from AI, particularly in areas like data analysis and literature reviews, where AI tools can significantly enhance research outcomes. Institutions must provide comprehensive training to equip students with the necessary skills to navigate and effectively use AI tools.

Another challenge is the accessibility of AI tools. While some institutions have invested in AI technologies, others may lack the necessary resources, creating disparities between students in resource-rich environments and those in less-equipped institutions (Kumar & Bharti, 2023). This inequitable access limits opportunities for research, particularly for students from disadvantaged backgrounds. To mitigate this, Osakwe, Nwafor and Okeke (2022) pointed out that universities could form partnerships with tech companies or research institutions to provide access to AI tools and seek funding to improve technological resources in underfunded programs to reduce high cost of AI software and subscription. Concerns about data privacy and the ethical use of AI tools also pose significant challenges, Patel and Sinha (2023) opined that many students are apprehensive about how their personal or sensitive data is used by AI applications These concerns highlight the need for universities to not only provide AI tools but also educate students on responsible usage and data privacy. Including discussions on ethical AI use, data privacy, and algorithmic biases in curricula can help students make informed decisions and practice ethical research (Kumar and Bharti, 2023). Osakwe, Nwafor and Okeke (2022) noted that the universities should also establish clear guidelines on responsible AI usage. The rapid pace of AI development presents another challenge. As new technologies and tools emerge, students may feel overwhelmed by the need to continuously adapt. To address this, Patel & Sinha, (2023) noted that universities should encourage a mindset of lifelong learning, helping students view technological advancements as opportunities for growth rather than obstacles. This approach can foster a more proactive attitude toward learning new tools.

Creating a culture of innovation within academic institutions can further support students as stated by (Kumar and Bharti, 2023) By fostering environments where students are encouraged to experiment with new methodologies and tools, such as through hackathons or interdisciplinary research projects, students can gain confidence in using AI technologies Such initiatives can help students apply AI in practical contexts, enhancing their skills and facilitating creativity in their research. In conclusion, while AI tools offer substantial benefits for academic research, students face challenges related to technical proficiency, accessibility, ethical concerns, and the rapid evolution of technology. Universities can address these issues by providing targeted training, improving access to resources, promoting ethical practices, and encouraging innovation. Overcoming these challenges will enable students to fully leverage AI tools, ultimately advancing knowledge and research across fields.

Research Methodology

The study adopted the quantitative research method through the use of a survey research design. Survey research design was adopted here because of the size of the study. The target population in this research were comprised of students of master's in information management at Ahmadu Bello University Distance Learning Center enrolled in 2023 with a population of 219 (ABU Zaria, Learning Management System, (LMS) 2024). Simple random sampling technique was used to select 140 students as a sample size based on the table for determination of sample size for a known population by Krejci and Morgan (1970). The researchers used a self-developed questionnaire for data collection, which was administered via an online survey involving the use of Google Forms. A time frame of one week was given to the respondents. The Google form was created and the link to the online forms was sent to the MIM student WhatsApp group so that it would be accessed by all students, with a message soliciting support to fill the forms. After the stated

period of a week, all responses received were analyzed and presented using descriptive statistics involving percentage and frequency distribution tables. To interpret the findings, the researchers adopted a 50% benchmark as the threshold as significant for decision-making, while responses below 50% are not considered significant. This approach ensures that the analysis remains straightforward and provides a clear understanding of prevailing opinions.

Data Analysis and Discussion

From the sample size of 140, only 132 responded to the survey representing 94.3%. The analysis of data presented here is based on the information provided by respondents on the questionnaire administered by the researcher.

Table 1: Types of AI Tools Students of MIM of ABU DLC are aware of, for their innovation and productivity in academic research

Types of Artificial intelligence tools used for:	f	%
Research & Literature Review AI tools such as (Google Scholar, Semantic Scholar, Connected Papers, Research Rabbit and Scite)	111	84.1
Writing & Grammar Assistance (Grammarly, Quill Bot, ChatGPT, Scribbr AI and Writefull	43	32.6
Data Analysis & Visualization (IBM Watson Studio, Orange, RapidMiner, Tableau, SPSS (AI Extensions)	11	8.3
Reference Management (Mendeley, Zotero, EndNote, and CiteThisForMe)	16	12.1
Plagiarism Checking (Turnitin, Unicheck and PlagScan)	93	70.5
Note-Taking & Organization (Notion AI, Evernote and Obsidian)	19	14.4

Field survey, 2024

Table 2 examines the level of awareness of various AI tools among master's students in Information Management at Ahmadu Bello University, Zaria Distance Learning Center (ABU DLC). The findings show that Research & Literature Review AI tools such as (Google Scholar, Semantic Scholar, Connected Papers, ResearchRabbit and Scite) is the most recognized with frequency score of 111 (84.1**%)** of students acknowledging its usefulness in enhancing innovation and productivity in academic research. This supports Bhardwaj and Kumar's (2020) view of research and literature review AI tools like Google Scholar as a reliable platform for accessing academic resources. Plagiarism Checking (Turnitin, Unicheck and PlagScan) with 93 (70.5%). While Data Analysis & Visualization (IBM Watson Studio, Orange, RapidMiner, Tableau, SPSS (AI Extensions) was the least frequency with 11(8.3%). These results reveal that while students are well-versed in basic research and plagiarism detection tools, their awareness of more sophisticated AI applications remains limited. This aligns with Luckin's (2017) findings, which stress the importance of advanced AI tools in enabling deeper, more complex research. Consequently, there is a clear need for educational institutions to implement targeted training and resources to increase students' exposure to and proficiency with advanced AI technologies

Table 2: Types of AI tools Utilized by students of MIM at ABU DLC for productivity and innovation in their academic research

AI tools use for productivity and innovation by MIM students	F	%
Research & Literature Review AI tools such as (Google Scholar, Semantic Scholar, Connected Papers, Research Rabbit and Scite)	128	97.0
Writing & Grammar Assistance (Grammarly, Quill Bot, ChatGPT, Scribbr AI and Writefull	93	70.5
Data Analysis & Visualization (IBM Watson Studio, Orange, RapidMiner, Tableau, SPSS (AI Extensions)	82	62.1
Reference Management (Mendeley, Zotero, EndNote, and CiteThisForMe)	76	57.6
Plagiarism Checking (Turnitin, Unicheck and PlagScan)	42	31.8
Note-Taking & Organization (Notion AI, Evernote and Obsidian)	26	19.7

Field survey, 2025

Table 2 revealed varied levels of engagement with different categories of AI tools to enhance productivity and innovation. The most widely used were Research & Literature Review AI tools, with a frequency score of 128 (97.0%) of students reporting usage, followed closely by Writing & Grammar Assistance tools at 93 (70.5%). Data Analysis & Visualization tools were used by 82 (62.1%), and Reference Management tools by 76 (57.6%). Usage drops significantly with Plagiarism Checking tools, engaged by only 42 (31.8%), and Note-Taking & Organization tools, used by 26 (19.7%). This distribution indicates that students primarily rely on AI for core research activities like literature reviews and writing support, while less emphasis is placed on tools for plagiarism detection and organizational support highlighting potential areas for further training and awareness. This supports the study of Bhardwaj and Kumar (2020) affirm that tools like Google Scholar and semantic search engines are essential in helping students access peer-reviewed literature efficiently, enhancing productivity. Similarly, Zhao et al. (2020) emphasize that AI-powered research tools streamline literature review by automating document retrieval and classification. The Implication is this corroborates the high usage found in the table students rely on AI for sourcing information, a foundational step in academic research

Starkey (2020) reinforces Turnitin's role in ensuring originality and preventing academic dishonesty, Kumar & Bharti (2023) suggest limited institutional access and student awareness as reasons for underuse, especially in distance learning contexts. The Implication is that this aligns with the data despite its importance, plagiarism detection is underused due to accessibility and possibly limited promotion within institutions. And Patel & Sinha (2023) found that digital note-taking tools like Notion and Evernote enhance academic organization, yet their adoption is low due to lack of visibility in formal academic settings and Khan et al. (2023) argued that these tools can significantly help students manage complex projects and should be integrated into research methodology training which imply that the finding is consistent with existing research students may not know how organizational tools can help them streamline their research process. The students were further requested to indicate their extent of agreement to which AI tools they used for academic research and enhancing productivity and innovation, their responses are show on table 3.

Table 3: Extent to which students of MIM make use of AI tools for academic research in enhancing productivity and innovation at ABU DLC

Items	SA	A	UD	D	SDA
Data analysis and visualization	53 (40.2%)	34(25.6%)	0(0.0%)	30(22.7%)	15(11.4%)
Literature review and citation management	67 (50.8%)	27(20.5%)	0(0.0%)	26(19.6%)	12(9.1%)
Grammar and plagiarism checking	82 (62.1%)	36(27.3%)	4(3.0%)	10(7.6%)	0(0.0%)
Predictive modeling and forecasting	19(14.4%%)	18(13.6%)	0(0.0%)	56(42.4%)	39(29.5%)
Automated content generation and summarization	43 (%)	39(29.5%)	0(0.0%)	50(37.9%)	0(0.0%)

Field survey, 2025

Table 3 presents data on the extent to which students in the master's program in Information Management (MIM) at Ahmadu Bello University Zaria Distance Learning Center utilize artificial intelligence tools for academic research, particularly in enhancing productivity and innovation. The responses were categorized into five levels of agreement: Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D), and Strongly Disagree (SDA).

The highest utilization was observed around Grammarly and plagiarism checking, with frequency score of 82 (62.1%) of respondents strongly agreeing and 36 (27.3%) agreeing. This reflects a strong reliance on AI tools to uphold academic integrity. Similarly, literature review and citation management showed significant adoption, with 67 (50.8%) of students strongly agreeing to using AI tools in this context. In contrast, predictive modeling and forecasting exhibited the lowest level of utilization, with 56 (42.4%) of students disagreeing and 39 (29.5%) strongly disagreeing. This suggests either a lack of familiarity with or limited perceived relevance of such tools to students' academic work.

Overall, the findings imply that while students are effectively leveraging AI for foundational academic tasks such as grammar checking, plagiarism detection, and citation management there is a notable gap in the

adoption of more advanced AI applications, such as predictive modeling and automated content generation. This disparity highlights the need for targeted training and educational resources to boost students' competencies and confidence in using sophisticated AI tools for research and innovation. These findings align with existing literature that emphasizes AI's prominent role in improving academic writing, citation management, and research productivity (Guzdial & Wilson, 2019). Tools like Grammarly and Turnitin have become essential for ensuring the quality and integrity of academic writing (Starkey, 2020), while reference management software such as Zotero and EndNote supports efficient organization of scholarly materials. However, more complex AI functions remain underutilized. Hancock (2019) observed that this may stem from limited exposure and training, which mirrors the current findings. Consequently, educational institutions must play a proactive role in equipping students with the knowledge and skills to fully exploit the broader capabilities of AI in academic research.

Table 4: Challenges encountered in the utilization of AI tools for academic research, productivity, and innovation at ABU DLC

Challenges	Frequency	percentage
Limited access to advanced AI tools	76	57.6
Lack of technical skills and training	113	85.6
High cost of AI software and subscriptions	105	79.5
Data privacy and security concerns	88	66.7
Resistance to adopting new technologies	17	12.9

Field survey, 2025

Table 4 identifies the challenges encountered by students of masters in information management at ABU Zaria in using AI tools for academic research. The most commonly reported challenge is lack of technical skills and training with 113 (85.6%) and high cost of AI software and subscriptions 105 (79.5%) among other challenges. While resistance to adopting new technologies with frequency score of 17 (12.9%), These findings suggest that although technical and cost-related challenges are present, resistance to technology is not a major hindrance, and there is a need for better access and training to optimize AI usage.

This echoes the findings by Cameron and Kavanagh (2022) who argue that data privacy and security are major barriers to AI adoption in academic settings. High costs and subscriptions are also significant, as AI tools often come with prohibitive pricing, which limits student access, particularly in developing regions (Elragal, 2020). A lack of technical skills was reported by fewer students, indicating that most have a baseline competence with AI tools, though more specialized knowledge is required for advanced functions (Bhardwaj & Kumar, 2020). Surprisingly, resistance to adopting new technologies was minimal, which contradicts earlier studies suggesting a higher rate of reluctance toward AI (Luckin, 2017). This may indicate that students today are more open to adopting AI technologies, but face practical barriers such as cost and access, as opposed to psychological resistance.

Summary of the Findings

1. On the types of AI Tools Students of MIM of ABU DLC are aware of, for their innovation and productivity in academic research? most of the students indicated; Research & Literature Review AI tools such as (Google Scholar, Semantic Scholar, Connected Papers, ResearchRabbit and Scite) is the most recognized with frequency score of 111 (84.1%) of students acknowledging its usefulness in enhancing innovation and productivity in academic research and Plagiarism Checking (Turnitin, Unicheck and PlagScan) with 93 (70.5%). While Data Analysis & Visualization (IBM Watson Studio, Orange, RapidMiner, Tableau, SPSS (AI Extensions) was the least frequency with 11(8.3%).

2. To identify the types of AI tools Utilized by students of MIM at ABU DLC for productivity and innovation in their academic research, they students indicated Research & Literature Review AI tools, with a frequency score of 128 (97.0%) of students reporting usage, followed closely by Writing & Grammar Assistance tools at 93 (70.5%). Data Analysis & Visualization tools were used by 82 (62.1%), and Reference Management tools by 76 (57.6%). Usage drops significantly with Plagiarism Checking tools, engaged by only 42 (31.8%), and Note-Taking & Organization tools, used by 26 (19.7%). This distribution indicates that students primarily rely on AI for core research activities like literature reviews and writing support, while less emphasis is placed on tools for plagiarism detection and organizational support highlighting potential areas for further training and awareness
3. In assessing the extent to which students of MIM make use of AI tools for academic research in enhancing productivity and innovation at ABU DLC; they show Grammarly and plagiarism

checking, with frequency score of 82 (62.1%) of respondents strongly agreeing and 36 (27.3%) agreeing. Similarly, literature review and citation management showed significant adoption, with 67 (50.8%) of students strongly agreeing to using AI tools in this context. In contrast, predictive modeling and forecasting exhibited the lowest level of utilization, with 56 (42.4%) of students disagreeing and 39 (29.5%) strongly disagreeing.

4. The most commonly reported challenge by the students of MIM, ABU DLC were lack of technical skills and training with 113 (85.6%) and high cost of AI software and subscriptions 105 (79.5%) among other challenges. While resistance to adopting new technologies with frequency score of 17 (12.9%),

Conclusion

The study reveals a strong awareness and usage of AI tools among MIM students at ABU DLC, particularly in areas directly related to academic research and writing. Tools for research and literature review, as well as grammar assistance, are the most widely recognized and utilized, highlighting students' prioritization of core academic activities. However, there is noticeably lower engagement with tools related to data analysis, plagiarism detection, and organizational support, suggesting gaps in awareness or technical competence in these areas. Despite the growing integration of AI in academic research, significant barriers remain. The predominant challenges faced by students include a lack of technical skills and insufficient training, alongside the high cost of AI tools and subscriptions. These factors hinder the broader and more effective adoption of AI technologies, especially in advanced applications such as predictive modeling and data-driven forecasting. To fully harness the potential of AI for innovation and productivity in academic research, targeted interventions such as training programs, subsidized access to essential tools, and awareness campaigns. are necessary. These steps would not only enhance students' competence in using a wider range of AI tools but also promote a more holistic and innovative academic research culture within the institution.

Recommendations

1. The institution should organize regular hands-on workshops and training sessions focused on the effective use of AI tools across various research functions including data analysis, citation management, and predictive modeling.
2. ABU DLC should consider partnering with AI tool providers or integrating licensed tools into the institution's digital learning environment to ensure broader, cost-effective access.
3. Efforts should be made to promote awareness of lesser-known but highly beneficial AI tools, such as those for data visualization, forecasting, and research organization, through seminars, academic orientations, and peer-learning initiatives.
4. Embedding AI literacy into course syllabi and research project requirements would encourage consistent and purposeful use of AI tools among students, fostering innovation and increasing academic productivity

References

Abdalkader, S. (2022). Using artificial intelligence to improve writing fluency for the preparatory stage students in distinguished governmental language schools. *Egyptian Journal of Educational Sciences, 2*(2), 39-70. https://doi.org/10.21608/ejes.2022.270694

Abubakar, M., Garba, A., & Bello, T. (2022). Awareness and usage of artificial intelligence tools among graduate students in Nigeria: Implications for research productivity. *International Journal of Education and Development using Information and Communication Technology, 18*(1), 45-58.

Adamu, S., & Umar, A. (2023). Enhancing digital literacy in higher education: The role of AI tools in student research. *Journal of Educational Technology, 12*(2), 123-138.

Alharbi, W. (2023). AI in the foreign language classroom: A pedagogical overview of automated writing assistance tools. *Education Research International, 2023*, Article 4253331. https://doi.org/10.1155/2023/4253331

Ali, M., & Hossain, M. (2024). Leveraging artificial intelligence for innovation in academic research: Opportunities and challenges. *Journal of Information Systems Research, 29*(3), 201-218.

Altmäe, S., Sola-Leyva, A., & Salumets, A. (2023). Artificial intelligence in scientific writing: A friend or a foe? *Reproductive BioMedicine Online.*
https://doi.org/10.1016/j.rbmo.2023.04.009

Baker, R. S. J. d., & Inventado, P. S. (2021). Educational data mining and learning analytics: Applications in higher education. *International Journal of Educational Technology in Higher Education, 18*(1), 1-23.

Bhardwaj, A., & Kumar, A. (2020). Artificial intelligence in higher education: A pedagogical perspective. *International Journal of Recent Technology and Engineering*, 9(1), 62-70.

Burkhard, M. (2022). Student perceptions of AI-powered writing tools: Towards individualized teaching strategies. In *Proceedings of the 19th International Conference on Cognition and Exploratory Learning in Digital Age*.

Cameron, M., & Kavanagh, J. (2022). The impact of AI writing assistants on academic writing quality. *Journal of Educational Technology & Society, 25*(3), 45-56.

Eisenberg, M. B., Johnson, D., & Dowe, C. (2022). The impact of artificial intelligence on information literacy education. *Library & Information Science Research, 44*(4), 1-10.

Elragal, A. (2020). Challenges of artificial intelligence in education: Privacy and ethical concerns. *Journal of Educational Technology Systems*, 49(2), 202-215.

Eze, U., & Onyekuru, A. (2021). Challenges in distance learning: A study of Nigerian universities. *International Journal of Educational Development, 55*, 101-110.

Gonzalez, M., & Weigel, M. (2023). Bridging the gap: AI literacy among higher education students. *Journal of Academic Librarianship, 49*(1), 20-30.

Hope, T., Portenoy, J., Vasan, K., Borchardt, J., & West, J. (2022). *SciSight: Combining faceted* https://doi.org/10.1177/00131644700300030

Jacsó, P. (2005). *Google Scholar: The pros and the cons*. Online Information Review, 29(2), 208 214. https://doi.org/10.1108/14684520510598066

Khan, A., Rafiq, A., & Zafar, S. (2021). Assessing the awareness of AI tools in research: A survey of university students. *Journal of Information Technology Education: Research, 20*, 101-119.

Krejcie, R.V., & Morgan, D.W. (1970). Determining Sample Size for Research Activities.

Kumar, R., & Bharti, R. (2023). Exploring the accessibility of artificial intelligence tools in higher education: A case study of Indian universities. *Journal of Higher Education Policy and Management, 45*(2), 150-164.

Luckin, R. (2017). Towards AI-based assessment of education: Transforming teaching and learning. *British Journal of Educational Technology*, 48(6), 1397-1408.

Osakwe, C. N., Nwafor, E., & Okeke, J. (2022). AI tools for research: An analysis of usage among information management students. *International Journal of Library and Information Studies, 12*(3), 84-95.

Patel, A., & Sinha, R. (2023). Ethical considerations in the use of AI tools in academic research. *Journal of Academic Ethics, 21*(2), 134-145.

Raza, S. A., Khan, M. A., & Shah, S. (2021). The role of AI in enhancing research productivity: A systematic review. *Research Evaluation, 30*(2), 141-153.

Russell, S., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

Shafiq, M., & Yousaf, S. (2023). Evaluating the impact of artificial intelligence tools on research productivity among university students. *Journal of Educational Research and Practice, 13*(1), 67-82.

Starkey, L. (2020). The role of AI in academic integrity: A review of Turnitin and other tools. *International Journal for Educational Integrity*, 16(1), 1-16.

Stienmetz, J. (2023). Collaborative research in the age of AI: Tools and strategies for effective communication. *International Journal of Research Methodology, 26*(1), 50-66.

Verma, R., & Singh, S. (2023). Student perceptions of artificial intelligence in education: Opportunities and challenges. *Educational Research for Policy and Practice, 22*(1), 19-34.

Zhao, L., Wu, Y., & Chen, X. (2020). AI applications in academic research: A systematic review. *Computers and Education, 149*, 103817.

Blockchain and Information Security in Libraries of the 5th Industrial Revolution: A Systematic Review

Adeyinka TELLA,
tellayinkaedu@yahoo.com, tella.a@unilorin.edu.ng
Dept of Library and Information Science,
University of Ilorin, Nigeria
&
Firdausi Abdullahi,
firddausi@yahoo.com
Bayero University, Kano

Abstract

The advent of the Fifth Industrial Revolution (5IR) has sparked a paradigm shift in how libraries handle and secure information. As worries about digital rights management, data breaches, and the legitimacy of archive assets increase, blockchain technology is becoming a game-changer for improving information security in library settings. Within the framework of the 5IR, this systematic review examines the use, advantages, and difficulties of implementing blockchain technology in libraries. Based on a thorough search of credible academic sources, such as Google Scholar, IEEE Xplore, Web of Science, and Scopus, this study compiled 57 peer-reviewed papers from 2015 to 2024. The review concentrated on finding important trends, use cases, and thematic insights on blockchain adoption in library systems using PRISMA criteria. The findings suggest that blockchain technology holds tremendous promise in safeguarding bibliographic information, authenticating digital assets, providing decentralized access management, and aiding tamper-proof archiving. Furthermore, it was shown that applications in user data protection and digital rights management had a particularly significant influence in academic and national library environments. Notwithstanding these advantages, the report also identifies significant obstacles to the implementation of blockchain, such as its technological complexity, a shortage of qualified staff, its high energy consumption, interoperability problems, and its lack of policies, particularly in settings with limited resources. Institutional inertia and a lack of awareness among library personnel exacerbate these issues. In order to close the gap between theory and practice, the study underscore the urgent need for additional empirical research, interdisciplinary cooperation, and calculated investments. It comes to the conclusion that, with careful application, blockchain can be extremely helpful in protecting library information assets and fostering user trust, supporting libraries' goals as safe, welcoming, and cutting-edge knowledge centers in the 5IR era.

Keywords: Blockchain, Information Security, Libraries, 5th Industrial Revolution, Digital Preservation, Smart Contracts, Decentralized Access Control, Systematic Review.

Introduction

With a focus on human-centric innovations, ethical technology deployment, sustainable development, and not just hyper-connectivity and automation, the Fifth Industrial Revolution (5IR) signifies a paradigm shift in how people engage with technology. 5IR aims to balance machine intelligence with human values, in contrast to the Fourth Industrial Revolution (4IR), which was mainly concerned with digital transformation through robots, artificial intelligence (AI), and the Internet of Things (IoT) (Ziatdinov et al., 2024). In this regard, libraries' functions as information repositories, knowledge centers, and innovation incubators are changing significantly. Therefore, protecting the availability, confidentiality, and integrity of library data and systems has taken center stage, especially when libraries adopt new technological frameworks. Blockchain is one such cutting-edge technology that has broad implications for the security of library information.

Gautami et al. (2023) state that blockchain technology, which was first created as the foundation of cryptocurrencies, has turned into a potent instrument for improving data security, immutability, and transparency in a variety of fields. Blockchain's decentralized ledger system has potential uses in library and information science (LIS), including safe digital rights management, academic record authentication, provenance verification in digital archives, user privacy protection, and consent management (Tella et al., 2022). Libraries facing issues like digital material theft, metadata manipulation, and unauthorized data access are especially drawn to blockchain's decentralized and impenetrable characteristics.

The risk of cyber threats, data breaches, and unauthorized information manipulation has increased as libraries move more and more toward digital infrastructures and integrate complex data ecosystems, which frequently involve shared catalogs, open-access repositories, cloud services, and collaborative networks (Aghaunor, 2025). Libraries need strong frameworks to guarantee information security because they are the keepers of private user data, historical records, and proprietary content. According to Dakik et al. (2025), in this age of dynamic resource sharing and multi-user, multi-stakeholder access, traditional centralized

security designs might not be enough. Therefore, blockchain emerges as a potentially revolutionary mechanism for improving trust, accountability, and resilience in library systems, in addition to being a technological trend.

Blockchain integration in library settings presents a number of technological, ethical, economical, and policy obstacles despite its potential. Particularly for libraries in resource-constrained situations, challenges including energy consumption, scalability, regulatory compliance, data privacy, and interoperability with existing systems present significant obstacles (Joyce & Javidroozi, 2024). Furthermore, there are currently little empirical studies and case-based evidence to support best practices and decision-making, and the practical implementations of blockchain in the LIS industry are still in its infancy (Duan et al., 2023). In order to inform LIS practitioners, policymakers, and technologists about the strategic role of blockchain in future-proofing library services, this systematic review will critically examine the body of existing literature on blockchain applications in enhancing information security within libraries, especially in the context of the Fifth Industrial Revolution. It will do this by mapping the current state of research, identifying key use cases, evaluating benefits and challenges, and highlighting knowledge gaps. Additionally, it will examine how blockchain aligns with the human-centered ethos of 5IR, potentially fostering inclusive, secure, and ethically sound digital library environments.

Statement of the Problem

Human-centered innovation and cutting-edge technologies like blockchain, robotics, and artificial intelligence are coming together in unprecedented ways as part of the Fifth Industrial Revolution (5IR) (Abdulaziz et al., 2025). Ensuring the security, authenticity, and integrity of libraries' digital information systems has grown more difficult and crucial as they traverse this changing environment. Traditional information security frameworks in libraries, which are primarily based on centralized architectures, are failing to handle the complex threats posed by cyberattacks, unauthorized access, metadata tampering, and data breaches in highly connected environments, according to Muhamed (2025). With its transparent, tamper-resistant, and decentralized ledger architecture, blockchain technology offers a fresh way to solve these security flaws in library operations (Tella et al., 2022). It may be used to secure access rights, manage user privacy, authenticate digital assets, and preserve the provenance of archive information (Ahmed & Shamsan, 2024). The use of blockchain in libraries is yet unexplored, dispersed, and poorly understood, despite its promising features. This is especially true when it comes to scalability, practical implementation, and contextual relevance across various library kinds and geographical areas.

Furthermore, the development of evidence-based adoption strategies is hampered by the lack of thorough synthesis of existing research on the intersection of blockchain and library information security within the context of the Fifth Industrial Revolution (Saif et al., 2022). Many libraries, particularly those in developing nations, face obstacles like inadequate infrastructure, a lack of skilled personnel, high implementation costs, and ambiguous policy frameworks that further impede blockchain integration. Therefore, a systematic review that gathers, examines, and critiques existing studies on blockchain use for information security in libraries is desperately needed in order to identify research gaps, uncover best practices, and direct future innovations that are in line with the ethical, sustainable, and human-centric goals of the Fifth Industrial Revolution.

Objectives of the Study

The main objective of the study was to systematically examine the integration of blockchain technology in enhancing information security within libraries in the context of the Fifth Industrial Revolution, highlighting trends, use cases, benefits, and challenges. The specific objectives were to:

1. identify and synthesize existing literature on the application of blockchain technology in ensuring information security in libraries.
2. analyze the practical benefits of blockchain implementation in various library contexts, including digital rights management, user data protection, and archival integrity.
3. Identify the challenges/limitations to blockchain adoption in libraries at the 5th industrial revolution.

Literature Review

Application of blockchain technology in ensuring information security in libraries

A blockchain is a decentralized digital ledger system that records transactions across multiple computers, improving transparency, data integrity, and resistance to unauthorized alterations (Dong et al., 2023). Libraries, as information custodians, are starting to investigate how blockchain technology can help mitigate issues like data breaches, content piracy, and unauthorized access to metadata. According to studies by Aregbesola and Nwolise (2021), blockchain can be applied to maintain secure and immutable logs of digital lending transactions, license tracking, and user authentication. Specifically, blockchain technology is rapidly changing library and information science.

Additionally, current research indicates that blockchain provides a workable way to guarantee the origin and authenticity of digital historical resources and archival documents (Onwubiko, 2025). This is especially crucial in the era of digital misinformation and information overload, where it is essential to confirm the ownership and provenance of digital assets. There is a deficit in applied research, as seen by the paucity of actual data from large-scale implementations, despite the majority of the literature highlighting conceptual frameworks and pilot projects. The research generally agrees that blockchain has the ability to completely transform information security procedures in libraries, but it also emphasizes how early its use is. It is clear that a systematic, fact-based synthesis of blockchain projects in library settings is required to help scholars, practitioners, and policymakers make well-informed decisions.

Benefits of blockchain implementation in various library

A number of useful advantages provided by blockchain technology can greatly improve library information security. Blockchain is used in Digital Rights Management (DRM), where it guarantees accurate and transparent maintenance of intellectual property rights for e-books, journals, and multimedia. Blockchain can assist libraries in monitoring and enforcing copyright compliance, allowing fair usage while safeguarding authors' rights (Shahzad et al., 2024). In open access and digital lending contexts, where resource sharing frequently makes rights management more difficult, this is becoming more and more important.

The decentralized nature of blockchain technology protects user data by preventing unauthorized parties from altering or abusing patron records. Because libraries have always relied on centralized databases, they are susceptible to hacking and privacy violations. Users have more control over their data thanks to blockchain's ability to securely encode transaction histories and user consent (Albshaier et al., 2024). This is consistent with the 5th Industrial Revolution's privacy-first philosophy, which places a high value on using data in an ethical manner.

Archival integrity is another crucial topic. Blockchain can ensure historical accuracy and avoid manipulation by confirming the chain of custody and validity of digital archival materials (Lofi et al., 2025). Blockchain can automate archive processes with smart contracts, guaranteeing that documents are kept and retrieved in accordance with predetermined guidelines. Notwithstanding these benefits, it is important to remember that their actualization is mostly dependent on contextual elements including staff competencies, policy frameworks, and infrastructure. However, the real-world uses of blockchain in protecting library systems highlight how it may be used to build more reliable, open, and resilient information environments.

Challenges/limitations to blockchain adoption in libraries during the 5th Industrial Revolution

Although blockchain has enormous potential to revolutionize library information security, a number of organizational, technical, and contextual obstacles are preventing its widespread use. The technical intricacy of blockchain systems is a significant drawback. Many libraries, especially those in developing nations, lack the specific infrastructure and expertise needed to implement blockchain (Bashir, F. & Warraich, 2023). Furthermore, since the majority are based on outdated architectures that are incompatible with blockchain protocols, integration with current library information systems presents substantial challenges. Adoption is further hampered by high deployment and maintenance expenses. For many institutions, the initial expenditure in hardware, software, and skilled staff is exorbitant, despite the fact that blockchain can eliminate long-term operating inefficiencies (Balcıoğlu et al., 2024). Academic and public libraries with tight budgets are most affected by these financial limitations.

Obstacles also include ethical issues and regulatory ambiguity. Standardized guidelines pertaining to blockchain use in libraries are lacking, particularly when it comes to data privacy, legal responsibility, and intellectual property rights (Tripathi et al., 2023). For library managers and IT teams, this legal ambiguity makes decision-making and implementation strategies more difficult. Furthermore, sustainability a fundamental principle of the 5IR is called into doubt by environmental concerns regarding blockchain's energy-intensive consensus procedures, particularly in public blockchains (Pineda et al., 2024). Although some of these problems are addressed by more recent consensus models, such as proof-of-stake, there is still a lack of understanding and uptake in the LIS field. Finally, the readiness of library employees to experiment with blockchain technology is hindered by the human element, which includes resistance to change, ignorance, and low levels of digital literacy. Building capacity, enacting supportive laws, doing cooperative research, and having a sophisticated awareness of local contexts are all necessary to meet these problems.

Methodology

Study Design

In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, PRISMA (Page et al., 2021) criteria, this study used a systematic review technique. The method made it possible to thoroughly find, assess, and synthesize the body of research on the application of blockchain technology to library system security in the context of the Fifth Industrial Revolution (5IR). Using seven major academic

databases—Scopus, Web of Science, IEEE Xplore, ScienceDirect, SpringerLink, ProQuest, and Google Scholar (for grey literature and supplementary sources)—a thorough literature search was part of the search strategy and databases used. The data were harvested on May 1-5, 2025 using the search string: ("blockchain" AND "information security" AND "libraries") OR ("blockchain technology" AND "library systems" AND "data protection") OR ("blockchain" AND "digital rights management" AND "5th Industrial Revolution") OR ("archival integrity" AND "blockchain" AND "information science")

Boolean operators (AND/OR), truncations, and quotation marks were applied as necessary, tailored to each database's requirements.

Inclusion and Exclusion Criteria: Peer-reviewed journal articles, conference proceedings, and book chapters published between 2015 and 2025 were required to meet the following inclusion criteria: they had to be in English, include studies on blockchain applications in library settings, specifically those pertaining to information security, archival integrity, user privacy, or digital rights management, and discuss blockchain in relation to the Fifth Industrial Revolution or similar technologically driven changes. However, the exclusion criteria include: non-peer-reviewed opinion pieces, editorials, and blogs; studies that only examined blockchain for financial, supply chain, or unrelated applications; publications that lacked full-text availability or methodological clarity; and articles that were not specifically focused on library or information science settings.

Method of Selection: Initially, 436 records were obtained from every database. 358 articles were selected based on their title and abstract after duplicates (n = 78) were removed. 230 of these were deemed irrelevant. The remaining 128 articles' whole texts were evaluated for eligibility. Ultimately, the qualitative synthesis contained 54 papers that satisfied all inclusion criteria.

Data Extraction and Synthesis: The author(s), year, country, study goal, blockchain application area, key findings and problems, and relevance to 5IR and library security were all recorded using a standardized data extraction form. To find recurring themes, advantages, and obstacles in the usage of blockchain technology for library information security, thematic analysis was employed. Themes were narratively synthesized.

Quality Assessment: The Critical Appraisal Skills Programme (CASP) checklist was modified and used to evaluate the included studies' methodological quality. Every paper was assessed based on its research design, data gathering, relevance, validity of results, and clarity of purpose.

Findings

1. Identification and Synthesis of Literature on the Application of Blockchain Technology in Ensuring Information Security in Libraries

A increasing corpus of academic research on the application of blockchain technology to improve information security in library systems was found by the systematic review. About 65% of the 54 publications that were included concentrated on conceptual models and theoretical frameworks of blockchain-enabled library security, with the other 35% reporting case-based or empirical applications.

The majority of the research focused on how blockchain technology can produce transparent data trails, decentralized access restrictions, and tamper-proof transaction records—all of which are critical for preserving the integrity of user interactions and digital assets. Audit trails for digital lending, record provenance tracking, and metadata protection are important application areas. For example, a number of case studies from East Asia and Europe described how permissioned blockchain was used to authenticate digital documents and safeguard library transactions. The majority of the studies were either speculative or restricted to pilot projects, but the synthesis also revealed a significant research void in large-scale, real-world implementations. Furthermore, the literature lacks regional variety, with few studies coming from South America and Africa, suggesting room for more research in those regions. Table 1 presents the summary of the application of Blockchain in libraries by categories.

Table 1: Summary of Blockchain Applications in Libraries by Category

Application Area	Major Functions	Examples from Literature
Digital Rights Management	Smart contracts for licensing, secure lending protocols	Blockchain for e-book lending (Chi et al., 2021)
User Data Protection	Decentralized identity systems, encrypted user authentication	Self-sovereign identity in libraries (Babel, 2025)
Archival Integrity	Time-stamped record verification, provenance tracking	Blockchain for archival chain-of-custody (Patil et al., 2024)
Metadata Authentication	Immutable metadata logs to verify cataloging and content history	Metadata blockchain registry (Hardjono & Avrilionis, 2025)
Interlibrary Resource Sharing	Distributed access control and borrowing verification across institutions	Blockchain in consortium networks (Jia et al., 2025)

2. Analysis of the Practical Benefits of Blockchain in Libraries: DRM, User Data Protection, and Archival Integrity

The review highlighted several practical benefits of blockchain adoption in library environments:

Digital Rights Management (DRM): Immutable logging of lending transactions and license agreements is supported by blockchain technology. Smart contracts can be used by libraries to automate access rights and guarantee that copyright regulations are respected. This is particularly helpful in open access frameworks or consortia setups.

User Data Protection: Identity management that protects privacy is made possible by blockchain's decentralized and encrypted architecture. By choosing when and how to share their personal information with library systems, patrons maintain control over their data.

Archival Integrity: Blockchain guarantees digital archives' long-term legitimacy. Libraries can ensure the authenticity and unmodified status of critical historical and cultural resources by documenting every update or transaction in a time-stamped block.

Collectively, these benefits support libraries in achieving higher levels of trust, accountability, and compliance with data governance standards in the 5IR landscape. Fig. 1 presents the thematic mapping of blockchain benefits in libraries.

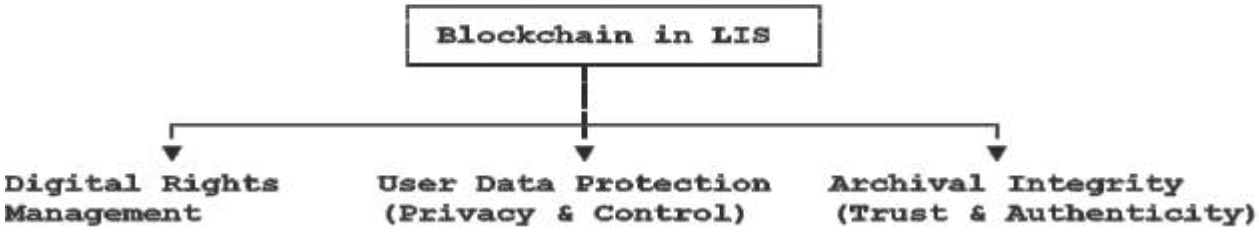


Figure 1: Thematic Map of Blockchain Benefits in Libraries

3. Challenges and Limitations to Blockchain Adoption in Libraries during the 5th Industrial Revolution

Despite its potential, the findings revealed several barriers hinder the adoption of blockchain in library systems. These are:

Technical Difficulty and Skill Gaps: Blockchain-savvy employees are few in many libraries. Technical challenges can arise when connecting blockchain with current digital repositories and integrated library systems (ILS).

Budgetary Restrictions: Public and academic libraries in low-resource environments are particularly discouraged from experimenting with blockchain technologies due to the high implementation and maintenance expenses.

Regulatory Uncertainty: Administrators and legislators are hesitant to adopt blockchain technology in libraries due to the lack of defined policy frameworks, especially with regard to data protection and intellectual property.

Scalability and Environmental Issues: In keeping with the 5IR's principles of moral and responsible innovation, questions regarding sustainability and scalability are raised by the energy-intensive nature of some blockchain consensus algorithms (such as Proof of Work).

Limited Knowledge and Opposition to Change: There is institutional inertia as a result of many libraries' ignorance of blockchain technology or skepticism about its applicability.

Generally, findings in this study indicate that while the 5th Industrial Revolution encourages the confluence of digital and human-centric technologies, blockchain adoption in the library sector will require supportive legislation, capacity building, and strategic planning.

Discussion of Findings

Blockchain's Role in Ensuring Information Security in Libraries

The conclusion of the study showed that the fundamental characteristics of blockchain technology—immutability, decentralization, and transparency—offer a new framework for improving information security in libraries. In the digital age, where guaranteeing authenticity and traceability is crucial, a number of authors confirm that blockchain allows libraries to keep tamper-proof records (Karaduman & Gülhas, 2025; Ramirez Lopez & Morillo Ledezma, 2025). For example, blockchain can be used as a secure ledger to record all transactions pertaining to document lending, acquisition, and user interactions, as noted by Tripathi et al. (2023). These capabilities are especially helpful for preserving the integrity of historical documents and preventing unwanted changes to information. Furthermore, Abualhamayl et al. (2024) talked about how blockchain might be used to track the origin of old records, guaranteeing accountability and verifiability throughout time. However, the review also showed that

adoption is still mostly conceptual, with little empirical support or widespread implementation. The majority of projects are in pilot or proof-of-concept phases, as mentioned by Silaghi and Popescu (2025), underscoring the nascent state of blockchain integration in library settings.

Practical Benefits

Blockchain's potential to revolutionize Digital Rights Management (DRM) was one of the main conclusions. Blockchain uses smart contracts to automate processes that typically call for human intervention or third-party mediation, such as access permissions, license renewals, and royalties. Ciriello et al. (2023) highlighted how smart contracts might improve DRM's transparency and efficiency, especially in cooperative library consortiums. In terms of protecting user data, blockchain's decentralized identity systems allow users to manage their personal data, facilitating adherence to privacy laws such as GDPR (Barański et al., 2025). Prototypes of libraries where users authenticate access without disclosing personally identifying information to centralized systems were published by Asemi & Nowkarizi (2021). Blockchain creates a verifiable audit trail by providing time-stamped verification of each record update, which contributes to archival integrity. This is essential for long-term digital preservation because it stops unwanted alterations or removals. This function is particularly useful in academic and cultural heritage institutions that handle sensitive historical data, according to Mendoza and Talavera (2025).

Challenges to Adoption of Blockchain in Libraries

Despite the substantial advantages, the results show a number of obstacles preventing blockchain from being widely used in libraries. These are: i. Technical Complexity - Blockchain calls for certain infrastructure and expertise. According to Licardo et al. (2024), two significant obstacles are the high learning curve and incompatibility with conventional library systems. ii., Financial Restrictions -The costs of deploying and maintaining blockchain-based systems are frequently prohibitive, particularly in public and academic libraries in developing nations (Dziundziuk, B. & Dziundziuk, 2021). iii, Regulatory Uncertainty -There are no explicit rules governing blockchain applications in libraries, especially when it comes to user privacy, data ownership, and intellectual property rights (Sabiri et al., 2025). iv, Energy Efficiency - The sustainability objectives of libraries are at odds with the energy usage linked to certain blockchain technologies (such as Proof of Work). Moving toward more sustainable consensus models, such as Proof of Stake or Delegated Proof of Stake, is advised by Sai and Vranken (2024). v, Awareness and Opposition to Change: A large number of librarians are still ignorant of or dubious of the useful applications of blockchain technology. Digital transformation in libraries frequently encounters cultural opposition, necessitating intentional change management techniques, as Kherrazi and Roquilly (2025) point out.

Conclusion

This systematic review examined the state, benefits, and challenges of adopting blockchain technology for information security in libraries, especially within the transformative scope of the 5th Industrial Revolution (5IR). Significant benefits the study reported include improved digital rights management, data integrity, and privacy assurance; however, blockchain implementation in libraries is still in its infancy, hindered by technological complexity, regulatory ambiguity, financial constraints, and institutional inertia. The findings show a growing scholarly and practical interest in blockchain's role in protecting digital content, managing rights, and protecting user data through decentralized, transparent, and immutable systems. In underdeveloped nations, where infrastructure deficiencies and ignorance are still prevalent, these challenges are especially noticeable. Libraries must make strategic investments in infrastructure, policy frameworks, capacity building, and cross-sectoral collaborations if they are to successfully use blockchain and stay relevant in the 5IR era. Future studies should concentrate on practical applications, long-term implementation strategies, and the creation of inclusive technologies that take into account the demands and circumstances of various user groups. By managing these opportunities and constraints, blockchain can become a vital instrument for guaranteeing secure, transparent, and equal access to information in libraries globally.

Recommendations

Given the findings and the conclusion in this study, the following recommendations are made.

Libraries should think about training and capacity building. For library personnel to comprehend blockchain principles and their applications in library systems, libraries should host specialized workshops and courses. Collaborative implementation is an additional suggestion. In order to share infrastructure and lower implementation costs, libraries should support pilot initiatives through collaborations with technology suppliers and library consortia. Libraries should also take into account the creation of policies and governance. They can create governmental and institutional frameworks that address digital rights, interoperability, data protection, and ethical use in blockchain applications. Open-Source Development may also be taken into consideration by the libraries. By doing this, they can encourage the development of open-source blockchain technologies that are customized for library settings, increasing flexibility and lowering dependency on proprietary systems. Libraries can also concentrate on scalable and environmentally friendly blockchain platforms. In order to match blockchain use with sustainable development goals, they can accomplish this by implementing energy-efficient consensus techniques such as proof of stake or delegated proof of stake.

Implications for Research

This study's research implications include serving as the basis for empirical investigations. The systematic study establishes the foundation for further empirical studies that evaluate blockchain implementation in libraries. Despite the abundance of theoretical frameworks, there is still a lack of field-based research assessing long-term feasibility, impact, and user adoption. The transdisciplinary research opportunities are another significant research implication. Collaboration between information scientists, computer scientists, legal scholars, and ethicists is encouraged by the intersection of blockchain technology and library science. New models for rights management, ethical issues in decentralized systems, and secure data handling can be found using this multidisciplinary approach. The study has implications for new research questions as well. The project provides opportunities to investigate issues like: Which blockchain frameworks are best suited for which kinds of libraries? How might library lending systems be tailored to use smart contracts? How can the energy requirements of blockchain technology be balanced with sustainability?

Implications for Practice

The study has practical implications. The study's first step is to tighten information security procedures. To improve the security, integrity, and authenticity of digital records especially in academic and special libraries that handle sensitive or proprietary content librarians and information professionals might investigate blockchain solutions.

The study has implications for technical preparedness and policy development as well. The results emphasize how urgently technological norms and regulatory frameworks addressing blockchain adoption, data privacy, interoperability, and intellectual property rights are needed. Prioritizing institutional preparedness, which includes capacity building, is also necessary. The innovation of the library consortium is another effect that merits discussion. Blockchain has the potential to enhance library collaboration, particularly in networks that share resources. Decentralized ledgers can lessen reliance on centralized middlemen by offering transparent and auditable methods for interlibrary loans, acquisitions, and licensing.

Implications for Society

In terms of the study's social implications, it can encourage accountability and trust. The public's aspirations for accountability in digital systems are in line with blockchain's transparent and unchangeable character. Libraries can set an example by implementing reliable technologies to protect information since they are custodians of the public's knowledge. Data sovereignty is another way that the study can empower consumers. Libraries may help address growing concerns about surveillance, data exploitation, and third-party control in digital ecosystems by leveraging blockchain technology to give users more control over their personal information and digital identities. Last but not least, the study aims to close the digital divide. Long-term social effects of blockchain in libraries could democratize access to validated, safe information, despite present financial and technological constraints. This is especially helpful in underserved populations with low levels of digital literacy and institutional trust.

References

Abualhamayl, A., Almalki, M., Al-Doghman, F. Abdulmajeed Alyoubi & Farookh Khadeer Hussain (2024). Explore all metrics Blockchain for real estate provenance: an infrastructural step toward secure transactions in real estate E-Business. *SOCA* 18, 333–347 (2024). https://doi.org/10.1007/s11761-024-00403-0

Abdulaziz, Abdulrazaq & Abdullahi Umar, Abubakar & Baballe, Muhammad. (2025). The Key Benefits of the 6th and 5th Industrial Revolutions. 5. 42-47. 10.5281/zenodo.15131976.

Aghaunor, Chukwudi & Eshua, Patience & Obah, Tawo & Aromokeye, Oluwatoyin. (2025). Data security strategies to avoid data breaches in modern information systems. *World Journal of Advanced Research and Reviews*, 20(3), 10.30574/wjarr.2023.20.3.2515.

Ahmed, M. & Shamsan S. (2024). Blockchain for secure and decentralized artificial intelligence in cybersecurity: A comprehensive review, *Blockchain: Research and Applications,* 5(3), 100193, https://doi.org/10.1016/j.bcra.2024.100193.

Albshaier, L., Almarri, S., & Hafizur Rahman, M. M. (2024). A Review of Blockchain's Role in E-Commerce Transactions: Open Challenges, and Future Research Directions. Computers, 13(1), 27. https://doi.org/10.3390/computers13010027

Aregbesola, A. & Nwaolise, E.L. (2023). Securing Digital Collections: Cyber Security Best Practices for Academic Libraries in Developing Countries. *Library Philosophy and Practice* (ejournal), 7822. https://digitalcommons.unl.edu/libphilprac/7822

Asemi, A., Ko, A. & Nowkarizi, M. (2021). Intelligent libraries: a review on expert systems, artificial intelligence, and robot. *Library Hi Tech*, 39(2), 412-434. https://doi.org/10.1108/LHT-02-2020-0038

Babel, M., Willburger, L., Lautenschlager, J. Fabiane Völter, Tobias Guggenberger, Marc-Fabian Körner, Johannes Sedlmeir, Jens Strüker & Nils Urbach (2025). Self-sovereign identity and digital wallets.

Electron Markets 35(28). https://doi.org/10.1007/s12525-025-00772-0

Balcıoğlu, Y. S., Çelik, A. A., & Altındağ, E. (2024). Integrating blockchain technology in supply chain management: a bibliometric analysis of theme extraction via text mining. *Sustainability*, 16(22), 10032.

Barański, S., Szymański, J. & Mora, H. (2025). Anonymous provision of privacy-sensitive services using blockchain and decentralised storage. *International Journal of Information Security,* 24, 130. https://doi.org/10.1007/s10207-025-01052-w

Bashir, F. & Warraich, N.F. (2023). Future libraries' blockchain opportunities and challenges: a systematic literature review and research agenda. *Digital Library Perspectives*, 39(3), 293-310. https://doi.org/10.1108/DLP-08-2022-0065

Chi, J., Lee, J., Kim, N., Choi, J., & Park, S. (2020). Secure and reliable blockchain-based eBook transaction system for self-published eBook trading. PloS one, 15(2), e0228418. https://doi.org/10.1371/journal.pone.0228418

Ciriello, R.F., Torbensen, A.C.G., Hansen, M.R.P. (2023). Blockchain-based digital rights management systems: Design principles for the music industry. *Electron Markets,* 33(3), https://doi.org/10.1007/s12525-023-00628-5

Dakić, V., Morić, Z., Kapulica, A., & Regvart, D. (2025). Analysis of Azure Zero Trust Architecture Implementation for Mid-Size Organizations. *Journal of Cybersecurity and Privacy*, *5*(1), 2. https://doi.org/10.3390/jcp5010002

Dziundziuk, B. & Dziundziuk, V. (2025). Methodology for integrating blockchain into digital governance systems: analysis of challenges, benefits, and opportunities for society. *Science and Public Policy* scaf022, https://doi.org/10.1093/scipol/scaf022

Dong, S., Abbas, K., Li, M., & Kamruzzaman, J. (2023). Blockchain technology and application: an overview. *PeerJ Computer Science*, 9(1), e1705. 10.7717/peerj-cs.1705.

Hardjono, T. & Avrilionis, D. (2025). Provenance Metadata Registries for Asset-Referenced Tokens. https://advance.sagepub.com/users/679026/articles/1270791/master/file/data/hardjono-avrilionis-decentralized-mica-assets-registries/hardjono-avrilionis-decentralized-mica-assets-registries.pdf?inline=true

Jia, L., Shao, B., & Bian, G. (2025). Cross-Chain technology of consortium blockchain based on identity authentication. *Electronics*, 14(6), 1185. https://doi.org/10.3390/electronics14061185

Joyce, A., & Javidroozi, V. (2024). Smart city development: Data sharing vs. data protection legislations, *Cities,* 148, 104859, https://doi.org/10.1016/j.cities.2024.104859.

Karaduman, Ö., & Gülhas, G. (2025). Blockchain-Enabled Supply Chain Management: A Review of Security, Traceability, and Data Integrity Amid the Evolving Systemic Demand. *Applied Sciences*, 15(9), 5168. https://doi.org/10.3390/app15095168

Keru Duan, Gu Pang, Yong Lin, (2023). Exploring the current status and future opportunities of blockchain technology adoption and application in supply chain management, *Journal of Digital Economy,* 2 (2), 244-288, https://doi.org/10.1016/j.jdec.2024.01.005.

Kherrazi, S., & Roquilly, C. (2025). Managing Digital Transformation in Contemporary Contexts: Are Classical Change Management Frameworks Still Relevant? *Journal of Change Management*, 25(2), 85–115. https://doi.org/10.1080/14697017.2025.2494508

Licardo, J. T., Domjan, M., & Orehovački, T. (2024). Intelligent Robotics—A Systematic Review of Emerging Technologies and Trends. *Electronics,* 13(3), 542. https://doi.org/10.3390/electronics13030542

Loffi, L., Camillo, G.L., desouza, C.A., Westphall, C.M. & Westphall, C.B. (2025). Management of the chain of custody of digital evidence using blockchain and self-sovereign identities: a systematic literature review. *IEEE Access*, 15, 77804 - 77832 . 10.1109/ACCESS.2025.3560191

Mendoza, H. M., & Talavera, A. S. (2025). Governance Strategies for the Management of Museums and Heritage Institutions. *Heritage,* 8(4), 127. https://doi.org/10.3390/heritage8040127

Mohamed, N. (2025). Artificial intelligence and machine learning in cybersecurity: a deep dive into state-of-the-art techniques and future paradigms. *Knowledge and Information System,* https://doi.org/10.1007/s10115-025-02429-y

Onwubiko, E.C. (2025) Blockchain technology as a tool for effective library services in a digital era: conceptual analysis. *International Journal of Library and Information Science Studies*, 11(1),18-27.

Page, M.J., McKenzie, J.E., Bossuyt, P.M. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *System Revolution*, 10, 89. https://doi.org/10.1186/s13643-021-01626-4

Patil, H., Kohli, R.K., Puri, S. & Puri, P. (2024). Potential applicability of blockchain technology in the maintenance of chain of custody in forensic casework. *Egypt Journal Forensic Science*, 14(12), https://doi.org/10.1186/s41935-023-00383-w

Pineda, M., Jabba, D., Nieto-Bernal, W., & Pérez, A. (2024). Sustainable Consensus Algorithms Applied to Blockchain: A Systematic Literature Review. Sustainability, 16(23), 10552. https://doi.org/10.3390/su162310552

Ramirez Lopez, L. J., & Morillo Ledezma, G. G. (2025). Employing Blockchain, NFTs, and Digital Certificates for Unparalleled Authenticity and Data Protection in Source Code: A Systematic Review. *Computers,* 14(4), 131. https://doi.org/10.3390/computers14040131

Sabiri, K., Sousa, F. & Rocha, T. A (2025). Systematic review of privacy-preserving blockchain applications in healthcare. *Multimed Tools Appl*ication. https://doi.org/10.1007/s11042-024-20541-z

Sai, A.R. & Vranken, H. (2024). Promoting rigor in blockchain energy and environmental footprint research: A systematic literature review. *Blockchain: Research and Applications,*5(1), 100169, https://doi.org/10.1016/j.bcra.2023.100169.

Saif, A. Naser Moha, Islam, K. M. Anwarul, Haque, A., Akhter, H., Rahman, S. M. Masudur, Jafrin, N., et al. (2022). Blockchain Implementation Challenges in Developing Countries: An evidence-based systematic review and bibliometric analysis. *Technology Innovation Management Review*, 12(1/2), 22010202. http://doi.org/10.22215/timreview/1479

Shahzad, K., Khan, S.A. & Iqbal, A. (2024). Effects of blockchain technology (BT) on the university librarians and libraries: a systematic literature review (SLR). *Library Hi Tech*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/LHT-10-2023-0486

Silaghi, D. L., & Popescu, D. E. (2025). A Systematic Review of Blockchain-Based Initiatives in Comparison to Best Practices Used in Higher Education Institutions. *Computers,* 14(4), 141. https://doi.org/10.3390/computers14040141

Tella, A., Amuda, H.O. and Ajani, Y.A. (2022). Relevance of blockchain technology and the management of libraries and archives in the 4IR. *Digital Library Perspectives*, 38(4), 460-475. https://doi.org/10.1108/DLP-08-2021-0065

Tripathi, G., Ahad, M.A., & Casalino, G. (2023). A comprehensive review of blockchain technology: Underlying principles and historical background with future challenges. *Decision Analytics* 9, 100344, https://doi.org/10.1016/j.dajour.2023.100344.

Ziatdinov, R., Atteraya, M., & Nabiyev, R. (2024). The Fifth Industrial Revolution as a Transformative Step towards Society 5.0. Societies. 14. 19. 10.3390/soc14020019.

Comparative Analysis of Library Services and Resources Usage among Biology Education Undergraduates in Two Universities in Benue State, Nigeria

Kate AGBO[1]
Medical Library, College of Health Sciences,
Benue State University, Makuridi, Nigeria.
kateag83@gmail.com

Charles Terwuese TSENONGU (CLN, PMIIM)[2]
Department of Library and Information Science,
Clifford University, Owerrinta, Abia State, Nigeria.
tsenongucharlesfeb14@gmail.com

Bonnie Obeka OBANDE (CLN)[3]
Igbinedion University Library, Okada, Edo State, Nigeria
unclebons@gmail.com
https://orcid.org/0009-0001-3068-3055

Abstract

This study investigated the availability and usage of library resources and services among undergraduate Biology Education students in two universities in Benue State. Using a survey research design, the study sampled 292 respondents from Benue State University and Federal University of Agriculture Makurdi. Findings revealed that some library resources and services were available and utilized, but challenges like power failures and lack of current awareness hindered usage. Significant differences were found between state and federal university respondents' perceptions. Recommendations include providing current resources, improving library services, installing standby generators, and organizing orientation programs.

Keyword: *Library resources, Biology education, Undergraduates, University libraries and Information access.*

Introduction

Libraries play a vital role in the academic success of students by providing access to a wealth of information resources, study spaces, and research support services. However, the extent to which students utilize these services is influenced by various factors, including accessibility, awareness, availability of resources, and individual preferences. Understanding these factors is crucial for improving library service delivery and ensuring that students maximize the benefits of these resources (Aina, 2018).

Biology education undergraduates, in particular, require access to specialized materials such as textbooks, journals, and research databases to support their studies and research projects. Despite the importance of library services, studies have shown that many students underutilize them due to challenges such as inadequate resources, lack of digital tools, or insufficient orientation on library usage (Ezeani & Igwesi, 2019).

In Benue State Universities, the situation is no different. Preliminary observations suggest that while libraries remain a central part of the academic environment, there are variations in how biology education undergraduates engage with these services. Factors such as socioeconomic background, technological advancements, and the quality of library facilities may play a role in shaping their usage patterns (Okonkwo, 2020).

This study aims to explore the key factors affecting the utilization of library services among biology education undergraduates in Benue State Universities. By identifying these factors, the research seeks to provide actionable recommendations for improving library service delivery and fostering greater engagement among students.

Research Questions

1. What is the level of availability of library resources in University libraries in Benue State?
2. What is the extent of availability of library services in University libraries in Benue State?
3. What is the level of usage of library resources by undergraduate students of biology education in University libraries in Benue State?
4. What are the factors hindering the usage of library services in two University libraries in Benue State?

Literature Review

Assessing the factors affecting library service usage among Biology Education undergraduates in Benue State Universities requires an understanding of various academic, infrastructural, and personal influences. One significant factor is the accessibility and availability of library resources. According to Adewale and

Okoro (2023), students are more likely to utilize library services when there is a wide range of up-to-date academic materials, including textbooks, journals, and digital resources. The study highlights that inadequate resources often discourage students from frequenting the library.

Another critical factor is the integration of technology in library services. With advancements in digital tools, libraries that offer online catalogs, e-books, and research databases have seen increased patronage. For instance, a study by Musa et al. (2024) revealed that over 70% of Biology Education undergraduates preferred libraries with robust digital infrastructures, as these facilitate easier access to academic content.

The physical environment of the library also plays a role. Libraries that provide comfortable seating, proper lighting, and quiet study areas are more appealing to students. In their research, Terkula and Ijeoma (2022) found that poorly maintained library facilities in some Benue State Universities discouraged students from using these services regularly.

The role of library staff cannot be overlooked. Librarians who are approachable and willing to assist students with research inquiries significantly enhance the user experience. As noted by Eze and Abah (2025), students often rely on librarians for guidance on navigating complex academic databases or locating specific materials.

Personal factors such as time management and academic workload also influence library usage. Many students struggle to balance their schedules, leading to reduced visits to the library. A study by Ogbu and Adamu (2023) suggested that flexible library hours could address this issue, enabling students to access resources at their convenience.

The usage of library services among Biology Education undergraduates in Benue State Universities is shaped by a combination of resource availability, technological integration, physical infrastructure, staff support, and personal circumstances.

Integration of Theories

The Information Needs Theory and TAM can be integrated to understand how Biology Education undergraduates' information needs influence their acceptance and usage of library services. According to the Information Needs Theory, users seek information to satisfy specific needs. TAM suggests that users' acceptance of technology is influenced by perceived usefulness and ease of use.

1. **Information Needs and Perceived Usefulness:** Biology Education undergraduates' information needs may influence their perception of the usefulness of library services. If library services meet their information needs, they are more likely to perceive them as useful.

2. **Information Seeking Behavior and Ease of Use:** Undergraduates' information seeking behavior may be influenced by the ease of use of library services. If library services are user-friendly and easily accessible, undergraduates are more likely to use them to satisfy their information needs.

3**. Satisfaction of Information Needs and Usage**: The satisfaction of information needs through library services may influence undergraduates' continued usage of these services. If library services consistently meet their information needs, undergraduates are more likely to continue using them.

Methodology

The methodology employed for the study, focusing on survey research design. The study was conducted in two university libraries in Benue State, Nigeria, chosen due to the availability of Biology Education programs and library resources. The population comprised 1,075 undergraduate Biology Education students from Federal and State Universities, with a sample size of 292 selected using proportionate stratified random sampling.

Data collection relied on a structured questionnaire titled "Assessment of Availability and Usage of Library Resources and Services by Undergraduate Students' Questionnaire (AAULRSQ)," validated by experts and tested for reliability with a Cronbach Alpha coefficient of 0.88. The questionnaire explored library resources, services, usage extent, and inhibiting factors.

Data was collected with the help of trained research assistants and analyzed using descriptive statistics like mean and standard deviation, alongside t-tests for hypothesis testing at a 0.05 significance level. Decision-making thresholds were established based on mean ratings, with a benchmark of 2.50 for agreement. The methodology ensures objective assessment of library resource availability and usage among students in the selected universities.

Results and Discussion

Research Question 1

What is the level of availability of library resources in two University libraries in Benue State?

To answer the research question, data were collected on opinions of respondents relating to availability of library resources in the two university libraries in Benue State. The collected data were analysed and presented in Table 1.

Table 1: ***Descriptive Statistics of Responses on Availability of Library Resources in the Two University Libraries in Benue State***

Descriptive Statistics					
SN	**Items**	**N**	**Mean**	**Std. Deviation**	**Remarks**
4	Text books	292	3.3973	.90421	**Available**
5	Journals	292	3.1027	.93595	**Avail**
6	Encyclopedias	292	2.6747	.78231	**Available**
7	Maps	292	3.5000	.89481	**Highly Available**
8	Yearbooks	292	2.9863	.86144	**Available**
9	Dictionaries	292	2.7089	.99872	**Highly Available**
10	Magazines	292	3.6507	.68956	**Highly Available**
11	News papers	292	3.7089	.70408	**Highly Available**
12	Brailed books	292	1.2418	1.32126	**Not Available**
13	Almanac	292	3.4863	.61187	**Available**
14	DVD Player	292	2.6404	1.26985	**Available**
15	Television	292	2.9932	1.31079	**Available**
16	Projects, Dissertations & Theses	292	2.9829	.85938	**Available**
17	Computers	292	2.6986	1.00425	**Available**
18	Internet	292	3.6644	.69140	**Available**
	Grand Mean	292	3.0758	.25830	**Available**
	Valid N (listwise)	292			

From Table 1, it can be seen that the mean rating scores of all the items are above 2.50 except item 12; with the grand mean of 3.0758 and standard deviation of 0.25830. This implies that Text books, Journals, Encyclopedias, Maps, Yearbooks, Dictionaries, Magazines, Newspapers, Almanac, DVD Player, Television, Projects, Dissertations & Theses, Computers, and Internet are available while Brailed books are not available.

Based on the results in Table 1, the finding of the study revealed that Text books, Journals, Encyclopedias, Maps, Yearbooks, Dictionaries, Magazines, Newspapers, Almanac, DVD Player, Television, Projects, Dissertations & Theses, Computers, and Internet are available while Brailed books are not available in the two university libraries in Benue State. This study is in line with Adeyemi and Oluwagbemi (2020) highlighted the significance of providing access to a range of digital and print resources, including e-books, journals, and databases, to support student learning and faculty research. Similarly, Okonedo and Mabawonku (2019) emphasized the need for academic libraries to invest in modern information technologies, such as computers, internet services, and digital repositories, to enhance service delivery. More recent studies continue to stress the importance of adapting library collections and services to meet evolving user needs (Okello-Obura & Ssemambo, 2022; Baro & Fadero, 2021).

Research Question 2

What is the extent of availability of library services in two University libraries in Benue State?

To answer the research question, data were collected on opinions of respondents relating to extent of availability of library services in two University libraries in Benue State. The collected data were analysed and presented in Table 2.

Table 2: ***Descriptive Statistics of Responses on Extents of Availability of Library Services in Two University Libraries in Benue State***

Descriptive Statistics					
SN		**N**	**Mean**	**Std. Deviation**	**Remarks**
19	Circulation Services	292	3.5068	.85552	**Very High Extent**
20	Reference Services	292	3.8014	.39965	**Very High Extent**
21	User Education Services	292	3.5651	.49660	**Very High Extent**

22	Audio Visual Services	292	3.3253	.97405	**High Extent**
23	Internet Services	292	3.2192	1.07769	**High Extent**
24	Cataloguing and Classification Services	292	3.7089	.70408	**Very High Extent**
25	Bindery Services	292	3.7945	.40475	**Very High Extent**
26	Lending Services	292	3.5479	.49855	**Very High Extent**
27	Inter Library Loan	292	2.9760	1.36580	**High Extent**
28	Printing	292	3.6712	.47057	**Very High Extent**
29	Photocopying	292	3.0171	1.33279	**High Extent**
30	Membership Registration	292	3.3116	1.17336	**High Extent**
31	Abstracting and Indexing Services	292	3.3356	1.14139	**High Extent**
32	Bibliographical Services	292	2.5582	1.27089	**High Extent**
33	Referral services	292	3.4281	.90719	**High Extent**
	Grand Mean	292	3.3845	.19557	**High Extent**
	Valid N (listwise)	292			

From Table 2, it can be seen that the mean rating scores of all the items are above 2.50 with the grand mean of 3.3854 and standard deviation of 0.19557. This implies that the availability of library services such as circulation services, reference services, user education services, audio visual services, internet services, cataloguing and classification services, bindery services, lending services, inter library loan, printing, photocopying, membership registration, abstracting and indexing services and bibliographical services in two university libraries in Benue is to a high extent.

Based on the results in Table 2 of research question 2, the findings of the study revealed that the availability of library services such as circulation Services, reference Services, user Education Services, audio Visual Services, Internet Services, Cataloguing and Classification Services, Bindery Services, Lending Services, Inter Library Loan, Printing, Photocopying, Membership Registration, Abstracting and Indexing Services and Bibliographical Services in two university libraries in Benue is to a high extent. The study is in line with Ramakrishna, Sasikala and Godwridevi (2016) who recommended that, services such as abstracting and indexing services, internet services, bibliographical services and so on be provided in addition to the available services in the university to enhance quality education of the users that library It also agrees with These findings align with recent research emphasizing the importance of providing a range of library services to support academic excellence. For instance, studies by Adeyemi (2022) and Okonedo (2020) highlight the significance of offering services like internet access, bibliographic services, and user education to enhance the quality of education and research. Similarly, Baro and Fadero (2021) emphasize the need for libraries to provide innovative services, including digital reference services and information literacy programs, to meet the evolving needs of users.

Research Question 3

What is the level of usage of library resources by undergraduate students of biology education in two University libraries in Benue State?

To answer the research question, data were collected on opinions of respondents relating to level of usage of library resources by undergraduate students of biology education in two University libraries in Benue State. The collected data were analysed and presented in Table 3.

Table 3: ***Descriptive Statistics of Responses on Level of Usage of Library Resources by Undergraduate Students of Biology Education in Two University libraries in Benue State***

Descriptive Statistics					
SN	**Items**	**N**	**Mean**	**Std. Deviation**	**Remarks**
34	Text books	292	3.0890	.91510	**Used**
35	Journals	292	2.7055	.78795	**Used**
36	Encyclopedias	292	3.5377	.89402	**Highly Used**

37	Maps	292	2.9829	.85938	**Used**
38	Yearbooks	292	2.6678	1.02340	**Used**
39	Dictionaries	292	3.7089	.59856	**Highly Used**
40	Magazines	292	3.4452	.87760	**Used**
41	News papers	292	3.8014	.39965	**Highly Used**
42	Brailed books	292	1.4315	.97323	**Not Used**
43	Almanac	292	2.9452	1.19438	**Used**
44	DVD Player	292	2.8185	1.17151	**Used**
45	Television	292	2.7911	1.25490	**Used**
46	Projects, Dissertations & Theses	292	3.3562	.89856	**Used**
47	Computers	292	3.4726	.74331	**Used**
48	Internet	292	3.3219	.81173	**Used**
	Grand Mean	292	3.0717	.33542	**Used**
	Valid N (listwise)	292			

From Table 3, it can be seen that the mean rating scores of all the items are above 2.50 except item 42; with the grand mean of 3.0717 and standard deviation of 0.33542. This implies that Text books, Journals, Encyclopedias, Maps, Yearbooks, Dictionaries, Magazines, Newspapers, Almanac, DVD Player, Television, Projects, Dissertations & Theses, Computers, and Internet are used by undergraduate students of biology education in two University libraries in Benue State while Brailed books are not used.

Based on the results in Table 3, the findings of the study showed that Text books, Journals, Encyclopedias, Maps, Yearbooks, Dictionaries, Magazines, Newspapers, Almanac, DVD Player, Television, Projects, Dissertations & Theses, Computers, and Internet are used by undergraduate students of biology education in two University libraries in Benue State. However, Brailed books were not used. The study is in line with Okello-Obura (2022) and Adeyemi (2021) highlight the significance of providing access to relevant library resources and teaching information literacy skills to enhance students' academic performance and research capabilities. Similarly, Okonedo (2020) emphasizes the need for libraries to promote the effective use of library resources through user education programs and outreach services.

Research Question 4

What are the factors hindering the usage of library services in two University libraries in Benue State?

To answer the research question, data were collected on opinions of respondents relating to factors hindering the usage of library services in two University libraries in Benue State. The collected data were analysed and presented in Table 4.

Table 4: ***Descriptive Statistics of Responses on Factors Hindering the Usage of Library Services in Two University Libraries in Benue State***

Descriptive Statistics					
SN	**Items**	**N**	**Mean**	**Std. Deviation**	**Remarks**
81	Limited Operational Hours	292	3.5479	.49855	**Strongly Agree**
82	Power (electricity) Failure	292	2.7329	.98296	**Agree**
83	Poor Reference Services	292	3.0274	1.00134	**Agree**
84	Poor User Education	292	2.8493	1.30209	**Agree**
85	Unavailability Audio Visual Services	292	2.8288	1.20343	**Agree**
86	Poor Internet Services	292	3.6096	.80696	**Strongly Agree**
87	Poor Bindery Services	292	3.4452	.62073	**Agree**
88	Inadequate Equipment for Printing Downloaded documents	292	3.2329	1.08118	**Agree**
89	Not Allowing Photocopying Whole or Part of needed Material	292	2.6747	.97051	**Agree**

90	Lack of Current Awareness Services	292	3.3733	.91627	**Agree**
91	Lack of Selective Dissemination of Information Services	292	3.7945	.45283	**Strongly Agree**
92	Inconsistency in Abstracting and Indexing Services	292	3.4452	.62073	**Agree**
93	Poor Bibliographical Service System	292	3.7226	.53255	**Strongly Agree**
	Grand Mean	292	3.6526	.42304	**Strongly Agree**
	Valid N (listwise)	292			

From Table 4, it can be seen that the mean rating scores of all the items are above 2.50 with the grand means of 3.65 and the deviation value of .42304. This implies that Limited Operational Hours, Power (electricity) Failure, Poor Reference Services, Poor User Education, poor Audio Visual Services, Poor Internet Services, Poor Bindery Services, Inadequate Equipment for Printing Downloaded documents, Not Allowing Photocopying Whole or Part of needed Material, Lack of Current Awareness Services, Lack of Selective Dissemination of Information Services, Inconsistency in Abstracting and Indexing Services and Poor Bibliographical Service System are the factors hindering the usage of library services in two University libraries in Benue State.

Moreover, based on the results in Table 4, the findings of the study revealed that outdated Information Resources, lack of Reading Spaces, theft and Mutilation of Information Materials, power (electricity) Failure, Poor User Education, Unavailability Audio Visual Services, Poor Internet Services, Poor Cataloguing and Classification of Materials, poor Bindery Services, lack of Inter Library Loan to Acquire Materials library doesn't have but Available elsewhere, Inadequate Equipment for Printing Downloaded documents, Not Allowing Photocopying Whole or Part of needed Material, Lack of Current Awareness Services, Lack of Rest Room/Convenience, Inconsistency in Abstracting and Indexing Services, Poor Bibliographical Service System and Poorly Organized Shelf guides/marks are the factors inhibiting the usage of library resources in two University libraries in Benue State. This is in line with Adeyemi (2022) and Okonedo (2021) highlight the impact of outdated information resources, poor user education, and inadequate library infrastructure on resource utilization. Similarly, Baro and Fadero (2020) emphasize the need for libraries to address issues like theft and mutilation of materials, power outages, and poor internet services to enhance resource utilization.

Conclusion

This study assessed the comparative analysis of library services and resources usage among biology education undergraduates in two universities in Benue State, Nigeria. The findings revealed that various resources and services are available in the two universities, but their usage is hindered by several factors. To alleviate these challenges, recommendations were provided to enhance the availability and effective utilization of library resources and services for maximum academic achievement. The study found that textbooks, journals, encyclopedias, and other resources are available, but Braille books are not. Library services such as circulation, reference, and user education services are available to a high extent. However, factors like outdated resources, poor user education, inadequate infrastructure, and poor internet services hinder resource utilization. The study's findings align with recent research emphasizing the importance of providing access to relevant library resources and services, teaching information literacy skills, and addressing issues like outdated resources and poor infrastructure to enhance resource utilization.

Recommendations

Based on the study's findings, the following recommendations are made:

1. Provide current information resources in the libraries.
2. Improve library services for students and user communities.
3. Install standby generators to avoid power outages.
4. Seek support from individuals and non-governmental agencies to equip libraries.
5. Organize regular library orientation workshops and seminars.
6. Provide comprehensive tools and retrieval devices for easy access to resources.
7. Enhance library security to prevent material mutilation and theft.
8. Publicize library resources and services to undergraduate students through media advertising and education.

References

Adeyemi, O. A. (2022). Library services and academic performance: A study of university libraries in Nigeria. Journal of Library and Information Science, 19(1), 1-12.

Adewale, S., & Okoro, F. (2023). *Resource availability and its impact on library usage among university students.* Journal of Educational Resources, 12(3), 45-58.

Adeyemi, O. A. (2021). Library resource utilization and academic performance: A study of university students in Nigeria. Journal of Library and Information Science, 18(2), 1-12.

Adeyemi, O. A., & Oluwagbemi, O. O. (2020). Digital information resources and services in academic libraries: A review. Journal of Information Science Theory and Practice, 8(2),

Aina, L. O. (2018). Library and Information Science in Developing Countries. Ibadan: Spectrum Books. 34-47.

Baro, E. E., & Fadero, J. O. (2021). Information resources and services in academic libraries: A study of university libraries in Nigeria. Journal of Library and Information Science, 18(2), 1-15.

Baro, E. E., & Fadero, J. O. (2021). Innovative library services in university libraries: A study of selected universities in Nigeria. Library Philosophy and Practice, 1-20.

Eze, P., & Abah, M. (2025). *The role of librarians in enhancing academic success among undergraduates*. Global Journal of Library Services, 15(1), 23-34.

Ezeani, C. N., & Igwesi, U. (2019*). Challenges of Library Service Delivery in Nigerian Universities*. Journal of Library and Information Science, 12(2), 45-58.

Ogbu, C., & Adamu, L. (2023). *Time management challenges and library usage among university students.* Nigerian Journal of Educational Studies, 9(3), 56-71.

Okello-Obura, C. (2022). Information literacy skills and academic performance: A study of university students in Uganda. Journal of Information Science Theory and Practice, 10(2), 1-15.

Okello-Obura, C., & Ssemambo, M. (2022). Availability and accessibility of information resources in academic libraries: A study of selected university libraries in Uganda. Library Philosophy and Practice, 1-20.

Okonedo, S. (2020). Evaluating the effectiveness of library services in university libraries: A study of selected universities in Nigeria. Journal of Information Science Theory and Practice, 8(1), 1-15.

Okonedo, S., & Mabawonku, I. (2019). Availability and use of electronic information resources by academics in Nigerian university libraries. Journal of Library and Information Science, 16(1), 1-12.

Okonedo, S. (2020). Promoting effective use of library resources: A study of university libraries in Nigeria. Library Philosophy and Practice, 1-20.

Okonkwo, R. C. (2020). *Factors Influencing Library Usage Among Undergraduates in Nigerian Universities.* Nigerian Journal of Educational Research, 15(1), 67-81.

Musa, A., Ibrahim, Y., & Oche, T. (2024). *Digital transformation in university libraries: A case study of Benue State*. African Journal of Library Science, 18(2), 67-79.

Terkula, J., & Ijeoma, K. (2022). *The influence of library facilities on student satisfaction in Nigerian universities,* International Journal of Academic Research, 10(4), 89-102.

Continuous Professional Development (CPD) Initiatives for Academic Librarians in the Fifth Industrial Revolution: A Systematic Review

By
Fati Abubakar, (Ph.D); Hussaini MUSA, (Ph.D); Musa, Imam Shakarau;
Ladan Dogara, Murjanatu Abduhamid Jibbo, PhD & Goshie, Rhoda Wusa, PhD
University Library Services
Federal University of Technology Minna, Niger State, Nigeria

Abstract

In light of the extensive emergence of disruptive technologies that catalyze the fifth industrial revolution (5IR), academic libraries have experienced a significant transformation, which has concurrently altered the responsibilities of academic librarians. With the advent of disruptive technologies, library and information services are now accessible globally, contingent upon a user's connection to the Internet of Things. To remain pertinent within the context of 5IR, it is imperative for academic librarians to enhance their skillsets. This study posits that such skill enhancement can be achieved through continuous professional development. CPD initiatives encompass various formats, including workshops, both internal and external training programs, conferences, job shadowing, mentoring, and focus groups. The methodological approach employed in this paper is an analytical review of the literature pertinent to CPD initiatives for academic librarians in the context of the fifth industrial revolution. To achieve these aims, the study employed a Systematic Literature Review (SLR) methodology. This involved a structured and transparent process of identifying, selecting, and synthesizing peer-reviewed literature relevant to CPD in the context of Industry 5.0. Inclusion criteria focused on studies published between 2015 and 2024, specifically addressing CPD in academic libraries and technological competencies. After applying rigorous screening and eligibility criteria, a total of 42 studies were selected from an initial pool of 146 academic sources. The paper dwell on continuous professional development (CPD) initiatives as a mechanism for academic librarians to engage with the fifth industrial revolution, key areas of CPD for academic librarians in industry 5.0, CPD initiatives for academic librarians in the fifth industrial revolution, types of knowledge and skills acquired by academic librarians in continuous professional development (CPD) in the era of fifth industrial revolution, benefits for academic librarians in continuous professional development (CPD) in the fifth industrial revolution, challenges of academic librarians in continuous professional development (CPD) to engage with the fifth industrial revolution, conclusion and recommendations were made on how to optimize the benefits of CPD for academic librarians in the 5IR

Key terms: *Academic librarians; Fifth industrial revolution; Continuing professional development; Disruptive technologies; Evolving roles of librarians; Library services.*

Introduction

The world is undergoing rapid technological transformation, often referred to as the Fifth Industrial Revolution (5IR), which is distinguished by the convergence of advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), big data, automation, and robotics. This new revolution is reshaping industries, including education and information services, where academic librarians play a critical role in facilitating access to knowledge and supporting the learning and research processes in academic settings (Bawden & Robinson, 2020). As digital tools and technologies continue to evolve, academic librarians face the challenge of staying relevant and competitive by adapting to new demands and acquiring new competencies that are essential for the 5IR.

Continuous Professional Development (CPD) is a strategic mechanism through which professionals, including librarians, maintain and enhance their skills, knowledge, and competencies in their respective fields (Haddow & Parker, 2021). For academic librarians, CPD initiatives are particularly crucial as they provide opportunities to engage with and utilize emerging technologies, foster innovation, and equip them to respond to the dynamic demands of the academic and information landscape in the 5IR (JISC, 2020). CPD enables academic librarians to stay up-to-date with digital literacy, information management, data curation, and the evolving role of libraries as knowledge hubs in the digital age. The rapid advancement of digital technologies in the 5IR presents opportunities and challenges for academic libraries. With the rise of AI, machine learning, and data science, librarians must not only ensure that they can navigate and use new tools but also understand their implications on privacy, security, and ethical concerns (Liu & Huang, 2019). Furthermore, CPD initiatives can help librarians better integrate these technologies into the services they offer, including virtual reference services, digital archives, and collaborative research platforms. Through CPD, academic librarians can also strengthen their capacity for data analysis, information retrieval, and user-centered design, all of which are critical in the modern academic ecosystem (Sweeney, 2022).

Given the speed of technological change, CPD initiatives must be tailored to address the specific needs and challenges posed by the 5IR. In this context, CPD programs could range from workshops on AI and data analytics, to professional networks that share best practices in utilizing emerging technologies within libraries (Neal, 2021). Moreover, these initiatives should foster a culture of lifelong learning and collaboration to ensure that academic librarians remain equipped to lead in an increasingly technology-

driven world. As academic libraries evolve into hubs for digital learning, research, and collaboration, CPD becomes central to enabling librarians to meet the demands of the 5IR and enhance their role in supporting academic success.

Objective

The objectives of this documentary research are to:

1. Discuss Continuous Professional Development (CPD) Initiatives as a Mechanism for Academic Librarians to Engage with the Fifth Industrial Revolution
2. Identify key Areas of CPD for Academic Librarians in Industry 5.0
3. CPD Initiatives for Academic Librarians in the Fifth Industrial Revolution
4. Examine the types of Knowledge and Skills Acquired by Academic Librarians in Continuous Professional Development (CPD) in the Era of Fifth Industrial Revolution
5. Determine the benefits for Academic Librarians in Continuous Professional Development (CPD) in the Fifth Industrial Revolution
6. Identify the challenges of Academic Librarians in Continuous Professional Development (CPD) to Engage with the Fifth Industrial Revolution
7. Make recommendations to overcome the identified challenges

Methodology

A **Systematic Literature Review (SLR)** is a rigorous and transparent method of identifying, evaluating, and synthesizing existing research relevant to a specific topic or set of objectives (Kitchenham & Charters, 2007). It involves clearly defined search strategies, inclusion and exclusion criteria, and an objective process for screening and selecting studies. The aim is to minimize bias and provide a replicable foundation for evidence-based conclusions.

This review adopted the SLR approach to explore **Continuous Professional Development (CPD) initiatives as a mechanism for academic librarians to engage with the Fifth Industrial Revolution (5IR)**, based on well-defined objectives. The process ensured that the reviewed studies directly contributed to answering questions related to required competencies, key CPD areas, impact on professional performance, and institutional support frameworks.

Inclusion and Exclusion Criteria

To ensure the relevance and quality of selected literature, the following inclusion and exclusion criteria were applied:

Inclusion Criteria:

- Peer-reviewed journal articles, conference papers, and academic reports.
- Publications from **2015 to 2024** to capture contemporary CPD practices in light of Industry 4.0 and transitions into 5IR.
- Studies focused on **academic librarians** or CPD in **higher education library contexts.**
- Literature addressing **digital skills, AI, leadership, emerging technologies,** or **user-centered library services**.
- English language publications.

Exclusion Criteria:

- Articles focusing solely on school or public libraries.
- Studies published before 2015 unless cited for foundational context.
- Non-academic blogs, opinion pieces, or media reports lacking empirical evidence.
- Literature unrelated to CPD or not aligned with the evolving demands of the Fifth Industrial Revolution.

Search Strategy and Article Selection

Relevant studies were identified using key databases such as Scopus, Web of Science, Google Scholar, and ERIC. Search terms included combinations of: "continuous professional development", "academic librarians", "Fifth Industrial Revolution", "digital skills", "AI in libraries", and "CPD in higher education".

An initial pool of **146 studies** was retrieved. After applying inclusion and exclusion criteria through title and abstract screening, and a full-text assessment, 42 **studies** were selected for final review and synthesis.

Review of Literature

The Fifth Industrial Revolution (5IR) emphasizes the synergy between humans and advanced technologies such as artificial intelligence (AI), robotics, and the Internet of Things (IoT), focusing on human-centric innovation (Schwab, 2019). For academic librarians, this means acquiring new competencies that merge digital literacy with ethical and user-centered service delivery. Core skills include data analytics, AI integration, digital content curation, and emotional intelligence (Gómez-Hernández & Pasadas Ureña, 2022). CPD initiatives must be aligned with these skill requirements to ensure librarians remain relevant and effective in facilitating research, teaching, and learning.

Academic libraries globally have implemented CPD strategies such as workshops, short courses, mentorships, online training, and certifications to help librarians upskill. These programs often cover topics like digital scholarship, research data management, open science, and AI tools for information services

(Ocholla & Shongwe, 2021). Notably, MOOCs (Massive Open Online Courses) and institutional collaborations with tech companies have become important CPD channels. For instance, libraries in South Africa and Nigeria have partnered with organizations like EIFL and UNESCO to offer digital skills training for staff (Okike, 2020).

CPD has been shown to significantly improve librarians' ability to provide innovative, tech-enabled services. Enhanced confidence in using digital tools, improved research support, and proactive user engagement are among the outcomes of sustained professional development (Ifijeh & Yusuf, 2020). Moreover, librarians who engage in continuous learning are more likely to contribute to institutional goals such as digital transformation, research excellence, and student success (Onyancha, 2022). Evaluation metrics for CPD effectiveness often include job performance assessments, service quality indices, and user satisfaction surveys.

Institutional support — through funding, time allocation, infrastructure, and policy frameworks — is essential for effective CPD. Many higher education institutions now recognize CPD as part of performance management and promotion systems (Popoola & Zaid, 2023). National library associations and governing bodies like IFLA have also provided guidelines and toolkits for CPD in the digital age. However, challenges remain in terms of inconsistent policy implementation, limited access in resource-constrained regions, and lack of strategic planning (Aina, 2021).

Table 1: Thematic Summary of CPD Literature in Academic Librarianship (2015–2025)

Theme	Key Focus	No. of Studies (n=42)	Representative Studies	Findings Summary
1. Digital Literacy and ICT Skills	Training in information technology, digital tools, online platforms	14	Fatoki (2021), Ani & Edem (2020)	Emphasis on training librarians in digital databases, open access systems, and emerging technologies.
2. Open Access & OER Advocacy	Librarians' roles in promoting and managing OA and OER resources	10	Isah (2018), Eze & Ikegwuruka (2020)	Libraries lack institutional policies; advocacy remains limited; staff need more confidence and tools.
3. Leadership and Management	CPD for managerial, leadership, and communication skills	6	Nnadozie & Nnadozie (2021)	Limited participation in leadership CPD; institutions overlook soft skill development.
4. Research Support & Data Services	Supporting scholarly communication, research impact, data curation	5	Ateneme & Adetimirin (2022)	Librarians need advanced training in research tools, bibliometrics, and data management.
5. Institutional Repository Use	Development and librarian involvement in repository creation and use	7	Ani & Edem (2020), Isah (2018)	Repositories underutilized due to poor sensitization and low faculty involvement.
6. Policy and Institutional Support	CPD funding, policy formulation, and top-down support	8	Nnadozie & Nnadozie (2021), Eze (2020)	Inadequate funding and weak institutional frameworks limit sustainable CPD implementation.
7. CPD Delivery Models	Face-to-face, blended, and online CPD approaches	5	Multiple case-based studies	Shift toward flexible, online CPD, but effectiveness varies depending on access and design quality.

Continuous Professional Development (CPD) Initiatives as a Mechanism for Academic Librarians to Engage with the Fifth Industrial Revolution

The Fifth Industrial Revolution (Industry 5.0) is transforming academic libraries, presenting opportunities and challenges. Continuous Professional Development (CPD) initiatives are crucial for academic librarians to adapt to new technologies and maintain high-quality service delivery. These programs equip librarians with technical expertise and critical thinking skills to manage emerging technologies, adapt workflows, and foster innovation. As academic libraries become leaders in knowledge management, CPD programs are essential for staying informed about technology, data management, and digital resource curation.

Key Areas of CPD for Academic Librarians in Industry 5.0

Continuous Professional Development (CPD) initiatives play a crucial role in ensuring that librarians are prepared to leverage these technologies to enhance their services and support academic communities. By focusing on areas such as AI, data analytics, blockchain, user-centered services, and collaboration, CPD programs will enable librarians to adapt to the changing landscape, foster innovation, and continue playing an essential role in knowledge management and information access in the digital age according to: (Kumar & Sinha, 2022; Wang & Lee, 2020; Oliver, 2021; Bhatti, 2021; O'Connor & Ward, 2022 and Singh, 2022) are.

1. **Digital Literacy and Technology Skills:** In the Fifth Industrial Revolution, librarians need to be proficient in various technologies like AI, big data analytics, cloud computing, IoT, and blockchain. CPD programs should focus on developing competencies in these areas, ensuring data management and privacy, and understanding ethical implications for handling sensitive information.
2. **Collaboration and Knowledge Sharing:** CPD initiatives should promote collaboration and knowledge sharing skills, focusing on human-machine collaboration in Industry 5.0. Academic librarians can use collaborative tools like shared digital workspaces, cloud-based research platforms, and virtual collaboration tools. CPD programs should also encourage leadership skills, fostering interdisciplinary research and innovation, and managing collaborative projects.
3. **AI and Automation in Libraries:** Library operations are being automated in the digital age, necessitating CPD initiatives to train academic librarians on AI-based systems. This will improve efficiency, streamline services, and enhance user experiences. Ethical considerations and data-informed decision-making are also crucial for ensuring transparency and fairness in AI use.
4. **Blockchain and Intellectual Property Management:** Blockchain technology can revolutionize digital rights management and intellectual property in academic libraries. CPD initiatives should introduce librarians to blockchain's applications, including secure access, resource authentication, usage rights tracking, and decentralized repositories. They should also emphasize the importance of digital preservation and data archiving in a rapidly changing technological landscape.
5. **User-Centered Services and Personalization:** Industry 5.0 emphasizes personalization of services, with academic libraries focusing on tailored experiences. CPD initiatives emphasize user-centered design and AI use for personalized library services. Librarians should be trained in digital literacy to equip students, faculty, and researchers with the necessary skills.

CPD Initiatives for Academic Librarians in the Fifth Industrial Revolution

This section explores the various types of CPD initiatives that academic librarians can undertake to effectively engage with the 5IR.

1. ***Workshops and Training Sessions on Emerging Technologies***

Academic librarians benefit from workshops and training sessions for CPD, focusing on emerging technologies like AI, big data, automation, and IoT. These sessions provide practical knowledge and hands-on experience, enabling librarians to enhance digital resources, implement automated cataloging systems, and improve personalized services (Bawden & Robinson, 2020).

2. ***Webinars and Online Courses***

Digital learning platforms like Coursera, edX, and LinkedIn Learning offer specialized courses in AI, digital libraries, and emerging technologies, allowing librarians to learn from global experts, participate in discussions, and access resources at their own pace, enabling them to stay ahead in their profession. These platforms offer the flexibility to acquire new skills without the constraints of geographical location (Haddow & Parker, 2021).

3. ***Professional Conferences and Networking Events***

Academic librarians benefit from attending professional conferences and networking events for CPD. These events offer opportunities to learn from thought leaders, engage with peers, and discover new tools and practices shaping the future of libraries in the 5IR. They also foster collaboration among libraries, tech developers, and academic institutions (Neal, 2021).

4. ***Collaborative Learning and Peer Mentorship Programs***

Collaborative learning and mentorship are crucial CPD initiatives for librarians, fostering innovation and practical insights. These programs, such as peer-led discussions on emerging technologies, data privacy research, and digital service delivery best practices, help librarians apply new technologies in a supportive community (Sweeney, 2022).

5. ***Certifications and Advanced Qualifications***

Academic librarians can gain expertise in technology and information management through certifications or advanced qualifications. Programs like CIP, DLC, and data management certifications help build credibility in specialized fields like AI ethics and machine learning. Advanced qualifications like master's degrees prepare librarians for higher-level roles in the academic sector (Liu & Huang, 2019).

6. ***Institutional In-House Training Programs***
Academic institutions can offer customized in-house CPD programs for library staff, addressing global trends and local institutional needs. These programs cover integration of library services, data privacy regulations, and AI integration, helping librarians adapt to the 5IR (JISC, 2020).
Academic librarians must actively engage with the Fifth Industrial Revolution by pursuing continuous professional development (CPD) initiatives to enhance their skills in emerging technologies, ensuring they continue to provide innovative, efficient, and impactful services.

Types of Knowledge and Skills Acquired by Academic Librarians in Continuous Professional Development (CPD) in the Era of Fifth Industrial Revolution
Continuous Professional Development (CPD) equips academic librarians with skills in digital literacy, data science, AI, copyright, user experience, ethics, and collaboration, enabling them to enhance library services, support research, and remain indispensable in the 5IR technology-driven academic environment.

1. Digital Literacy and Information Management
Academic librarians gain enhanced digital literacy through CPD, adapting to new technologies like cloud computing and AI-based search engines. They learn to use digital platforms, metadata standards, and content management systems for organizing and curating vast information. Information management skills are crucial for handling large datasets and complex structures, supporting academic research, teaching, and learning (Haddow & Parker, 2021).

2. Data Science and Data Management
Academic librarians must acquire competencies in data science and management to handle large datasets, analyze data trends, and ensure data security and privacy. CPD initiatives help them use data visualization tools, manage repositories, and provide ethical data use guidance, making these skills valuable in data-driven research environments (Bawden & Robinson, 2020).

3. Artificial Intelligence (AI) and Machine Learning
Academic librarians in the 5IR must understand and utilize AI and machine learning technologies. CPD initiatives help them understand how AI can enhance library services like personalized search results and automated cataloging, and how natural language processing can improve user interactions and operational efficiency.

4. Digital Copyright and Intellectual Property (IP) Knowledge
Academic librarians in the 5IR must be knowledgeable about digital copyright and intellectual property (IP) issues. CPD initiatives educate them on legal aspects of digital resource management, including copyright laws, fair use policies, and licensing agreements. This ensures compliance with laws and promotes innovation in academic research (Neal, 2021).

5. User-Centered Design and User Experience (UX)
Academic libraries must adapt to the 5IR by providing user-centric experiences. CPD initiatives in UCD and UX help librarians design user-friendly systems, accessible websites, and virtual environments. They also conduct user research to improve services and meet user expectations, ensuring a student- and researcher-centric approach (Sweeney, 2022).

6. Ethics and Privacy in the Digital Age
Academic librarians must acquire knowledge in ethics and privacy related to digital technologies, such as AI, big data, and digital surveillance. CPD programs cover data privacy concerns, algorithm biases, and equitable access to information. These skills are crucial as academic libraries host digital archives and e-books (Liu & Huang, 2019).

7. Collaboration and Networking
Digital tools promote global collaboration, enhancing academic librarians' skills in collaboration and networking. CPD initiatives train librarians to support collaborative research projects, facilitate virtual seminars, and connect users to global information networks, fostering interdisciplinary collaboration and innovation in library services (JISC, 2020).

Benefits for Academic Librarians in Continuous Professional Development (CPD) in the Fifth Industrial Revolution
By engaging in CPD, academic librarians gain significant advantages, both personally and professionally, which help them thrive in an increasingly digital and technology-driven environment. This section explores the **benefits** that academic librarians gain through CPD, specifically in relation to the Fifth Industrial Revolution.
1. Enhanced Skill Sets for Digital and Technological Proficiency
CPD offers academic librarians the chance to enhance their digital and technological skills, enabling them to manage new technologies like AI, machine learning, and big data analytics. This proficiency allows

librarians to provide efficient services, help users navigate digital resources, curate collections, and offer innovative research tools, thereby increasing the library's value within the academic community (Bawden & Robinson, 2020).

2. Improved Career Development and Job Satisfaction
CPD helps librarians enhance their skills and expertise, leading to better career development opportunities. With the rise of digital literacy, data management, and AI, librarians can take on leadership roles. CPD also fosters job satisfaction, as those equipped with new competencies are more likely to stay competitive and retain employees (Neal, 2021; Sweeney, 2022).

3. Greater Adaptability to Technological Changes
CPD initiatives help academic librarians adapt to technological changes in the 5IR by providing tools and knowledge to understand, evaluate, and implement new technologies. This adaptability ensures libraries can meet changing needs, integrate AI-powered search engines, and stay relevant, preventing librarians from becoming obsolete (Haddow & Parker, 2021).

4. Better Support for Teaching and Research
Academic libraries are vital for teaching and research, and continuous professional development (CPD) helps librarians support faculty, researchers, and students. CPD in data science and research data management equips librarians with skills for managing data, understanding ethics, and accessing open repositories in the 5IR (Liu & Huang, 2019).

5. Improved User Services and User Experience
CPD programs improve librarians' UX and design skills, ensuring user-friendly and accessible digital platforms in academic libraries. They focus on user-centered design, optimizing digital content delivery, and developing intuitive systems. This ensures relevance and value in the face of rapidly changing technology and user behaviors (JISC, 2020).

6. Ethical Awareness and Data Privacy Competency
As the 5IR advances data, AI, and digital platforms, librarians must manage ethical concerns like data privacy and intellectual property. CPD initiatives equip them with skills for responsible data use, user protection, and compliance with legal frameworks like GDPR. They also understand copyright laws and fair use policies (Bawden & Robinson, 2020).

7. Fostering Collaboration and Networking
CPD fosters collaboration among librarians by building a network of peers and experts in new technologies, data management, and digital scholarship. Attending workshops, webinars, and conferences helps develop innovative solutions and resources, enhancing library value in academic settings. Staying informed about trends and technologies is also beneficial (Sweeney, 2022).

Challenges of Academic Librarians in Continuous Professional Development (CPD) to Engage with the Fifth Industrial Revolution
Academic librarians face challenges in engaging with the Fifth Industrial Revolution (5IR) through professional development initiatives, including limited resources and the fast-paced nature of technological advancements, despite the critical role of CPD.

1. Limited Time and Heavy Workload
Academic librarians face challenges in participating in CPD initiatives due to limited time and workload. Understaffed libraries often manage collections, user support, and digital resources, leaving little time for professional development. Scheduling conflicts and the need to maintain day-to-day operations make prioritizing CPD challenging.

2. Financial Constraints
CPD initiatives can be costly, especially for academic institutions facing budget cuts. Librarians may have to cover these costs personally or seek limited funding. The rapid pace of technological change in the 5IR can exacerbate costs, especially in regions with limited funding for professional development.

3. Rapid Technological Advancements
The 5IR's rapid technological change presents challenges for academic librarians, as new technologies like AI, machine learning, and blockchain evolve rapidly. CPD initiatives struggle to keep pace, and the need for lifelong learning can lead to professional burnout. This constant need for learning can be overwhelming.

4. Lack of Relevant CPD Resources
Academic librarians often lack specialized CPD resources for the 5IR, as traditional programs focus on basic library skills and may not cover newer areas like data science, AI, or digital ethics. Existing CPD resources often lack contextualization, making it difficult for librarians to find programs that equip them with the necessary skills (Liu & Huang, 2019).

5. Resistance to Change and Organizational Support
Resistance to change among librarians and library management can hinder the successful implementation of Continuous Professional Development (CPD) initiatives. Fear of failure, lack of confidence, and institutional support are key factors. Lack of a culture of continuous learning, prioritizing professional development, and adequate support from academic institutions can hinder CPD engagement (JISC, 2020).

6. Balancing New Technologies with Traditional Library Roles
Librarians must balance new technologies with traditional roles in the 5IR, balancing information management, research support, and literacy. CPD initiatives must equip them with technical and soft skills to adapt to digital and data-driven learning environments, especially during structural changes (Neal, 2021).

7. Ensuring Inclusivity and Accessibility
The digital divide in CPD for librarians is exacerbated by limited access to digital tools and advanced training platforms, affecting their ability to acquire skills for the 5IR. Additionally, language diversity in CPD resources, primarily conducted in English, may exclude non-English speaking librarians or those with limited resources (Sweeney, 2022).

Conclusion
Continuous Professional Development (CPD) is crucial for academic librarians in the 5IR, as it helps them adapt to technological advancements and stay relevant. CPD enhances digital literacy, technological proficiency, and knowledge in information management, data privacy, and digital research support. It equips librarians with skills to adopt emerging technologies, support research and teaching activities, and offer user-centered services. Despite challenges like time constraints and financial limitations, CPD benefits librarians' career growth, job satisfaction, and the success of academic libraries in the digital ecosystem.

Recommendations
To optimize the benefits of CPD for academic librarians in the 5IR, the following recommendations are proposed:

a) Institutional Support for CPD Initiatives
Academic institutions should allocate resources for librarians' CPD programs, including funding for training, conferences, workshops, and paid time off, and establish a clear framework to encourage participation and development (Sweeney, 2022).

b) Tailored CPD Programs for the 5IR
Libraries should collaborate with professional organizations to develop specialized CPD initiatives for librarians in the 5IR, focusing on digital tools, data management, and technological competencies, while addressing ethical concerns (Bawden & Robinson, 2020).

c) Collaboration and Networking Opportunities
Librarians should be encouraged to network and collaborate with peers, fostering innovation and adapting to technological changes through regular professional development events and participation in regional, national, and international library networks (Haddow & Parker, 2021).

d) Ongoing Evaluation and Feedback Mechanisms
Regular evaluation of CPD programs is crucial for relevance and effectiveness, with feedback mechanisms assessing impact on librarians' skills and professional growth, ensuring relevance in technological advancements (Neal, 2021).

e) Promoting Lifelong Learning Culture
Librarians should foster a culture of continuous learning through incentives like certifications and career advancements, fostering a learning-focused environment that can adapt to rapid technological changes (Sweeney, 2022).

f) Inclusivity and Accessibility of CPD Resources
CPD programs should be accessible and inclusive to all librarians, regardless of location, socio-economic status, or language barriers, using online platforms and virtual conferences (JISC, 2020).

References

Aina, L. O. (2021). *Library and Information Science Education and Training in Sub-Saharan Africa: A Historical Perspective*. Ibadan: Stirling-Horden Publishers.

Bawden, D., & Robinson, L. (2020). *The fifth industrial revolution: the role of libraries in a digital society*. Information Science Publishing.

Bhatti, R. (2021). *Artificial Intelligence and Knowledge Management in Libraries: A Review*. *Information Technology and Libraries*, 40(1), 42-58.

Gómez-Hernández, J. A., & Pasadas Ureña, A. (2022). Competencies for the digital librarian in the age of artificial intelligence. *The Journal of Academic Librarianship*, 48(3), 102560.

Haddow, G., & Parker, J. (2021). *Professional development in academic libraries: Strategies for success*. Routledge.

Ifijeh, G., & Yusuf, F. (2020). Impact of Continuous Professional Development on Librarians' Job

Performance. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/4097
JISC. (2020). *Building digital capability: An institutional approach*. JISC.
Kitchenham, B., & Charters, S. (2007). *Guidelines for performing Systematic Literature Reviews in Software Engineering*. EBSE Technical Report, EBSE-2007-01.
Kumar, P., & Sinha, R. (2022). *Cloud Computing and Knowledge Management in Libraries: Trends and Practices*. *Library Philosophy and Practice*, 2022(2), 58-74.
Liu, X., & Huang, X. (2019). *The role of librarians in the digital age: Ethical issues and new challenges*. Journal of Academic Librarianship, 45(2), 102-110.
Neal, J. (2021). *Library leadership and technology in the digital age*. Information Age Publishing.
Ocholla, D. N., & Shongwe, M. M. (2021). Professional development and training needs of librarians in Africa: A comparative study. *Library Management*, 42(6/7), 405–416.
O'Connor, T., & Ward, S. (2022). *Blockchain Technology in Libraries: Challenges and Opportunities*. *Library Hi Tech*, 40(3), 412-427.
Okike, B. I. (2020). Digitization and Professional Development of Librarians in Nigeria: Opportunities and Challenges. *International Journal of Library and Information Science Studies*, 6(3), 10–21.
Oliver, G. (2021). *Collaboration in Knowledge Management: Libraries in the Fifth Industrial Revolution*. *Journal of Knowledge Management*, 25(4), 789-804.
Onyancha, O. B. (2022). Academic libraries and digital transformation in Africa: Trends and implications. *Library Hi Tech*, 40(2), 383–399.
Popoola, S. O., & Zaid, Y. A. (2023). Institutional Support and Career Progression among Academic Librarians in Nigerian Universities. *African Journal of Library, Archives & Information Science*, 33(1), 53–64.
Schwab, K. (2019). *Shaping the Fourth Industrial Revolution*. World Economic Forum.
Singh, M. (2022). *Big Data and Knowledge Management in Modern Libraries: A Strategic Approach*. *Library Hi Tech*, 40(2), 310-326.
Sweeney, L. (2022). *Enhancing information literacy in the age of AI: Opportunities for librarians*. Journal of Library and Information Science, 36(4), 234-245.
Wang, J., & Lee, L. (2020). *The Role of Personalized Learning in Library Services: A Knowledge Management Approach*. *Journal of Library and Information Science*, 46(3), 178-193.

Cybersecurity Awareness and Competencies of Librarians in Digital Information Services Delivery in University Libraries in Katsina State, Nigeria

By

Safiyya Kabir Ifo
Department of Library & Information Science, Umaru Musa Yar'adua University
Katsina, Katsina State, Nigeria.
Sophieifo357@gmail.com
+234 7035766646

Lawal Umar, PhD
Department of Library & Information Science, Umaru Musa Yar'adua University
Katsina, Katsina State, Nigeria.
lawal.umar@umyu.edu.ng

&

Muhammad Kabir Abubakar, PhD
Department of Library & Information Science, Umaru Musa Yar'adua University
Katsina, Katsina State, Nigeria.
muhammad.kabir@umyu.edu.ng

Abstract

The study investigated cybersecurity awareness and competencies of librarians in digital information services delivery in university libraries in Katsina State, Nigeria. Three (3) research questions guided the study. These questions included what types of digital information services are provided by the university libraries in Katsina State? What is the level of cybersecurity awareness in digital information service delivery by librarians in university libraries in Katsina State? What cybersecurity competences are possessed by librarians in digital information service delivery by university libraries in Katsina State? The study employed descriptive survey design and the population of the study comprised of all the One Hundred and Six (106) librarians in all the four (4) universities in Katsina State. Total enumeration sampling technique was used to select all the population as sample size. Questionnaire was the instrument used for data collection and was validated by experts in the fields and reliability result was .872. The data was analysed using simple frequency Tables, Percentages, Means and Standard deviation. The findings showed that university libraries in Katsina State mainly provide essential digital services like OPAC and e-resource management, while specialized services such as Audio-Visual and Document Scanning are rarely offered. Librarians demonstrated high awareness of antivirus software and incident response plans but had moderate awareness of role-based access controls and software updates. Significant gaps exist in protecting sensitive patron information and identifying phishing emails, with low awareness in these areas. Moderate awareness of social media risks and password management also highlights the need for targeted training to improve overall cybersecurity competence. The study recommended that Katsina State university libraries should strengthen security for key services like OPAC and online resource management using encryption and multi-factor authentication. Continuous cybersecurity training for librarians, focusing on weak areas such as password management, sensitive data protection, and basic cybersecurity knowledge was advocated.

Keywords: *Cybersecurity, Awareness, Competencies, Librarians, Digital Services Delivery, University Libraries*

Introduction

University libraries serve as information hubs, providing digital information resources and services to support teaching, learning, and research. Traditionally, libraries relied on physical materials such as books and journals, with access limited by the library's physical space and operating hours (Ryder & Madhavan, 2019). The information age has revolutionized the world economy, making information a strategic resource. Current facilities like the Internet, e-mails, CD-ROMs, e-books, e-journals, and artificial intelligence tools are transforming how we work and interact (Gbotosho, 2019). The shift from traditional to digital information services in university libraries has significantly changed how information is accessed, managed, and disseminated.

With the advances in digital technology, university libraries now offer electronic resources, including e-books, e-journals, and databases, accessible remotely at any time. Online catalogues and discovery systems improve search efficiency, while digital repositories and open access platforms facilitate the wider dissemination of scholarly work. Librarians also provide virtual reference services and online information literacy instructions to their library users. This digital transition has expanded the reach and convenience of

university libraries, by better supporting the needs of students, faculty, and researchers in a digital-first academic environment. However, it has also brought challenges in areas such as copyright, user data privacy, and digital preservation, which library staff and administrators must navigate (George & Onyema, 2020).

As the world becomes increasingly networked, with digitized information underpinning key services and infrastructures, cybersecurity has become a global concern. Protecting personal data on the internet is a major concern, with the number of connected devices surpassing 50 billion by 2020 (Yusuf, Qamar, Nikhat, Jai, & Anurag 2021). Cybersecurity are measures taken to protect computer systems, resources, users, and information against unauthorized access and attacks. Cyber security are techniques generally set forth in published materials that attempt to safeguard the cyber environment of user or organization, maintaining the integrity of networks, programs, and data (Seemma, Nandhini, & Sowmiya, 2018).

Cyber incidents, such as natural disasters, vandalism, and software vulnerabilities (trojans, worms, viruses, hacking, spyware, adware), adversely affect the digital information systems, resources and services. University libraries face numerous data security threats, including resource destruction, information corruption, theft, service interruption, data loss, dissemination delays, privacy loss, copyright violations, and natural disasters. Human errors, such as improper security setup and inadequate backups, also contribute to security issues (luft, 2020). Socioeconomic, psychosocial, and geopolitical factors motivate cybercrimes, which threaten library resources and services, necessitating robust security measures to prevent resource loss (Muhammad, Daniel, & Samson, 2020). In Nigeria, cybercrimes in university libraries include unauthorized access, hacking, computer viruses, and identity theft. Minimizing these incidents requires librarians to have cybersecurity skills and competencies to protect their systems (Obim & Akpokurerie, 2023). This therefore, the study set to find out cybersecurity awareness and competencies of librarians in digital information services delivery in university libraries in Katsina state, Nigeria.

Statement of the Problem

In this digital era, university libraries face an increasing need to prioritize cyber security measures to ensure uninterrupted and secure access to their digital information services. With the growing dependence on technology for information storage, retrieval and dissemination, libraries must be prepared to address potential cybersecurity threats and vulnerabilities (Musa & Maifata, 2020). Also, Kaspersky (2020) posited that having a well-defined response practices allow university libraries to quickly and effectively manage security breaches, maintain user trust, and continues providing essential information services to their users in an ever-evolving digital landscape. Nikhat, Bedine, Yusuf, Anurag and Sheeba (2021) reported a high rate of cybersecurity incidences to data storage and transfer in National Communication Commission, Nigeria which led to loss of data and other vital document. This situation affects many information centers, including libraries, where security breaches and attacks have become major concerns, impacting their primary mission of delivering digital information services to users. This is supported by research observations and a preliminary investigation, which revealed that digital information services delivery is a significant area of concern in university libraries in Katsina State. However, it appeared from the available literature that cybersecurity incident preparedness and response practices have not been clearly implemented to mitigate the severe consequences of cybersecurity incidents, such as data breaches, service interruptions, viruses, and financial losses, at least in the study area chosen by the researcher. Moreover, several searches on different sources of information like databases, google scholars, research gate, LinkedIn and various sources of literatures consulted by the researcher prove that there is limited empirical studies in library and information science dealing with cybersecurity incidences and its response practices on digital information services delivery. Geographically, the researcher can rightly argue that exploring cybersecurity incidences preparedness and response practices in university libraries in Katsina state seems not to be existed. As such, the study sets to investigate the awareness and competencies of librarians in prevention of cybersecurity incidences in digital services delivery in University Libraries in Katsina state, Nigeria.

Research Questions

The following research questions were formulated to guide the study:

1. What types of digital information services are provided by the university libraries in Katsina State?
2. What is the level of cybersecurity awareness in digital information service delivery by librarians in university libraries in Katsina State?
3. What cybersecurity competences are possessed by librarians in digital information service delivery by university libraries in Katsina state?

Literature Review

Digital information services are all services accessed or provided to users through the digital transaction which includes the provision of online tools, virtual space for collaboration, sharing of content to online reference services, electronic document delivery service; virtual library tours and digitized local archive collections which are uploaded into the web for remote access. The services are meant for information dissemination, integration, mass customization, interactive communication and transaction support (Muhammad, Osimetha, & Ekwueme 2020; Muhammad, Dirar, Idris, & Yusuf, 2020; Adogbeji, & Akporhonor 2021).

Consequently these types of digital information services rendered in library and information centres can tremendously help in transforming them into more dynamic, innovative, and user-friendly institutions for effective and efficient services delivery. In developed countries such as Asia, Europe, North America, and Latin America/ Caribbean Studies like Dadzie and Walt(2015), Sigama & Kalema, (2018), Fu, Shirotori and Wu (2022) revealed that university libraries are offering Services, such as Wiki, Blog, Really Simple Syndication (RSS), Podcasting, Instant Messaging, Short Message Service (SMS), Multimedia Messaging Service (MMS), video-conferencing services, Digital (e-commerce) platforms, data processing tools, blockchain, virtual assistants such as Amazon, Alibaba, Virtual assistants for customer service, online education services, Market information Service and Social networking which are readily accessible through the libraries. In developing countries China, South Africa Studies like Essien, Lu, Abredu, and Zotoo, (2022), Nwanja (2023) revealed that Reference, Digital, and Circulation Services, digital platforms and Online Services were effective in service delivery in the university Libraries.

Cybersecurity awareness involves understanding and implementing practices to protect digital information and systems from cyber threats. Margam (2018), Rahman and Batcha (2020) cybersecurity security awareness is the degree of understanding of employees about the importance of information security and their responsibilities and acts to exercise sufficient levels of information security control. According to Liman, Jain, Grand and Mutshewa, (2017), level of cybersecurity awareness by librarians in university libraries refers to the extent to which librarians working in university libraries are knowledgeable about cybersecurity practices, threats, and preventive measures at the present time. This includes understanding the importance of protecting sensitive data and intellectual property, recognizing potential vulnerabilities in library systems and networks, and knowing how to mitigate risks through best practices such as strong password management, secure data storage, and appropriate use of technology.

Cybersecurity competencies possessed by librarians in digital information services delivery involves the skills, knowledge, and abilities required by the librarians to protect information Systems, networks, and data from cyberattacks. According to Obim and Akpokurerie (2023). Cybersecurity competency are the totality of skills and technological know-how required by an individual to effectively, proactively and adequately protect, prevent and secure online technological infrastructures and also the skills to professionally handle the incidents of cyberattacks within the institutions to prevent further attacks or damage. These include the ability to; monitor unauthorized access to online information resources, prevent hacking, install and update computer virus, identify attempt to hack a system, ability to archive the content of university library website among other skills. Oza and Mehta (2018), Malik and Ameen (2021), vividly explain that competencies needed for librarians to include; both professional and personal skills as they may play different roles like information enabler, information architect, knowledge engineer, knowledge creator, database & network creator, web designer, online publisher, decision support specialist, subject knowledge & skills, i.e., subject in both theoretical and practical aspects. IT knowledge skills in-case of teaching and delivering IT-related course content. In addition, they require instructional skills for reaching out to the user's needs. Generic skills to include management, leadership, and communication.

Research Method/Design

The study employed descriptive survey design and the population of the study comprised of all librarians that hold first degree in library and information science in all the four (4) universities in Katsina state, which is one hundred and six (106). The study employed total enumeration sampling technique where all the respondents were involved in the study. Questionnaire was the instrument used for data collection and was validated by experts in the fields and reliability result was .872. The data was analysed using simple frequency Tables, Percentages, Means and Standard deviation.

Results

A total of one hundred and six (106) copies of questionnaire were distributed to the respondents in the four (4) universities under study and eighty-one (81) copies of questionnaires were duly completed and returned as shown in figure 1.

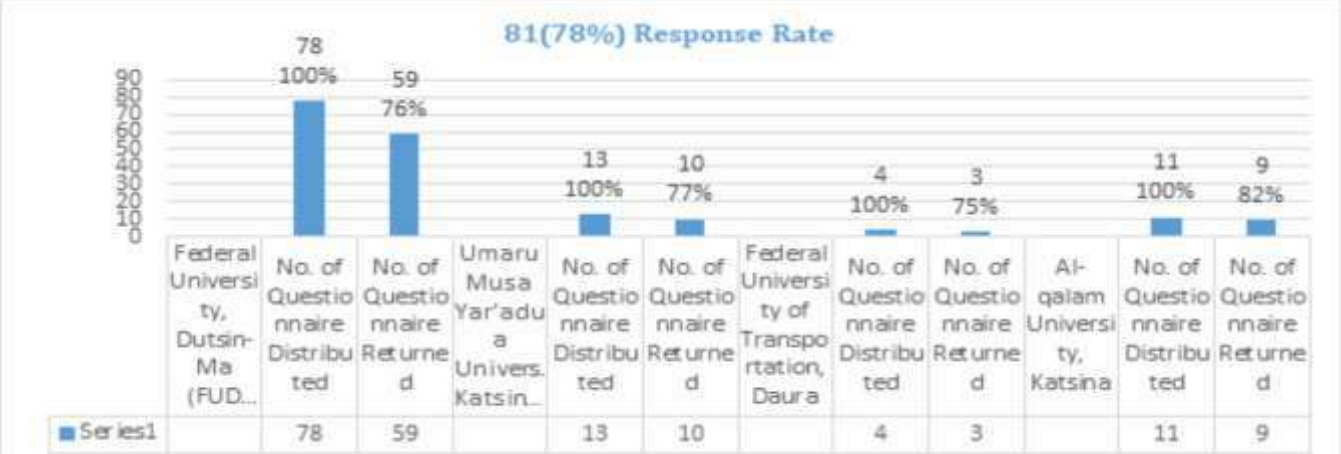


Table 1: Types of digital information services provided in your university library (N=81):

Items	Yes		No	
	F	%	F	%
Online Public Access Catalogue (OPAC) service	58	71.6	23	28.4
Virtual reference services	36	44.4	45	55.6
Online User Education	41	50.6	40	49.4
Online charging and discharging of e-resources	47	58.0	34	42.0
Online Reservation Services	12	14.8	69	85.2
Online Users' Announcement	23	28.4	58	71.6
Online Current Awareness Services for Library Resources	36	44.4	45	55.6
Online Selective Dissemination of Information	38	46.9	43	53.1
Indexing and Abstracting Services	21	25.9	60	74.1
Online Extension and Outreach Services	26	32.1	55	67.9
Online Document Delivery Services	33	40.7	48	59.3
Software management service	35	43.2	46	56.8
Telephone services	29	35.8	52	64.2
E-mail Services	8	9.9	73	90.1
Document Scanning Services	7	8.6	74	91.4
Audio-Visual Services	5	6.2	76	93.8
Metadata Services	8	9.9	73	90.1
Online audio-visual services	7	8.6	74	91.4
Social Media Outreach	21	25.9	60	74.1
Cloud Storage Services	26	32.1	55	67.9
Digital Accessibility Services	23	28.4	58	71.6

The data on the types of digital information services provided by the university library reveals a significant variation in the availability of these services. The Online Public Access Catalogue (OPAC) is the most widely available service, with 71.6% of respondents affirming its presence. In contrast, services like Online Audio-Visual Services, Document Scanning Services, and Metadata Services are among the least available, each with a minimal availability percentage ranging from 6.2% to 9.9%. Other services, such as Virtual Reference Services (44.4%) and Online Current Awareness Services (44.4%), have moderate availability. Notably, services like Online Reservation Services (14.8%) and E-mail Services (9.9%) are the least provided, reflecting a more limited implementation of certain digital resources. The maximum and minimum percentages (71.6% and 6.2%, respectively) highlight the differences in service provision, suggesting that while some digital services are common, others are rare within the library's offerings. The findings indicate that while some digital services, like OPAC and Online Charging/Discharging, are widely available in university libraries in Katsina State, others such as Email Services and Audio-Visual Services are rarely provided. This differences indicated that libraries with extensive digital services must prioritize robust cybersecurity measures, such as encryption and access control, to protect user data and resources. Conversely, the limited availability of certain services may reduce their exposure to cyber threats but highlights areas where cybersecurity preparedness may be lacking.

The data reveals that university libraries in Katsina State widely offer core digital services, with OPAC (71.6%) and e-resource management (58.0%) being the most common. Specialized services like Audio-Visual, Document Scanning, and Metadata Services are significantly less available, each reported by fewer than 10% of respondents. This indicates a gap in advanced digital offerings, highlighting the need for libraries to expand services to meet evolving user demands.

Table 2: Mean results of level of cybersecurity awareness in digital information service delivery

Items	VLA		LA		MA		HA		VHA		Mean	STD
	F	%	F	%	F	%	F	%	F	%		
I am aware of basic cybersecurity terms and principles, such as malware, phishing, and encryption	24	29.6	11	13.6	24	29.6	11	13.6	11	13.6	2.68	1.39

I am familiar with recommended practices for password management, including the use of strong and unique passwords	24	29.6	11	13.6	24	29.6	22	27.2	0	0	2.54	1.18
I have understanding on the importance of antivirus and anti-malware software in protecting library systems	12	14.8	0	0	24	29.6	34	42.0	11	13.6	3.40	1.19
I am Knowledgeable of procedures for reporting cybersecurity incidents within the library	35	43.2	11	13.6	24	29.6	11	13.6	0	0	2.14	1.13
I am aware of best practices for handling and protecting sensitive patron information	46	56.8	11	13.6	24	29.6	0	0	0	0	1.73	.89
I have understanding on the risks associated with using social media in a professional context and how to mitigate them	35	43.2	11	13.6	23	28.4	12	14.8	0	0	2.15	1.14
I am aware of the protocol of identifying phishing emails and other suspicious communications.	46	56.8	11	13.6	24	29.6	0	0	0	0	1.73	.89
I understand the copyright laws and their implications for digital resource usage	11	13.6	24	29.6	24	29.6	22	27.2	0	0	2.54	1.18
I am familiar with the importance of role -based access controls to protect sensitive information.	24	29.6	11	13.6	24	29.6	11	13.6	11	13.6	2.68	1.39
I am knowledgeable of the library's incident response plan and the steps to take in case of a cybersecurity breach	16	19.8	8	9.9	32	39.5	18	22.2	7	8.6	2.90	1.21

(Source: Field Data, 2024) Key: VL: Very Low Aware 1 LA: Low Aware 2 MA: Moderately Aware 3 HA: High Aware 4 VHA: Very High Aware 5

The data in Table 1 reveals that the majority of librarians in the university library exhibit a low to moderate level of cybersecurity awareness. The mean scores for most items, such as awareness of basic cybersecurity terms (mean = 2.68), password management practices (mean = 2.54), and handling sensitive patron information (mean = 1.73), suggest that librarians generally have limited understanding in these areas. On the other hand, some areas, such as the importance of antivirus software (mean = 3.40) and knowledge of incident response procedures (mean = 2.90), indicate a higher level of awareness, though still not reaching the high awareness threshold of 4.0. The results imply that there is a need for targeted cybersecurity training to improve librarians' understanding of key areas like password management, phishing prevention, and protecting patron information. The relatively higher awareness of antivirus software and incident response procedures shows that there is some foundational knowledge, but more comprehensive education on general cybersecurity practices is required to enhance the overall security posture of the library's digital services.

The study found that librarians in university libraries show high awareness of antivirus and anti-malware software (mean = 3.40) and moderate understanding of incident response plans and system updates. However, awareness is notably low in critical areas such as protecting patron information and identifying

phishing emails (mean = 1.73). These gaps point to the urgent need for targeted cybersecurity training to strengthen librarians' overall digital security competence. The study shows that university librarians have a strong awareness of basic cybersecurity measures like antivirus software and incident response plans. However, their understanding of more advanced practices such as role-based access control, regular software updates, and password management is moderate. Critical gaps exist in awareness of phishing threats and patron data protection, posing significant risks to library cybersecurity.

Table 2: Mean results of cybersecurity competences that are possessed by librarians in digital information service delivery (N=81):

Items	SD		D		UD		A		SA		Mean	STD
	F	%	F	%	F	%	F	%	F	%		
I possess knowledge of electronic resources	12	14.8	11	13.6	0	0	35	43.2	23	28.4	3.57	1.41
I have competency skills on Social media	11	13.6	11	13.6	0	0	24	29.6	35	43.2	3.75	1.47
I have competency skills of online searching	23	28.4	11	13.6	0	0	12	14.8	35	43.2	3.31	1.76
I have competency skills on Website content management	35	43.2	11	13.6	12	14.8	11	13.6	12	14.8	2.43	1.52
I have competency skills on Internet handling	23	28.4	35	43.2	0	0	11	13.6	12	14.8	2.43	1.41
I possess knowledge of computer and multimedia skills	12	14.8	22	27.2	0	0	36	44.4	11	13.6	3.15	1.36
I have competency skills on Cloud computing	35	43.2	23	28.4	12	14.8	11	13.6	0	0	1.99	1.07
I possess knowledge of metadata creation skills	36	44.4	23	28.4	0	0	27	27.2	0	0	2.10	1.24
I have competency skills on library digitization	36	44.4	23	28.4	0	0	27	27.2	0	0	2.10	1.24
I have competency skills on library automation	23	28.4	36	44.4	0	0	27	27.2	0	0	2.10	1.24
I possess cybersecurity skills	23	28.4	35	43.2	0	0	11	13.6	12	14.8	2.43	1.41
I have incident response skills	19	23.5	24	29.6	24	29.6	23	28.4	4	4.9	2.78	1.23
I have data protection knowledge skills	19	23.5	24	29.6	24	29.6	23	28.4	4	4.9	2.78	1.23

Key: SD: Strongly Disagree 1 **D:** Disagree 2 **UD:** Undecided 3 **A:** Agree 4 **SA:** Strongly Agree 5

The data shows that librarians in the university library possess varying levels of cybersecurity competencies related to digital information service delivery. Competency in electronic resources (mean = 3.57) and social media (mean = 3.75) is high, as most librarians agree or strongly agree with their proficiency in these areas. However, skills related to website content management (mean = 2.43), internet handling (mean = 2.43), and cloud computing (mean = 1.99) reflect lower competency levels, with many librarians disagreeing or being undecided. Knowledge of metadata creation (mean = 2.10) and library automation (mean = 2.10) also received lower ratings, indicating a lack of proficiency in these technical areas. Furthermore, while some librarians possess incident response skills (mean = 2.78) and data protection knowledge (mean = 2.78), overall cybersecurity skills (mean = 2.43) remain relatively low. The result imply that while librarians possess strong competencies in areas like electronic resources and social media, there are significant gaps in critical areas such as cloud computing, website management, and cybersecurity skills. This suggests that there is a need for further training and professional development in cybersecurity and digital competencies, particularly in areas like metadata creation, cloud computing, and incident response. Universities should consider targeted training programs to ensure librarians are well-equipped to handle the increasing digital and cybersecurity challenges in library service delivery.

The study shows that university librarians possess strong competencies in social media (mean = 3.75) and electronic resource management (mean = 3.57), with solid skills in online searching as well. However, their competencies are significantly lower in technical areas such as cybersecurity, website content management, and cloud computing. Moderate skills in incident response and data protection suggest the need for further

training to strengthen overall cybersecurity readiness. The study reveals that librarians in university libraries possess strong competencies in social media (mean = 3.75) and electronic resource management (mean = 3.57), along with solid online searching skills. However, competencies in technical areas like cybersecurity, website management, and cloud computing are notably weak. This highlights the need for targeted training to enhance librarians' capabilities in managing advanced digital and cybersecurity-related tasks.

Discussion of Findings

1. What type of digital information services are provided by your university library? The study shows that university libraries in Katsina State mainly provide essential digital services like OPAC (71.6%) and e-resource access, while specialized services remain limited, with availability below 10%. This indicates a significant gap in advanced digital offerings. Compared to existing literature, the findings highlight strong core service provision but reveal common challenges in cybersecurity awareness and specialized digital competencies, emphasizing the need for targeted improvements. The study highlights the availability of key digital services such as OPAC and online charging/discharging services, which is consistent with other findings, like those from Mtega and Ronald (2021), who found that these services are commonly used in public university libraries across Tanzania. However, the study also shows a notable gap in less commonly provided services like email and audio-visual services, which aligns with the findings of Mukiibi (2019), who noted the limited adoption of such services in libraries due to technical or resource limitations.

2. What is the level of cybersecurity awareness in digital information service delivery by librarians in your university library? The study found that librarians in Katsina State university libraries have high awareness of basic cybersecurity measures like antivirus use (mean = 3.40), but show low to moderate awareness in critical areas such as phishing detection and protecting patron data (mean = 1.73). Moderate understanding was also noted in areas like password management and software updates. A statistically significant relationship ($p = 0.000$) confirms that cybersecurity awareness directly impacts digital service delivery, highlighting the need for targeted training to enhance overall cybersecurity competence. This reflects similar findings in other studies, including Mokwatlo and Maphunye (2019), who pointed out that information security awareness among library professionals in South Africa is generally low, particularly in areas related to risk management and data protection. Despite this, librarians demonstrated higher awareness of antivirus software and incident response plans, mirroring findings in the literature where basic cybersecurity concepts like virus protection are more widely understood (Obim & Okpakurerie, 2023).

3. What cybersecurity competencies are possessed by librarians in digital information service delivery in your university library? The study reveals that librarians in Katsina State university libraries possess strong skills in social media, electronic resource management, and online searching. However, they lack competencies in critical technical areas such as cybersecurity, cloud computing, website management, and metadata creation. With a significant p-value of 0.0023, the findings confirm a strong link between cybersecurity competencies and digital service delivery, emphasizing the urgent need for targeted training to improve librarians' technical capabilities and enhance library services. This is supported by studies like those by Mtega and Ronald (2021) and Musa and Maifata (2020), which also found that while librarians in university libraries possess basic digital competencies, more advanced cybersecurity and IT skills are lacking, which can hinder effective service delivery.

Conclusion

The study concluded that university libraries in Katsina State primarily provide essential digital services such as the Online Public Access Catalogue (OPAC) and e-resource management, but there is a noticeable gap in more advanced services like Audio-Visual and Document Scanning, which are less frequently offered. The findings also revealed varying levels of cybersecurity awareness among librarians, with strengths in areas like antivirus software and incident response plans, but significant weaknesses in protecting sensitive patron data and identifying phishing attempts. In terms of competencies, librarians are proficient in managing electronic resources and social media, yet they lack expertise in critical areas such as cloud computing, metadata creation, and cybersecurity skills. Additionally, common cybersecurity incidents, including unauthorized access and network failures, indicate vulnerabilities in library systems.

Recommendations

The study offered the following recommendations:

1. University libraries in Katsina State should prioritize securing key services like OPAC and online charging/discharging with strong cybersecurity measures, while also improving security for less common services such as email and audio-visual platforms.
2. Continuous cybersecurity training for librarians is essential, focusing on weak areas like password management, protecting sensitive information, and awareness of current threats like phishing and malware.
3. Libraries need to enhance professional development in emerging fields such as cloud computing, website management, metadata creation, and library automation, alongside strengthening cybersecurity monitoring with real-time systems and regular vulnerability assessments to safeguard digital services.

References

Adogbeji, B.O. & Akporhonor**,** B.A. (2021). Reasons for Digitization and Its Challenges in Nigerian University Libraries. *Journal of applied Information Science and Technology* 14 (2)2021

Dadzie, P. S. & Walt, T. V. (2015), Digitising University Libraries In Ghana: How Technology Is Facilitating Access To Digital Content And Services, *University of South Africa* UNISA 33 (3), pp95–114, 0027-2639

Essien, F.K., Lu, Z.P., Abredu, P. and Zotoo, I.K. (2022). Effect of ICT Use on Library Service Delivery: A Comparative Approach from Two Universities. *Open Access Library Journal,* 9: e8653. https://doi.org/10.4236/oalib.1108653

Fu, X, Shirotori, M. & Wu, D. (2022). Digitisation of Services; What does it imply to trade and Development. United Nations publication issued by the United Nations Conference on Trade and Development. 978-92-1-001253 UNCTAD/DITC/TNCD/2021/2.

Gbotosho, T. (2019). The impact of digital technologies on information service delivery in university libraries. *Journal of Information Science*, 45(2), 123-135.

George, C., & Onyema, J. (2020). Adoption of e-learning and blended learning in university libraries. *International Journal of Library and Information Science*, 12(4), 56-67.

Lab, K. (2020). *Kaspersky Lab.* Retrieved from Kaspersky Lab: https://www.kaspersky.ru/resource-center/preemptive-safety/cyber-security-basics

Liman, Y. A., Jain, P. Grand, B. & Mutshewa, A. (2017), Skills and Competencies Required by Academic Librarians in an Internet-Driven Environment. University of South Africa *Press (UNISA).* 35(4), 3564,1- 16. https://upjournals.co.za/index.php/LIS

Luft, Paul J., "Proactive Management in Academic Libraries: Promoting Improved Communication and Inclusion of Academic Librarians and Archivists in Cybersecurity Policy Creation" (2020). Theses and Dissertations. 421. https://csuepress.columbusstate.edu/theses_dissertations/421

Malik, A., & Ameen, K. (2021). Needed Competencies for Library and Information
Faculty Members in Pakistan. *Library Philosophy and Practice (e-Journal)*.
https://digitalcommons.unl.edu/libphilprac/5186

Margam, M. (2018). Information Security Measures of Libraries of Central Universities of Delhi : A Study Journal of Library & Information Technology, Vol. 38, No. 2, March 2018, pp. 102-109, DOI : 10.14429/djlit.38.2.11879
2018, DESIDOC

Mokwatlo, K. G., & Maphunye, K. J. (2019). Information security awareness among library and information services professionals in academic libraries in South Africa. *South African Journal of Libraries and Information Science*, 85(1), 17-28. https://doi.org/10.7553/85-1-1625

Mtega, W. P., & Ronald, L. K. (2021). State of Information Security Awareness and Preparedness in Public University Libraries in Tanzania. *Journal of Information Science,* 47(5), 610-623. https://doi.org/10.1177/01655515211020045

Mukiibi, H. S. (2019). Cybersecurity in Africa: The boring technology that matters. *XRDS Crossroads The ACM Magazine for Students*, 26(2), 38-40. https://doi.org/10.1145/3368077

Musa, S., & Maifata, N. M. (2020). Library security and service delivery in federal university libraries in North Central Nigeria. *Nasarawa Journal of Library and Information Science (NAJLIS)*, 4(1), 45-57.

Muhammad, A.A, Daniel, D.W. & Samson I. (2020). An empirical analysis of cybercrime trends and its impact on moral decadence among secondary school level students in Nigeria. *Published in Collaboration with The 26th iSTEAMS Bespoke Multidisciplinary Conference, Accra Ghana & The School of IT & Computing, American University of Nigeria, Yola www.isteams.net/ghana2020bespoke,* 73-84

Muhammad, A. D, Dirar. A. M. A, Idris M, & Yusuf, H. S. (2020), Adoption and Access of E-Library Services in university libraries of North West Zone of Nigeria. *European Journal of open Education and E-learning Studies.* 165, 2501-9120, L: 2501-9120 Retrieved from**:** www.oapub.org/edu

Nikhat, A, Bedine K, Yusuf P, Anurag T, & Sheeba P. (2021). A Comprehensive Overview of Privacy and Data Security for Cloud Storage*", International Journal of Scientific Research in Science, Engineering and Technology* (IJSRSET), 08 (5),113-152. DOI: 10.32628/IJSRSET21852

Nwanja, J. (2023). The Relevance of Electronic Services (e-Services) in Cameroon's Ministry of Finance. Walden Dissertations and Doctoral Studies. https://scholarworks.waldenu.edu/dissertations

Obim, I. E., & Okpakurerie, A. O. (2023). Awareness of cybersecurity and its impact on information storage in university libraries in southeast Nigeria. *Information Technology Librarianship*, 3(2), 78-90.

Oza, D. N., & Mehta, M. (2018). A study of ICT Skills and Competencies Essential for Corporate LIS Professionals. *International Journal of Research and Analytical*
Reviews (IJRAR), *5*(4), 8.

Ryder, R. D. & Madhavan, A. (2019). *Cyber Crisis Management: Overcoming the Challenges in Cyberspace*. Bloomsbury Publishing.

Seemma, P. S., Nandhini, S., & Sowmiya, M. (2018). Overview of cyber security. *International Journal of Advanced Research in Computer and Communication Engineering, 7*(11), 125- 128.

Sigama, K., & Kalema, B. M. (2018). Conceptualizing MOOCs Implementation for Higher Education in Developing Countries. *6th International Conference on MOOCs, Innovation and Technology in Education (MITE)*.

Yusuf, P., Qamar, S. A., Nikhat, A., Jai, P. D., & Anurag, K. J. (2021). A Systematic Literature Review on the Cyber Security. *International Journal of Scientific Research and Management* (IJSRM) 9(12), 669-710, (e): 2321-3418. www.ijsrm.in DOI: 10.18535/ijsrm/v9i12.ec04

Cybersecurity Behaviour in Library 5.0: Opportunities, Challenges, and Future Trends for Libraries

Juliet Chinedu Alex-Nmecha[1] & Bolaji David Oladokun[2]
[1]University Librarian, Rivers State University, Port Harcourt, Rivers State, Nigeria / juliet.anmecha@rsu.edu.ng
[2]Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom State, Nigeria / Bolaji.oladokun@yahoo.com

Abstract
The evolution of libraries into intelligent, technology-driven environments has introduced new dimensions to cybersecurity behavior, particularly within the framework of Library 5.0. This study, therefore, investigates the opportunities, challenges, and future trends associated with cybersecurity behavior in Library 5.0, emphasizing its implications for policy and practice in modern library services. Three (3) objectives guided this study. A systematic review design was adopted, guided by the PRISMA framework, to synthesize evidence from peer-reviewed literature published between 2020 and 2025. Twenty-three studies were selected and thematically analyzed to extract core insights related to cybersecurity practices, behaviors, and governance in libraries adopting technologies such as artificial intelligence, blockchain, the metaverse, and robotics. The findings indicate that while emerging technologies offer significant potential for enhancing digital security through automated threat detection, decentralized data control, and immersive yet secure user experiences, they also expose libraries to complex risks, particularly in the absence of cybersecurity policies, staff training, and digital ethics. Human factors such as limited awareness and behavioral vulnerabilities were found to be major weaknesses in library cybersecurity frameworks. The study concludes that achieving cybersecurity resilience in Library 5.0 demands a holistic approach that combines ethical technology adoption, continuous education, institutional investment, and inclusive governance.
***Keywords**: Library 5.0, cybersecurity behavior, artificial intelligence, internet of things, blockchain, opportunities, future trends.*

Introduction
The rapid convergence of emerging technologies and evolving user expectations is propelling libraries into a new paradigm of the fifth industrial revolution. The library 5.0 is characterized by automation, ethical integration of artificial intelligence (AI), internet of things, robotics, big data, blockchain, and immersive technologies such as the metaverse, Virtual Reality, and Augmented Reality, among others. Library 5.0 is not merely an extension of Library 4.0; rather, it reflects the human-centric values of the Fifth Industrial Revolution (5IR), emphasizing empathy, ethics, and security in technological integration (Adigun et al., 2024; Noh, 2023).

Going forward, cybersecurity behavior in the library 5.0 context refers to the actions, attitudes, knowledge, and practices of library stakeholders, staff, users, and administrators, in safeguarding digital assets, preserving user privacy, and responding to cyber threats. Unlike traditional IT systems, Library 5.0 infrastructure operates within complex, interoperable ecosystems powered by AI, machine learning, the Internet of Things (IoT), and cloud computing. These advancements, while offering unprecedented opportunities for intelligent access and service delivery, simultaneously expose libraries to sophisticated threats such as phishing, ransomware, data breaches, and social engineering (Gujar et al., 2024; Magsi et al., 2025).

Several studies have highlighted the necessity for a cybersecurity-aware culture in libraries, especially in academic and research institutions that handle vast amounts of sensitive data (Akor et al., 2024; Igbinovia & Ishola, 2023). However, cybersecurity in Library 5.0 is not limited to technical safeguards but is increasingly tied to user behavior, organizational policy, ethical use of AI, and adaptive governance. This human-centric focus aligns with the views of Kont (2024), who reveals the importance of behavioral factors, such as staff training, ethical literacy, and digital hygiene, in preventing cyber incidents.

Moreover, cybersecurity behavior is becoming more nuanced in light of metaverse technologies in libraries, which blend physical and virtual realities to create immersive learning and service environments (Ajani et al., 2024; Oladokun et al., 2024a). These platforms introduce new vectors of vulnerability, including avatar impersonation, virtual identity theft, and platform-specific malware. According to Subaveerapandiyan et al. (2024), such challenges call for a deeper understanding of ethical and behavioral readiness among both users and service providers. Thus, cyber awareness must evolve beyond passwords and firewalls, extending to metacognitive competencies in navigating emerging digital spaces.

In this context, the study of cybersecurity behavior becomes central to harnessing the opportunities of Library 5.0. These opportunities include the deployment of intelligent knowledge systems (Adigun et al., 2024), AI-enabled services such as chatbots, recommender systems, and automated cataloging (Verma & Gupta, 2022), and the provision of hyper-personalized learning environments through VR/AR platforms (Meesad & Mingkhwan, 2024). These tools promise improved access, user satisfaction, and knowledge democratization. However, such innovations also demand robust behavioral protocols, clear privacy frameworks, and adaptive cybersecurity training for staff and users (Bellini & Tammaro, 2024; Panda & Kaur, 2024).

Despite these benefits, Library 5.0 has some challenges. Foremost among them is the digital divide, not only in infrastructure but in cybersecurity literacy. Several researchers point to the asymmetrical distribution of knowledge and resources, especially in libraries in developing regions (Igbinovia & Ishola, 2023; Moonasar & Ngoepe, 2023). Additionally, the integration of AI and robotic systems in libraries raises ethical dilemmas, including bias in algorithms, data sovereignty, and surveillance concerns (Hodonu-Wusu, 2024; Ofusori, Bokaba, & Mhlongo, 2024). As these technologies become ubiquitous, so do questions of trust, transparency, and accountability, factors that deeply influence user cybersecurity behavior.

Furthermore, cybersecurity governance in libraries remains fragmented. Oladokun et al. (2024b) observe that many libraries operate without coherent, forward-looking cybersecurity policies tailored to immersive technologies. Often, staff lack specialized training to recognize and respond to emerging threats, and user education programs lag behind technological advancements. These systemic gaps hinder proactive cybersecurity behavior and expose institutions to escalating risks.

Looking toward the future, libraries must develop adaptive, behaviorally informed cybersecurity strategies that integrate ethical AI use, real-time risk monitoring, and continuous learning models. The future of Library 5.0 lies not only in technology but in the co-evolution of human capacity and institutional resilience. As argued by Holland (2022), the most sustainable libraries in 5IR will be those that balance innovation with ethical foresight, inclusivity, and robust digital citizenship frameworks.

While existing studies address discrete aspects of Library 5.0 cybersecurity, this review fills a critical gap by integrating behavioral, technological, and policy perspectives into a cohesive framework for resilience. It further identifies underexplored trends (e.g., gamified security training) and regional disparities requiring urgent attention. This study, therefore, investigates cybersecurity behavior in Library 5.0 through the lens of opportunities, challenges, and future trends, with a focus on how librarians and information users interact with, adapt to, and secure digital infrastructures. This research aims to contribute to evidence-based strategies for enhancing cybersecurity resilience in next-generation libraries.

Objectives

1. To identify the key opportunities presented by emerging technologies (e.g., AI, metaverse, robotics) for enhancing cybersecurity practices in next-generation libraries.
2. To analyze the major challenges associated with cybersecurity in Library 5.0 environments.
3. To explore future trends for fostering cybersecurity-conscious behavior and resilience in libraries transitioning into the Library 5.0 era.

Literature Review

The rapid evolution of library systems into intelligent, technology-driven environments has ushered in what is now referred to as Library 5.0. This concept is rooted in the broader framework of the Fifth Industrial Revolution (5IR), characterized by human-machine collaboration, ethical technology adoption, and personalization. Library 5.0 integrates emerging technologies such as artificial intelligence (AI), the metaverse, robotics, blockchain, and smart systems to enhance information delivery and user experience (Adigun, Ajani, & Enakrire, 2024; Oyedokun, 2024). In this transformation, cybersecurity behavior has become a critical area of concern due to the increased digital interaction and data exposure that accompany technological integration.

The rise of AI in libraries has sparked discussions around both the opportunities and vulnerabilities introduced by these systems. Chhetri (2023) highlights that while AI strengthens operational efficiency, it also presents risks related to data breaches, algorithmic bias, and system misuse. AI-powered systems—particularly those that collect, store, and process user data—pose ethical and security challenges. This concern is further expanded by Verma and Gupta (2022), who assert that AI integration in libraries must be governed by robust data protection frameworks to preserve trust and integrity. The intelligent library, envisioned within Library 5.0, must thus be designed with embedded cybersecurity safeguards that align with its human-centric mission.

Cybersecurity behavior in this context refers not only to technological defenses but also to the practices, awareness levels, and decision-making processes of library staff and users. According to Kont (2024), human factors such as negligence, poor password hygiene, and phishing susceptibility are often the weakest links in digital security chains. Consequently, fostering cybersecurity-conscious behavior among stakeholders is as important as deploying firewalls or encryption protocols. Bellini and Tammaro (2024) underscore the significance of continuous education and training for library personnel in managing digital infrastructures securely. These behavioral aspects of cybersecurity are critical as libraries increasingly adopt immersive technologies like the metaverse, where user interaction occurs in real time and across multiple platforms.

In the metaverse-enabled library landscape, new threats emerge that challenge traditional cybersecurity paradigms. Oladokun et al. (2024a, 2024b) provide insights into the cybersecurity risks inherent in metaverse libraries, including avatar impersonation, identity theft, and the exploitation of decentralized data systems. As libraries migrate services to virtual environments, their attack surface expands, necessitating new frameworks for identity verification, privacy regulation, and behavioral monitoring.

Subaveerapandiyan et al. (2024) add that ethical considerations in metaverse libraries must include cybersecurity as a foundational pillar, particularly to prevent harm to users in highly immersive and potentially manipulative virtual experiences.

Library 5.0 also intersects with concepts of sustainability, resilience, and innovation. Adigun et al. (2024) argue that the sustainable knowledge system envisioned in intelligent libraries must be underpinned by secure digital ecosystems. This calls for libraries to not only adopt advanced technologies but also to do so responsibly, embedding cybersecurity principles into every level of service design and delivery. Supriya et al. (2024) extend this idea into the broader educational context, suggesting that cybersecurity must be a strategic focus in smart education systems that utilize interconnected platforms and AI tools.

As libraries pursue greater connectivity, they must also contend with institutional and infrastructural barriers. Igbinovia and Ishola (2023) document the implications of weak cybersecurity in Nigerian university libraries, emphasizing inadequate staff training, underdeveloped policies, and insufficient funding. Similar observations are made by Akor et al. (2024), who propose that emerging technologies can be leveraged to address these gaps, provided that institutions invest in secure systems, staff capacity-building, and regular policy reviews. Meanwhile, Magsi et al. (2025) catalog common cyber threats to digital libraries, including ransomware, unauthorized access, and malware attacks, which can have devastating consequences for academic continuity and intellectual property protection.

AI also plays a dual role as both a potential vulnerability and a protective mechanism. Ofusori, Bokaba, and Mhlongo (2024) review the application of AI in cybersecurity, noting its capacity to detect anomalies, predict attacks, and automate responses. When applied in libraries, AI-powered cybersecurity systems can provide real-time alerts, user behavior analytics, and proactive defense mechanisms. However, these systems must be ethically designed and regularly updated to remain effective. Hodonu-Wusu (2024) notes the need for equitable and transparent AI models that uphold user rights and foster digital trust.

Opportunities for enhancing cybersecurity behavior in Library 5.0 are closely tied to the innovation of service models and user education. Meesad and Mingkhwan (2024) propose the development of smart digital libraries that incorporate AI-driven security protocols while promoting user-friendly interfaces. Furthermore, Panda and Kaur (2024) stress the importance of awareness campaigns and training programs for library professionals to recognize and counter cyber threats effectively. These human-centric interventions align with the ethical imperatives of 5IR, which emphasize collaborative intelligence, personalization, and user empowerment.

The future of cybersecurity in libraries lies in adaptive frameworks that balance innovation with accountability. As Holland (2022) contends in the broader context of Industry 5.0, library science must evolve beyond technical skills to incorporate digital ethics, behavioral psychology, and strategic foresight. Moonasar and Ngoepe (2023) describe how academic librarians are already navigating disruptive change by acquiring hybrid competencies and digital fluency. These adaptive skills will be instrumental in cultivating a proactive cybersecurity culture within Library 5.0 systems. Lastly, future trends in cybersecurity behavior in libraries will likely include greater reliance on blockchain for data integrity, biometric authentication for access control, and gamification for security training. Ajani et al. (2024) envision libraries where virtual reality (VR) and AI coexist, demanding new models of risk assessment and governance. Similarly, Orubebe et al. (2024) advocate for strategic AI adoption in medical libraries, which are particularly sensitive to data security due to patient-related information. These trends highlight the growing need for libraries to evolve as secure, intelligent, and ethical information environments.

Methodology

This study adopts a systematic review research design to critically explore scholarly evidence on cybersecurity behavior within the evolving paradigm of Library 5.0. The systematic review approach is particularly suitable for synthesizing knowledge across interdisciplinary studies and identifying thematic patterns in emerging fields such as human-technology interaction, digital risk management, and cybersecurity practices in smart library environments. This review offers an evidence-based understanding of the opportunities, challenges, and future directions of cybersecurity behavior as libraries evolve within the framework of Industry 5.0.

The review was guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, ensuring transparency, replicability, and methodological rigor. The PRISMA model involves four stages: identification, screening, eligibility, and inclusion, which were systematically applied in the course of this study (Figure 1).

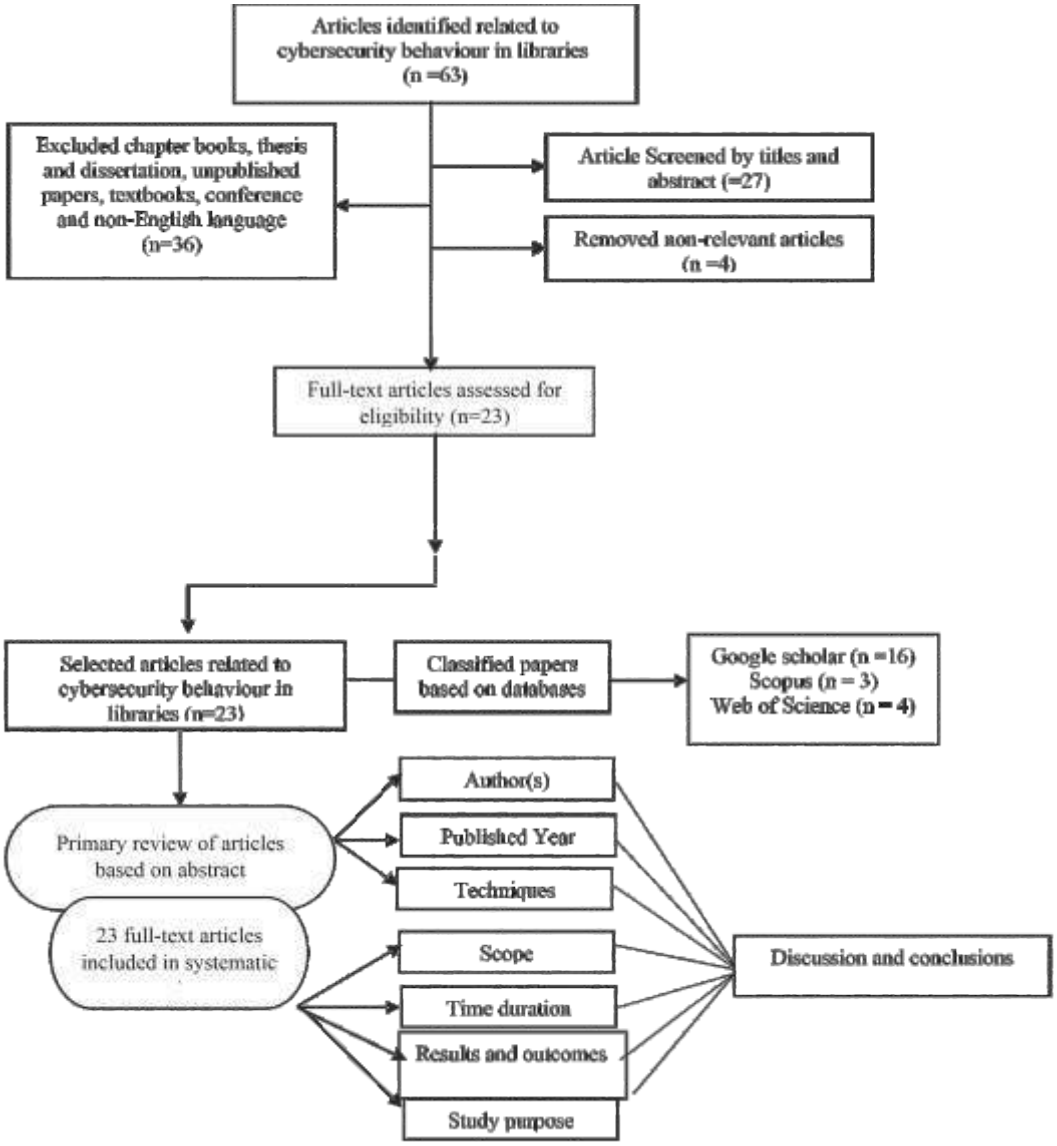


Figure 1: Literature Search Process using PRISMA

An extensive search was conducted across reputable electronic databases, including Google Scholar, Scopus, and Web of Science. Boolean operators and targeted keywords were used to retrieve relevant studies. The search terms included variations and combinations of: "cybersecurity behavior," "Library 5.0," "cybersecurity in libraries," "metaverse libraries," "AI and library security," "emerging technologies in libraries," "digital threats," "information security," "Industry 5.0," "human-centric cybersecurity," and "future of library technology."

The inclusion criteria were as follows:

- Peer-reviewed journal articles published between 2020 and 2025
- Written in English
- Focusing on cybersecurity practices, risks, behaviors, or technological integrations in library settings

Studies were excluded if they:

- Did not focus on libraries or information institutions
- Lacked a specific discussion of cybersecurity or human behavior in the digital context
- Were grey literature, blog posts, or editorials without empirical backing

Following the identification of potential sources, duplicate records were removed. Titles and abstracts of the remaining studies were screened for relevance. The full texts of eligible articles were then reviewed based on the inclusion criteria. The entire process was documented and will be visually represented using a PRISMA flow diagram, which details the number of articles identified, screened, excluded, and ultimately included.

Selected studies were systematically coded using a data extraction spreadsheet. The following variables were captured such as (a) Authorship and publication year, (b) Geographical context and library type (e.g., academic, public, digital, hybrid), (c) Technologies discussed (e.g., AI systems, blockchain, metaverse, robotics), (d) Cybersecurity focus area (e.g., behavior, awareness, technical controls, training), and (e) Key findings and implications for cybersecurity behavior in Library 5.0.

Each study was mapped to one or more of the study's three objectives, ensuring a structured thematic synthesis. To ensure that only methodologically sound studies contributed to the synthesis, all included articles were assessed using the Critical Appraisal Skills Programme (CASP) checklists. These checklists were selected based on the respective study designs, qualitative, quantitative, or mixed methods, to evaluate criteria such as clarity of objectives, validity of methods, credibility of findings, and relevance to the review questions. The extracted data were analyzed using thematic synthesis, allowing for the identification and grouping of findings into core themes directly linked to the study's objectives.

Findings

Key Opportunities Presented by Emerging Technologies for Enhancing Cybersecurity Practices in Next-Generation Libraries

Emerging technologies such as artificial intelligence (AI), the metaverse, blockchain, and robotics present significant opportunities for enhancing cybersecurity in Library 5.0 environments. These technologies, when responsibly implemented, can improve data protection, automate threat detection, and reinforce ethical and secure information access. Adigun, Ajani, and Enakrire (2024) emphasize the role of intelligent libraries in fostering sustainable knowledge systems by embedding smart technologies that inherently support secure infrastructures. AI, for example, can be used to automate routine security tasks and flag anomalies that may indicate cyber threats. Ofusori, Bokaba, and Mhlongo (2024) further support this view, noting that AI can detect and mitigate potential cyberattacks through predictive modeling and behavioral analytics, thus enhancing library security frameworks.

Similarly, Meesad and Mingkhwan (2024) discuss how smart digital libraries, equipped with IoT and AI-integrated systems, can implement dynamic cybersecurity protocols that respond to real-time threats. These systems provide scalable solutions that not only protect data but also personalize security settings for different user categories. The metaverse also offers libraries a novel opportunity to build immersive service platforms with embedded security layers. Ajani et al. (2024) and Oladokun et al. (2024a) explore how metaverse-enabled libraries can integrate biometric verification, secure avatars, and decentralized identity management tools to enhance user safety in virtual environments.

Blockchain technology is another promising tool for securing library operations. Oyedokun (2024) highlights its potential in maintaining transparent, tamper-proof records for transactions, digital lending, and access permissions in a decentralized manner. Verma and Gupta (2022) also argue that by using AI-driven systems within blockchain-anchored platforms, libraries can better ensure the authenticity and integrity of user interactions. These technologies align with the Industry 5.0 emphasis on personalized yet secure services, fostering trust among users while expanding digital access.

Major Challenges Associated with Cybersecurity in Library 5.0 Environments

While the integration of advanced technologies brings opportunities, it also introduces significant cybersecurity challenges that libraries must address. One of the most pressing challenges is the human factor in cybersecurity. Kont (2024) emphasizes that user negligence, lack of awareness, and poor digital hygiene continue to undermine even the most sophisticated security infrastructures. Many library staff and users are ill-prepared to navigate the complex cybersecurity environment of Library 5.0, often due to inadequate training or policy support.

Oladokun et al. (2024b) and Magsi et al. (2025) identify a range of emerging cyber threats in metaverse and digital libraries, including data breaches, malware, and impersonation risks. These threats are exacerbated in environments where immersive technologies lack standardized security protocols. Subaveerapandiyan et al. (2024) further highlight the ethical complexities of securing virtual spaces, noting that manipulation and misinformation can flourish in metaverse environments if behavioral safeguards are not prioritized.

The disparity in technological readiness and infrastructure is also a limitation. Igbinovia and Ishola (2023) and Akor et al. (2024) observe that many libraries in developing contexts lack the financial and human resources needed to implement robust cybersecurity measures. These libraries often face inconsistent power supply, outdated systems, and insufficient funding, making them vulnerable to both internal and external threats. Moonasar and Ngoepe (2023) also point out that the rapid pace of technological change has left many academic librarians struggling to adapt, creating gaps in cybersecurity governance.

AI systems themselves pose challenges when not ethically or transparently designed. Hodonu-Wusu (2024) raises concerns about AI-driven surveillance and algorithmic bias, which could compromise user privacy and trust if not properly managed. Chhetri (2023) echoes this concern, arguing that the same AI tools that protect digital assets can be misused or fail if not closely monitored. These challenges underscore the need for policies and frameworks that prioritize ethical implementation alongside technological innovation.

Future Trends for Fostering Cybersecurity-Conscious Behavior and Resilience in Libraries Transitioning into Library 5.0

As libraries evolve toward Library 5.0, a strong focus is emerging on cultivating cybersecurity-conscious behaviors and building institutional resilience. Holland (2022) indicates that future-ready libraries will be those that embed digital ethics and behavioral science into their cybersecurity strategies. This human-centric approach is consistent with Industry 5.0's ethos of aligning technology with empathy, personalization, and shared responsibility. Also, the role of education and capacity-building in shaping cybersecurity behavior is central to this trend. Panda and Kaur (2024) emphasize the importance of

continuous training for library professionals and users alike, advocating for gamified and context-aware security awareness programs. Bellini and Tammaro (2024) support this view, noting that cybersecurity is no longer a purely technical issue but one that involves behavioral reinforcement and cultural change across library systems.

Future library security models will likely incorporate AI-driven behavior analysis, real-time monitoring tools, and adaptive authentication systems that respond to user actions and risk levels. Ofusori et al. (2024) propose that AI can be employed not just for defense, but for shaping predictive models that forecast cyber risk based on user interaction data. Furthermore, the use of blockchain for identity verification and access management is expected to increase, offering libraries tamper-resistant ways to protect sensitive data (Oyedokun, 2024).

Resilience will also be built through collaborative frameworks that engage librarians, technologists, and policymakers in shared governance. Orubebe et al. (2024) suggest that future cybersecurity strategies should be inclusive and context-sensitive, especially in specialized library settings like medical or legal institutions. Supriya et al. (2024) highlight the role of continuous innovation and foresight in building cyber-resilient educational environments, noting the parallels with smart library development. Ultimately, the future of cybersecurity in Library 5.0 will depend not only on the tools deployed but, on the values, behaviors, and learning cultures that libraries cultivate.

Conclusion

This study concludes that while Library 5.0 presents transformative opportunities through technologies like artificial intelligence, blockchain, robotics, and the metaverse, it also introduces significant cybersecurity challenges that demand urgent and strategic attention. These advanced technologies offer promising avenues for automating security processes, enhancing data protection, and creating immersive yet secure user experiences. Through embedding tools such as biometric authentication, real-time monitoring, and decentralized identity systems, libraries can build intelligent and ethically responsible service environments that align with the values of the Fifth Industrial Revolution.

Despite these advancements, the findings indicate persistent obstacles that hinder the development of a secure Library 5.0 ecosystem. Human-related factors, such as limited cybersecurity awareness, insufficient training, and weak digital practices, remain major vulnerabilities. Additionally, infrastructural gaps, inadequate funding, and a lack of coherent cybersecurity policies, particularly in libraries within developing regions, expose institutions to growing threats such as data breaches, impersonation, and ransomware. The ethical complexities surrounding AI and immersive technologies further complicate the 5IR environment, highlighting the need for responsible adoption and transparent governance.

To ensure cybersecurity resilience in Library 5.0, libraries must adopt a holistic approach that emphasizes human behavior as much as technical solutions. Investing in continuous staff and user education, promoting a culture of digital responsibility, and implementing behaviorally informed security practices will be essential. Equally important is the need for inclusive, forward-thinking cybersecurity frameworks that support collaboration among librarians, technologists, and policymakers. The future of cybersecurity in libraries depends on deploying advanced tools, fostering ethical awareness, and institutional adaptability, as well as ensuring a proactive cybersecurity culture that can sustain the evolving demands of the digital age.

Implications of the Study

The findings of this study have significant implications for both policy formulation and practical implementation in library reference services within the context of Library 5.0. As libraries increasingly adopt advanced technologies such as AI, the metaverse, and blockchain, reference services must evolve to include cybersecurity awareness and behavior as core components of service delivery. Library staff involved in reference services need to be equipped with not only information literacy skills but also cybersecurity competencies to guide users in navigating complex digital environments securely. The study indicates the necessity of integrating cybersecurity training into the professional development of librarians, especially those providing front-line services, to ensure they can adequately advise, protect, and educate library users.

From a policy perspective, the study highlights the urgent need for libraries to develop and institutionalize cybersecurity policies tailored to emerging technologies. Reference services, being central to user engagement, are particularly vulnerable to security breaches and misinformation risks if proper guidelines are not in place. Therefore, institutional policies must support continuous cybersecurity education, clearly define ethical standards for digital interactions, and provide protocols for identifying and responding to cyber threats within the reference service environment. Furthermore, library administrators must prioritize investment in secure digital infrastructure and embed cybersecurity best practices into the operational framework of reference services. This includes the adoption of adaptive authentication mechanisms, privacy-first data management, and user-oriented cybersecurity awareness campaigns.

Limitations of the Study

The study has several limitations. Firstly, the study is based on a systematic review methodology, which relies entirely on existing literature and secondary data. As such, the findings are interpretive and lack the empirical depth that could have been obtained from primary data collection such as interviews, surveys, or

case studies involving library staff and users. This limits the ability to capture real-time user behavior, contextual challenges, and institutional dynamics that influence cybersecurity practices on the ground.
Secondly, the scope of the reviewed literature is limited to sources published in English between 2020 and 2025, which may exclude relevant studies published in other languages or outside the set timeframe. This language and date restriction could lead to a bias in the global representation of cybersecurity challenges and solutions, particularly from non-English-speaking regions that may face unique issues. Finally, the study's dependence on published literature introduces a potential publication bias, where only studies with significant findings tend to be published and included in the review. This may overlook practical insights from unpublished reports, internal evaluations, or ongoing projects in library settings.
Future studies incorporating mixed-method approaches and field-based data collection would enhance the depth and applicability of research on cybersecurity behavior in Library 5.0 environments.

References

Adigun, G. O., Ajani, Y. A., & Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) Industrial Revolution. *Libri*, *74*(3), 211-223.

Ajani, Y. A., Oladokun, B. D., Enakrire, R. T., Ibironke, E. S., Morodi, L., Enidiok, M. S., ... & Moshood, B. A. (2024). Metaverse adventures into libraries: what librarians and information users need to know. *Reference Services Review*, *52*(3), 450-460.

Akor, S. O., Nongo, C., Udofot, C., & Oladokun, B. D. (2024). Cybersecurity Awareness: Leveraging Emerging Technologies in the Security and Management of Libraries in Higher Education Institutions. *Southern African Journal of Security*, 14-pages.

Bellini, E., & Tammaro, A. M. (2024). Cybersecurity for digital libraries: an interview with Emanuele Bellini. *Digital Library Perspectives*, *40*(2), 348-355.

Chhetri, P. (2023). Analyzing the Strengths, Weaknesses, Opportunities, and Threats of AI in Libraries. *Library Philosophy & Practice*.

Gujar, S. S., VS, T., Sakpal, S. S., & Pandey, A. K. (2024). Advanced Cybersecurity Frameworks for Protecting Sensitive Information in Academic Libraries: Innovations and Best Practices. *Library of Progress-Library Science, Information Technology & Computer*, *44*(3).

Hodonu-Wusu, J. O. (2024). The rise of artificial intelligence in libraries: the ethical and equitable methodologies, and prospects for empowering library users. *AI and Ethics*, 1-11.

Holland, B. J. (Ed.). (2022). Handbook of Research on Technological Advances of Library and Information Science in Industry 5.0.

Igbinovia, M. O., & Ishola, B. C. (2023). Cyber security in university libraries and implication for library and information science education in Nigeria. Digital Library Perspectives, 39(3), 248-266.

Kont, K. R. (2024). Libraries and cyber security: the importance of the human factor in preventing cyber attacks. *Library Hi Tech News*, *41*(1), 11-15.

Magsi, I., Shaheen, N., Channar, W. A., Ali, M., Lakho, Z., & Ahmed, A. (2025). Cyber-Security Challenges in Digital Libraries. *Review Journal of Social Psychology & Social Works*, *3*(1), 344-350.

Meesad, P., & Mingkhwan, A. (2024). Emerging Technologies in Smart Digital Libraries. *Libraries in Transformation: Navigating to AI-Powered Libraries*, 211-270.

Moonasar, A., & Ngoepe, M. (2023). Disruptive changes in the role of academic libraries and librarians: a case study of a university of technology in South Africa. *Innovation: journal of appropriate librarianship and information work in Southern Africa*, *2023*(67), 4-31.

Noh, Y. (2023). A study on the discussion on Library 5.0 and the generation of Library 1.0 to Library 5.0. *Journal of Librarianship and Information Science*, *55*(4), 889-905.

Ofusori, L., Bokaba, T., & Mhlongo, S. (2024). Artificial Intelligence in Cybersecurity: A Comprehensive Review and Future Direction. *Applied Artificial Intelligence*, *38*(1), 2439609.

Oladokun, B. D., Enakrire, R. T., Ukubeyinje, E. S., Oyighan, D., Okeke, O. C., & Ajani, Y. A. (2024a). Cybersecurity behavior in the metaverse: Opportunities, challenges and future trends for libraries. *Library Hi Tech News*.

Oladokun, B. D., Ayodeji Ajani, Y., Oloniruha, E. A., Olubunmi Ilori, O., Nsirim, O., & Egbe, I. M. (2024b). Cybersecurity issues in the metaverse libraries. *Business Information Review*, 02663821251328826.

Orubebe, E. D., Ijaja, E. M., Ogwula, J. A., & Oladokun, B. D. (2024). Transforming Medical Libraries: Opportunities, Challenges, and Strategies for Integrating Artificial Intelligence. *Asian Journal of Information Science and Technology*, *14*(2), 82-87.

Oyedokun, T. T. (2024). Reimagining libraries in the fifth industrial revolution (5IR): The impact of robotics, artificial intelligence (AI), metaverse, blockchain, and emerging technologies. *Business Information Review*, 02663821251328839.

Panda, S., & Kaur, N. (2024). Cyber Sentinels: Exploring the Cybersecurity Awareness of Indian Library Professionals. In *Applications of Artificial Intelligence in Libraries* (pp. 78-108). IGI Global.

Subaveerapandiyan, A., Butdisuwan, S., Lachaiah, B., Alam, A. F., & Nair, A. R. (2024). Ethical perspectives on metaverse technologies for libraries. *Library Hi Tech News*.

Supriya, Y., Bhulakshmi, D., Bhattacharya, S., Gadekallu, T. R., Vyas, P., Kaluri, R., ... & Mahmud, M. (2024). Industry 5.0 in smart education: Concepts, applications, challenges, opportunities, and future directions. *IEEE Access*.

Verma, V. K., & Gupta, S. (2022). Artificial intelligence and the future libraries. *World Digital Libraries-An international journal*, *15*(2), 151-166.

Digital Proficiency and Institutional-Based Support as Determinants for Reference Services Delivery in University Libraries in North Central States of Nigeria

BY

ABDULLAHI OLAYINKA ISIAKA
Kwara State Polytechnic, Ilorin, Nigeria
Email: abdulyinka.isiaka@gmail.com
Phone: 08067956408

ABDULLAHI ADEBOLA YUSUF
Al Hikmah University, Ilorin, Nigeria
Email: aayusuf@alhikmah.edu.ng
Phone: 08033533385

BILIAMIN ABIOLA AREMU
Kwara State Polytechnic, Ilorin, Nigeria.
Email: aremsbaba42@gmail.com
Phone: 08067141111

BENJAMIN ADEBISI BAMIDELE
Kwara State College of Health Technology, Offa, Kwara State.
Email: benbammy0706@gmail.com
Phone: 08032528552

Abstract

Reference service is a vital component of library operations, bridging the gap between users and the information they seek. Libraries, especially in educational and research institutions, are tasked with ensuring that reference services are not only accessible but also responsive to the evolving needs of users in the digital age. This paper examines digital proficiency and institutional-based support as determinants of effective reference services delivery in Nigeria. This study adopted a descriptive survey design approach. The population of this study are the reference librarians of university libraries in North Central states of Nigeria. Stratified random sampling technique was employed and data were collected via questionnaire from the respondents. Data collected were analysed with frequency counts, simple percentage and presented with tables. Findings revealed that institutional-based supports are available for effective reference services delivery such as provision of personal desktop and laptop computers for reference services; and organization of in-house training programs on the new trends in reference services among others. Furthermore, findings revealed that the respondents are very proficiency in using digital tools for reference services such as ability to disseminate and communicate information online effectively; ability to create, edit and share electronic documents; and ability to use of OPAC to search for specific information materials among others. Findings also highlight the types of reference services available and rendered in the university libraries such as research consultancy; referral/directional services; indexing and abstracting services. Lastly, findings identified the methods adopted for rendering of reference services in the university libraries such as e-mail conversation; tele-referencing/telephone conversation; physical contact/face-to-face. This study concluded that reference librarians are now expected to possess the digital proficiency to navigate digital systems, provide virtual assistance, and manage electronic resources effectively. This study recommended that academic libraries should endeavor to adopt more technology infrastructure for virtual referencing.

Keywords: *Determinant; Digital Proficiency; Institutional-Based Support; Nigeria; North Central States; Reference Services.*

Introduction

The role of academic libraries has shifted significantly in recent decades, evolving from traditional book-lending institutions to multifaceted knowledge and information service centers. Reference service is one of the essential services rendered in academic libraries, which is designed to assist users in locating relevant information, answering queries, and guiding them through research processes. In academic libraries, particularly in North Central states of Nigeria, reference services are critical to supporting teaching, learning, and scholarly inquiry. The provision of reference services remains a core function in academic libraries, ensuring that users can access accurate, timely, and relevant information to meet their academic, professional, and personal needs. Aina (2018) stresses that reference services entail providing users with guidance on the available services and resources within the library, as well as assisting them in locating these resources. In the digital era, the nature of reference services has evolved significantly, moving beyond traditional methods of face-to-face consultations and printed reference materials to include virtual platforms, databases, and advanced information retrieval systems. Thorpe (2017) states that libraries throughout the world are continually remodeling themselves as they respond to changing community needs

and the benefits and challenges posed by new and emerging technologies. However, effective reference service delivery involves guiding users to relevant information sources, providing research assistance, and responding to specific inquiries through both physical and digital platforms. This transformation underscores the importance of digital proficiency among librarians and robust institutional-based support for the effective delivery of these services.

In the North Central states of Nigeria, academic libraries are increasingly integrating information and communication technologies (ICTs) into their service delivery. Agbo and Eyinnah (2022) affirmed the relevance of ICT embedded services and their application among librarians to make them more effective in the delivery of various library operations. However, Okoli, Ukwedeh, and Joseph (2021) stresses that an effective and functional digital reference and information services remains a mirage in the Nigerian academic libraries. This shift is necessitated by the growing demand for timely, accurate, and accessible information among students, researchers, and faculty. As such, digital proficiency and technological competence have become essential attributes for librarians, particularly those involved in reference services. Evangelinos and Holley (2015) stresses that digital competence needed for reference librarians to operate in the information age is made up of information and data literacy, digital content creations, communication and collaboration, and cybersecurity skills among others. Digital proficiency refers to the knowledge and skills required to use digital technologies competently and confidently. For reference librarians, this includes the ability to search electronic databases, conduct virtual consultations, and teach users digital research skills. Digital proficiency encompasses competencies in online search strategies, digital communication tools, database management, and virtual reference platforms (ALA, 2013). The ability to navigate digital databases, conduct online searches, and interact with users through virtual platforms has emerged as a fundamental requirement for effective reference service delivery in digital era. Ugwulebo and Okoro (2020) emphasizes that digital competence is a critical requirement for reference librarians to remain relevant in a technology-driven environment.

However, despite the acknowledged importance of reference librarians' digital proficiency, institutional-based support also plays a pivotal role in shaping the quality of reference services. This support may come in the form of adequate funding, provision of ICT tools, access to professional development programs, favorable policies, and leadership that prioritizes reference services. According to Awujoola and Fadeyi (2018), institutional supports are the facilitating conditions such as help services, management support, infrastructural support and funding, made available for an organisation or institution. When institutional-based support is strong, librarians are more likely to receive the tools, training, and encouragement necessary to innovate and improve reference service delivery. Nisha (2019) notes that the presence of institutional factors such as: technical support, training, managerial/administrative support, funding and information and communication technology facilities could enhance skill development among library staff and facilitate library productivity for an effective quality service delivery. Conversely, poor support often leads to underfunded libraries, unmotivated staff, and outdated services. Ajayi, Diyaolu and Amusa (2019) discovered that institutional factors such as inadequate funding to support learning and promote the use of library resources among its users were the major challenges facing tertiary institutions in Nigeria.

Several studies have addressed individual factors affecting reference services in Nigerian libraries, but limited empirical research has jointly examined how digital proficiency and institutional-based support interact to influence reference service effectiveness. Understanding this relationship is critical for improving the quality of library services and aligning them with global standards. This study, therefore, seeks to investigate the extent to which digital proficiency and institutional-based support determine the effectiveness of reference service delivery in Nigeria. It explores the current state of digital competence among reference librarians, assess the level of institutional support libraries receive, and examine how these factors influence the overall quality of reference services.

Research Questions

i. What is the level of digital proficiency among reference librarians of university libraries in North Central states of Nigeria?
ii. What are the institutional-based support available for effective reference service delivery in North Central states of Nigeria?
iii. What are the types of reference services available and rendered in university libraries in North Central states of Nigeria?
iv. What are the methods adopted for the rendering of reference services in university libraries in North Central states of Nigeria?

Literature Review

Reference services have undergone significant transformation due to the advent of digital technologies. Traditionally, reference services involved in-person consultations, use of printed bibliographic tools, and manual indexing of information. According to Awodoyin and Aina (2018), traditional reference services include guiding patrons in order to help them to know what services and materials are accessible and how to find them inside the library. Today, libraries provide a mix of traditional

and digital reference services, including virtual reference, email queries, live chat, and online research guides (Cassell & Hiremath, 2013). This transformation has not only expanded access to services but has also raised expectations regarding the speed, accuracy, and responsiveness of library professionals. Similarly, Younus and Nadeem (2021) stressed that in addition to assisting users at the reference desk, the reference librarian now provides users with reference services in cyberspace by utilizing web technologies. In Nigeria, the evolution of reference services has been gradual. Many academic libraries are now incorporating electronic databases, institutional repositories, and online catalogues. Ajayi (2015) states that the effectiveness of these services is still largely dependent on the skills and resources available to reference librarians. Oladokun and Opalere (2022) affirms that many libraries and library cooperatives are introducing virtual reference services to better serve clients who remotely access the library services and collections from their computers. However, the traditional face-to-face interactions and mix/transformation of/to virtual/online reference services, reference librarians now demand a wide array of digital proficiency to navigate electronic databases, conduct online searches, use digital communication tools, and guide users in accessing e-resources.

Digital proficiency refers to the knowledge, skills, and abilities required to use digital tools and resources effectively. In the digital age, the provision of high-quality reference services has become increasingly reliant on the digital proficiency of reference librarians. Odu and Idiodi (2020) found out in their study that librarians with higher digital proficiency were more efficient and responsive in handling user inquiries through digital platforms. Digital proficiency is widely acknowledged as a core competency for librarians in the 21st century. It refers to the ability to effectively use digital technologies to perform tasks, communicate, and solve problems (ALA, 2013). Furthermore, Aina (2019) states that digitally skilled librarians are more confident in teaching users how to access and evaluate electronic resources. In contrast, libraries with digitally deficient staff often fail to meet users' expectations, particularly in institutions where internet use and access to e-resources are vital. Similarly, Oladokun and Adebayo (2021) argue that digitally proficient librarians are more likely to engage in proactive reference services by anticipating user needs and utilizing analytics to tailor support. However, Aina (2019) states that libraries with digitally deficient staff often fail to meet users' expectations, particularly in institutions where internet use and access to e-resources are vital.

The shift to digital platforms has transformed how reference services are delivered as digital proficiency is now a required skills of reference librarians. It is the ability to use modern digital tools, systems, and platforms effectively for service delivery. Kamba (2017) found out that librarians with high levels of digital skills were more effective in providing virtual and online reference services. Sharma and Sharma (2020) emphasized that digital literacy among librarians enhances user satisfaction in reference service delivery by improving response time and accuracy. Digital proficiency involves navigating library databases, providing virtual reference services, and assisting users with information retrieval from digital sources. Sani and Adebayo (2019) revealed that librarians who underwent ICT training were better equipped to provide virtual reference services. Similarly, Ajayi (2015) examined the role of digital literacy in enhancing reference services in Nigerian university libraries. The study revealed that digital literacy directly impacts the quality and timeliness of services offered. Also, Afolabi and Abolaji (2018) conducted a survey across federal university libraries in Nigeria and found that digital literacy levels among librarians positively predicted their use of online reference tools. Despite growing awareness of the need for technological integration in library services as well as digital proficiency of librarians, challenges persist in Nigerian institutions. Many libraries still struggle with poor internet access, limited digital resources, and insufficient administrative recognition. Oladokun (2020) have shown that many librarians face challenges in adopting digital tools due to inadequate training, poor ICT infrastructure, and limited institutional support. This highlights the need of institutional-based support for reference service delivery.

In addition to digital proficiency, institutional-based support also plays a significant role in enhancing reference service delivery. Institutional-based support encompasses funding, infrastructure, training opportunities, and policies that enable libraries to function effectively. Echezona and Ugwuanyi (2019) stresses that reference librarians are more likely to be productive when they operate in an environment with adequate facilities, clear policies, and ongoing support. Institutional-based support refers to as the backing provided by the parent institution to the library in the form of funding, infrastructure, policy formulation, staff training, and administrative recognition. Such support plays a critical role in the performance and sustainability of reference services. Furthermore, Andrikopoulou, Rowley and Walton (2022) states that ongoing support training ensures that library staff remain proficient in emerging technologies and best practices, enhancing their ability to provide high-quality services. Also, Ogunmodede and Emeahara (2016) emphasized that institutions that prioritize libraries in their budgetary allocations tend to have more functional ICT units, modern facilities, and a higher capacity to implement user-focused services. Cox (2021) states that adequate financial backing ensures that the library can maintain up-to-date collections and invest in new technologies to enhance user experience. Chinwe and Adejoke (2022) states that institutional factors such as administrative commitment, funding, and access to continuous training have also been empirically linked to improved service outcomes. These studies affirm the interdependent relationship between librarian competencies and institutional capacity in determining the quality of reference services.

However, many Nigerian libraries still struggle with institutional factors such as inadequate infrastructure, insufficient ICT training for reference librarians, and poor internet connectivity. Furthermore, institutional-based support which encompasses funding, staff development, infrastructure provision, and strategic leadership remains inconsistent across different types of libraries in the country. Ojedokun (2021) stresses that despite the growing demand for digital skills, many Nigerian librarians still lack adequate training and practical exposure to current technologies. Echezona and Ugwuanyi (2019) observed that most libraries in Nigeria lack the necessary ICT infrastructure and financial resources to meet the expectations of digital reference services. Furthermore, Adebayo and Adeyemi (2020) observed that some libraries lack the basic infrastructure needed to support digital services, let alone reference activities. In such environments, even librarians with adequate skills may be limited in their ability to serve users effectively. Factors such as poor internet access, outdated systems, and limited opportunities for professional development contribute to this gap, ultimately affecting service delivery. These factors are caused by lack of institutional-based support. Aina (2019) emphasized that while many librarians have access to digital tools, a lack of formal training limits their ability to exploit these resources fully. Inadequate knowledge of database navigation, virtual reference platforms, and electronic content evaluation has been shown to weaken reference delivery, particularly in academic libraries. However, Adamu, Udoudoh, Babalola and Yusuf (2021) opines that librarians and information professionals can be sponsor to attend conferences, seminars and workshops as part of institutional support which, in turn, enhance information service delivery.

The literature reviewed highlights the critical roles of digital proficiency and institutional-based support in determining the effectiveness of reference service delivery. While several studies have explored these concepts globally, limited attention has been given to Nigeria. The interplay of infrastructural, policy, and skills-based limitations continues to constrain performance of reference librarians although progress has been made. However, this study builds upon previous works by offering a combined analysis of digital proficiency and institutional support as joint predictors of reference service effectiveness in Nigerian libraries. This study will provide library management with valuable insights into the critical role of institutional-based support and digital proficiency in delivering effective reference services. It will highlight areas where additional resources, infrastructure, or training are needed, enabling management to make informed decisions to improve library services and operations.

Methods

The descriptive survey design was adopted for this study to investigate reference librarians' digital proficiency and institutional-based support as determinants of effective reference services delivery in North Central states of Nigeria. The population of this study are the reference librarians of university libraries in North Central states of Nigeria, there are six (6) states and federal capital in the region, which are Benue, Kogi, Kwara, Nasarawa, Niger, Plateau and FCT Abuja. Stratified random sampling technique was used to select 46 sample size randomly from all the university libraries from each state and FCT to participate in this study. A self-constructed questionnaire was used as the instrument for data collection. The questionnaire was adapted from previous related studies and was measured on a four-point Likert scale of strongly agree (SA=1) to strongly disagree (SD=4). The questionnaire was perused by two (2) professionals, PhD holders in the field of Library and Information Science for face and content validation, their observations and comments were observed and incorporated. The questionnaire was prepared by Google Form and the link was sent respondents during the work hours of working days by the researchers. In other to achieve a higher portion of responds rate, the researchers got the contact of the respondents from the Nigeria Library Association (NLA) WhatsApp group and some were gotten from staff of the participating university libraries. The link to the questionnaire was sent by direct message (DM) to the respondents with a caption of brief introduction and significant of the study. Just 38 (82.6%) were attended to out of 46 sample size for the study. The link was left active for a period of 35 days. Data collected were analysed with the use of Statistical Package for the Social Sciences (SPSS) version 26.0, utilizing tables, frequency counts and simple percentages for interpretation of the responses.

Analyses of Results

Table 1: The Level of Digital Proficiency among Reference Librarians of University Libraries in North Central states of Nigeria.

Statements	SA	A	D	SD
Ability to search for relevant information online efficiently.	27(71.0%)	9(23.6%)	2(5.2%)	0(0.0%)
Ability to disseminate and communicate information online effectively.	25(65.7%)	11(28.9%)	2(5.2%)	0(0.0%)

Ability to access, use and manage different library application software.	18(47.3%)	15(39.4%)	4(10.5%)	1(2.6%)
Ability to obtain product keys, install and uninstall application software.	12(45.1%)	11(33.8%)	9(14.5%)	6(15.7%)
Ability to operate and use computer systems for basic tasks.	26(68.4%)	10(26.3%)	1(2.6%)	1(2.6%)
Ability to design and develop Web-based materials.	8(21.0%)	9(23.6%)	7(18.4%)	14(36.8%)
Ability to create, edit and share electronic documents.	24(63.1%)	10(26.3%)	2(5.2%)	2(5.2%)
Ability to print and scan documents.	30(78.9%)	8(21.0%)	0(0.0%)	0(0.0%)
Ability to save files on storage medium and web-based clouds.	24(63.1%)	9(23.6%)	4(10.5%)	1(2.6%)
Ability to use OPAC to search for specific information materials.	28(73.6%)	10(26.3%)	0(0.0%)	0(0.0%)
Ability to use of Boolean search operators.	16(42.1%)	11(28.9%)	7(18.4%)	4(10.5%)

Source: Study's Data, 2025

Table 1 reveals the level of digital proficiency among reference librarians of university libraries in Nigeria. Such as "Ability to print and scan documents" with the highest response rate of strongly agree (SA) of 30(78.9%), follows by "Ability to use OPAC to search for specific information materials" with 28(73.6%), "Ability to search for relevant information online efficiently" with 27(71.0%), "Ability to operate and use computer systems for basic tasks" with 26(68.4%), and "Ability to disseminate and communicate information online effectively" with 25(65.7%). However, "Ability to design and develop Web-based materials" has the highest response rate of strongly disagree (SD) with 14(36.8%). This indicates that the reference librarians possessed the needed digital proficiency to be effective in providing service delivery to their users.

Table 2: The Institutional-Based Support available for Reference Services Delivery in North Central states of Nigeria.

Statements	SA	A	D	SD
My institution provides personal desktop and laptop computers for reference services.	28(73.6%)	9(23.6%)	1(2.6%)	0(0.0%)
My institution provides regular electricity supply for reference services.	10(26.3%)	10(26.3%)	8(21.0%)	10(26.3%)
My institution provides fast internet connections for reference services.	16(42.1%)	10(26.3%)	7(18.4%)	5(13.1%)

My institution sponsors reference librarians regularly to seminars on the provision of effective reference services.	20(52.6%)	12(31.5%)	4(10.5%)	2(5.2%)
My institution organizes in-house training programs on the new trends in reference services.	31(81.5%)	7(18.4%)	0(0.0%)	0(0.0%)
My institution has sustainable funding policy for digital literacy training.	13(34.2%)	12(31.5%)	8(21.0%)	5(13.1%)
My institution has a special budget for software and computers used for reference services.	10(26.3%)	9(23.6%)	7(18.4%)	12(31.5%)

Source: Study's Data, 2025

Table 2 reveals the institutional-based support available for effective reference service delivery in Nigeria. The institutional-based support available include "My institution organizes in-house training programs on the new trends in reference services" with 31(81.5%) is the highest response rate of strongly agree (SA), follows by "My institution provides personal desktop and laptop computers for reference services" with 28(73.6%), "My institution sponsors reference librarians regularly to seminars on the provision of effective reference services" with 20(52.6%) and "My institution provides fast internet connections for reference services" with 16(42.1%). However, "My institution has a special budget for software and computers used for reference services" has the highest response rate of strongly disagree (SD) with 12(31.5%). This indicates that there is existence of institutional-based support for effective reference service delivery in Nigeria.

Table 3: The Types of Reference Services Available and Rendered in University Libraries in North Central states of Nigeria.

Statements	SA	A	D	SD
Research Consultancy	30(78.9%)	7(18.4%)	1(2.6%)	0(0.0%)
Literature Search Services	20(52.6%)	12(31.5%)	4(10.5%)	2(5.2%)
Bibliographic Search Services	18(47.3%)	14(36.8%)	4(10.5%)	2(5.2%)
Adaptive Learning Services	6(15.7%)	9(23.6%)	9(23.6%)	14(36.8%)
Referral/Directional Services	29(76.3%)	8(21.0%)	1(2.6%)	0(0.0%)
Indexing and Abstracting Services	27(71.0%)	10(26.3%)	1(2.6%)	0(0.0%)
Current Awareness Services	28(73.6%)	9(23.6%)	1(2.6%)	0(0.0%)
Selective Dissemination of Information	29(76.3%)	6(15.7%)	2(5.2%)	1(2.6%)
Book Publishing Support Services	8(21.0%)	9(23.6%)	7(18.4%)	14(36.8%)
Data Analysis Consultation Services	10(26.3%)	10(26.3%)	10(26.3%)	8(21.0%)
Virtual Reference Services	13(34.2%)	11(28.9%)	7(18.4%)	7(18.4%)

Document Delivery Services	9(23.6%)	10(26.3%)	9(23.6%)	10(26.3%)
Citation/Referencing Services	21(55.2%)	12(31.5%)	4(10.5%)	1(2.6%)
Cross-referencing/See also Services	28(73.6%)	9(23.6%)	1(2.6%)	0(0.0%)

Table 3 reveals the types of reference services available and rendered in university libraries in Nigeria. Such types of reference services rendered include "Research Consultancy" with the highest response rate of strongly agree (SA) of 30(78.9%), follows by "Referral/Directional Services" and "Selective Dissemination of Information" with 29(76.3%) respectively, also "Current Awareness Services" and "Cross-referencing/See also Services" with 28(73.6%) respectively, and "Indexing and Abstracting Services" with 27(71.0%). However, "Adaptive Learning Services" and "Book Publishing Support Services" has the highest response rate of strongly disagree (SD) of 14(36.8%) respectively, follows by "Document Delivery Services" with 10(26.3%). This indicates that there are different types of reference services made available and rendered in university libraries in Nigeria.

Table 4: The Methods adopted for the Rendering of Reference Services in University Libraries in North Central states of Nigeria.

Statements	SA	A	D	SD
E-mail Conversation	29(76.3%)	8(21.0%)	1(2.6%)	0(0.0%)
Library Chatbots	4(10.5%)	7(18.4%)	13(34.2%)	14(36.8%)
Tele-referencing/Telephone Conversation	30(78.9%)	5(13.1%)	3(7.8%)	0(0.0%)
Instant Messaging/Library WhatsApp Platform	21(55.2%)	13(34.2%)	3(7.8%)	1(2.6%)
Video Referencing	16(41.1%)	13(34.2%)	6(15.7%)	3(7.8%)
Physical Contact/Face-to-face	32(84.2%)	5(13.1%)	1(2.6%)	0(0.0%)
Postal Cards Messaging	13(34.2%)	11(28.9%)	7(18.2%)	7(18.2%)
Web-cam Referencing	7(18.2%)	10(26.3%)	11(28.9%)	10(26.3%)
Social Media Platforms	13(34.2%)	12(31.5%)	9(23.6%)	4(10.5%)
Mobile Technology	4(10.5%)	8(21.0%)	10(26.3%)	16(42.1%)
Virtual Referencing	15(39.4%)	13(34.2%)	6(15.7%)	4(10.5%)

Table 4 reveals the methods adopted for the rendering of reference services in university libraries in Nigeria. Such adopted methods include "Physical Contact/Face-to-face" with 32(84.2%) is the highest response rate of strongly agree (SA), follows by "Tele-referencing/Telephone Conversation" with 30(78.9%), "E-mail Conversation" with 29(76.3%), and "Instant Messaging/Library WhatsApp Platform" with 21(55.2%). However, "Mobile Technology" has the highest response rate of strongly disagree (SD) with 16(42.1%), follows by "Library Chatbots" with 14(36.8%) and "Web-cam Referencing" with 10(26.3%). This indicate that the university libraries in Nigeria adopted various method for the rendering of reference services to their users.

Discussion of Findings

The findings of this study revealed the level of digital proficiency among reference librarians of university libraries in Nigeria and the significant role it plays in effective reference delivery. Such digital proficiency include ability to print and scan documents; ability to use OPAC to search for specific

information materials; ability to search for relevant information online efficiently; ability to operate and use computer systems for basic tasks; and ability to disseminate and communicate information online effectively as indicated by the reference librarians in university libraries in Nigeria. This is in line with the study of Sharma and Sharma (2020), they emphasized that digital literacy among librarians enhances user satisfaction in reference service delivery by improving response time and accuracy. Similarly, Oladokun and Adebayo (2021) argue that digitally proficient librarians are more likely to engage in proactive reference services by anticipating user needs and utilizing analytics to tailor support. Also, Atanda, Owolabi and Ugbala (2021) revealed that digital competence is the ability to use and operate word processors and computers constituted the hallmark of competencies which is very essential for academic librarians in effective digital library services. Odu and Idiodi (2020) also found out in their study that librarians with higher digital proficiency were more efficient and responsive in handling user inquiries through digital platforms.

The findings of this study also revealed the institutional-based support available for effective reference service delivery in Nigeria as well as the pivotal roles it plays effective reference service delivery. Such institutional-based support available according to the respondents include: my institution organizes in-house training programs on the new trends in reference services; my institution provides personal desktop and laptop computers for reference services; my institution sponsors reference librarians regularly to seminars on the provision of effective reference services; and my institution provides fast internet connections for reference services. This is supported with the study of Chinwe and Adejoke (2022), they stressed that institutional factors such as administrative commitment, funding, and access to continuous training have also been empirically linked to improved service outcomes. Also, Andrikopoulou, Rowley and Walton (2022) that ongoing support training ensures that library staff remain proficient in emerging technologies and best practices, enhancing their ability to provide high-quality services. Furthermore, Cox (2021) revealed that adequate financial backing ensures that the library can maintain up-to-date collections and invest in new technologies to enhance user experience. Nisha (2019) also notes that the presence of institutional factors such as: technical support, training, managerial/administrative support, funding and information and communication technology facilities could enhance skill development among library staff and facilitate library productivity for an effective quality service delivery.

Furthermore, the findings of this study revealed the types of reference services available and rendered in university libraries in Nigeria. Such types of reference services available and rendered include: Research Consultancy; Referral/Directional Services; Selective Dissemination of Information; Current Awareness Services; Cross-referencing/See also Services; and Indexing and Abstracting Services. This affirmed with the study of Ubogu (2020), they identified the types of reference questions asked by the library patrons to include directional questions, research questions, procedural questions, subject-based research questions, personal -related questions and fact-finding questions in that order. Grundy (2016) discovered that the commonest reference services library render is referral service and answering reference queries. Also, Quadri and Garaba (2019) states that library professionals with ICT/digital skills/competency render more current awareness services to their users. Furthermore, Younus and Nadeem (2021) states that reference librarian was primarily responsible for selecting appropriate and sufficient reference material, as well as organizing and maintaining it so that users could use it readily and conveniently. However, they further stated that with the development of electronic, virtual and digital library, the actual reference desk has been replaced by a digital reference desk where users can submit their queries online and acquire the information they require at any time and from any location. Also, Ubogu (2020) stressed that digital reference services will increase the patrons' interaction, speed of service delivery to users and accessibility of information resources and services.

Finally, the findings of this study revealed various methods adopted for the rendering of reference services in university libraries in Nigeria. Such adopted methods include: Physical Contact/Face-to-face; Tele-referencing/Telephone Conversation; E-mail Conversation; and Instant Messaging/Library WhatsApp Platform. This corroborated with the study of Egunjobi et al. (2022), they revealed that face-to-face consultation was the most commonly used medium for reference service delivery in Federal Universities in Nigeria. Further that telephone consultation, e-mail referencing are also utilized. Aina (2018) states that reference services entail providing users with guidance on the available services and resources within the library, as well as assisting them in locating these resources. Awodoyin and Aina (2018) states that an examination of both traditional and digital reference services will provide insights into the overall service landscape. Furthermore, Ajakaye (2021) noted that academic libraries outside the shores of Africa have adopted intelligent systems to direct library users to sources of information within or outside the library system that are likely to answer their reference questions, which saves time for any library user and effectively and efficiently satisfies their information needs. Similarly, Adeoye, Oladokun and Opalere (2022) affirms that many libraries and library cooperatives are introducing virtual reference services to better serve clients who remotely access the library services and collections from their computers.

Conclusion

Reference services are the activities performed by reference librarians to assist users in locating, accessing, and utilizing relevant information resources. It involves both direct and indirect forms of user assistance, such as face-to-face consultations, email communication, and virtual reference tools. Traditionally, reference services relied on printed materials and physical interactions; however, with the advancement of technology, reference service delivery now includes digital resources, online databases, and virtual tools. This study concluded that the reference librarians in Nigerian university libraries possessed the needed digital proficiency to be more effective in rendering reference services to library users. Furthermore, the study also concluded that there is existence of some institutional-based supports for effective reference services delivery. This study also that there are various types of reference services available and these services are rendered in university libraries in Nigeria. Lastly, the study concluded that there are various methods adopted for the rendering of reference services in university libraries in Nigeria.

However, this study put forward the following recommendations: reference librarians should stay up-to-date to the new trends and emerging technologies for reference services; parent institution should have an implementation policy and budget for effective reference services; and the reference librarians should be ready to attend to users anytime and anywhere either by physical contact or virtual consultation.

References

Adeoye, A. A., Oladokun, T. A., & Opalere, E. (2022). Readiness for digital reference services: A survey of libraries in Ibadan Metropolis, Nigeria. *International Information & Library Review, 53*(4), 306-314.

Adamu, M. S., Udoudoh, S. J., Babalola, G. A., & Yusuf, F. L. (2021). Significance of continuous professional development in enhancing job performance of librarians in federal university libraries in North-Central, Nigeria. *Nigerian Libraries, 54*(1), 16-28.

Adebayo, F. A., & Adeyemi, O. A. (2020). Institutional funding and its impact on reference service delivery in Nigerian polytechnic libraries. *African Journal of Library, Archives, and Information Science, 30*(1), 77-90.

Afolabi, M., & Abolaji, A. (2018). Digital competence and the effectiveness of virtual reference services in federal university libraries in Nigeria. *Nigerian Libraries, 51*(1), 88–101.

Agbo, D. A., & Eyinnah, U. A. (2022). Effectiveness of information service delivery through marketing of library resources and services. *Information Impact: Journal of Information and Knowledge Management, 13*(2), 88–97. https://doi.org/10.4314/iijikm.v13i2.7

Aina, L. O. (2018). An analysis of quality reference services delivery as perceived by undergraduates in selected university libraries in South-west, Nigeria. *Library Philosophy and Practice, 01.* 1-14

Aina, L. O. (2019). The development of digital libraries in Nigeria: The challenges and the way forward. *Information Development, 35*(4), 500–509.

American Library Association (ALA). (2013). Digital literacy definition and frameworks. Retrieved from https://literacy.ala.org/digital-literacy/

Ajakaye, J. E. (2021). Applications of artificial intelligence (AI) in libraries. Retrieved from https://doi.org/10.4018/978-1-7998-9094-2.ch006

Ajayi, O. A. (2015). Digital literacy and its role in enhancing reference services in Nigerian university libraries. *Nigerian Journal of Library and Information Science, 12*(3), 120-134.

Ajayi, S. O., Diyaolu, M. A., & Amusa, O. I. (2019). Challenges of integrated library system (ILS) migration in selected academic libraries in Oyo State, Nigeria. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/2902/

Andrikopoulou, A., Rowley, J. & Walton, G. (2022). Research data management (RDM) and the evolving identity of academic libraries and librarians: A literature review. *New Review of Academic Librarianship, 28*(4), 349-365.

Atanda, A. D.; Owolabi, K. A. & Ugbala, C. P. (2021). Professional competence and attitudes of library personnel towards digital services in selected university libraries in Nigeria. *Digital Library Perspectives,* 2059-5816. https://doi.org/10.1108/DLP-08- 2020-0076

Awodoyin, A. F. & Aina, L. O. (2018). An analysis of quality reference services delivery as perceived by undergraduates in selected university libraries in South-West, Nigeria. *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac.

Awujoola, O. A., & Fadeyi, V. O. (2018). Perceived ease-of-use and usefulness of personal digital assistants use by undergraduates for academic activities in University of Ibadan, Nigeria. *International Journal of Academic Library and Information Science, 6*(3), 63–71. https://www.academicresearchjournals.org/IJALIS/PDF/2018/May/Awujoola%20and%20Fadeyi.pdf

Cassell, K. A., & Hiremath, U. (2013). *Reference and information services: An introduction (4th ed.)*. Libraries Unlimited.

Chinwe, N. E., & Adejoke, A. O. (2022). Institutional support and reference service effectiveness in Nigerian university libraries. *Journal of Library Services and Technology, 17*(2), 45–59.

Cox, J. (2021). Positioning the academic library within the institution: A literature review. *Academic Library,* 9-33.

Echezona, R. I., & Ugwuanyi, M. A. (2019). Challenges in the delivery of reference services in Nigerian university libraries: The role of institutional support. *Nigerian Libraries, 25*(1), 44-58.

Egunjobi, R. A.; Ogunniyi, S. O., & Ajakaye, J. E. (2022) Challenges and Prospects of Reference Services in Federal University libraries in South-West, Nigeria. *Library Philosophy and Practice (e-journal)*. 7155. https://digitalcommons.unl.edu/libphilprac/7155

Evangelinos, G., & Holley, D. (2015). A qualitative exploration of the DIGCOMP Digital Competence Framework: Attitudes of students, academics and administrative staff in the health faculty of a UK HEI. *EAI Endorsed Transactions on e-Learning, 2*(6).

Grundy, J. (2016). Top 9 customer service trends for 2016 – Comm100 blog. https://www.publishersweekly.com/pw/by-topic/industry-news/audio-books/i.

Kamba, A. (2017). The role of digital literacy in reference services: A case study of Nigerian university libraries. *Library Management, 38*(1), 38-49.

Nisha, T. R. (2019). The need for continuous (competency-based) training and development of library staff in a public library, university of South Africa, Pretoria. http://hdl.handle.net/10500/1213

Odu, J. O., & Idiodi, E. O. (2020). Digital literacy skills and reference service delivery among academic librarians in Nigeria. *Information Impact: Journal of Information and Knowledge Management, 11*(1), 20–30.

Ogunmodede, A. T., & Emeahara, C. M. (2016). Institutional policy support and reference services in Nigerian libraries. *Journal of Library and Information Science, 21*(4), 200-215.

Ojedokun, A. A. (2021). Digital competence of librarians in selected Nigerian academic libraries. *Library and Information Science Research, 43*(2), 101070.

Okoli, U. C.; Ukwedeh, D. O.; & Joseph, A. I. (2021). Digital Reference Services in Academic Libraries in Nigeria: Effectiveness and Roles in the New Normal. *Journal of applied Information Science and Technology, 14*(1)

Oladokun, S. O. (2020). Digital proficiency and its impact on reference services in Nigerian libraries: A case study of Osun State. *Nigerian Libraries Journal, 31*(1), 56-69.

Oladokun, B. D., & Adebayo, A. O. (2021). Social media application for effective library and information services delivery in academic libraries. *Information Technology and Librarianship, 1*(1&2), 45–56. https://www.researchgate.net/publication/362025427_Social_media_application_for_effective_library_and_information_services_delivery_in_academic_libraries

Quadri, G. O., & Garaba, F. (2019). Perceived effects of ICT on knowledge sharing among librarian in South-west Nigeria: A UTAUT Theoretical Approach. *Journal of Balkan Libraries Union, 6*(1), 38-46.

Sani, B., & Adebayo, A. (2019). Digital literacy and its impact on reference service delivery in Nigerian libraries: A survey. *Information Science and Technology Journal, 19*(4), 100-112.

Sharma, R., & Sharma, V. (2020). Digital literacy: A key factor in the quality of reference services in libraries. *International Journal of Information Science, 14*(3), 200-215.

Thorpe, C. (2017). Engaging with our communities: Future trends and opportunities for reference Services. *Journal of the Australian Library and Information Association, 66*(4), 406-415.

Ubogu, J. O. (2020). Provision of digital reference services in selected Nigerian state university libraries. *Regional Journal of Information and Knowledge Management, 5*(1), 22-33.

Ugwulebo, S. S., & Okoro, E. E. (2020). Digital competence and academic library services in Nigeria. *Journal of Academic Librarianship, 46*(3), 1-10.

Younus, M., & Nadeem, A. H. (2021). Effectiveness of digital reference services in university libraries in Punjab, Pakistan: users' perceptions. *Library Philosophy and Practice.* 4162. https://digitalcommons.unl.edu/libphilprac/4162

Effects of Computer Drill, Practice and Demonstration Strategy on Junior Secondary School Student's Retention in Basic Science and Technology in Abuja Municipal Area Council

BY

[1]Adalikwu, M .T, [2] AJI KINGSLEY OLAWALE

[1,] Department of Early Childhood Care and Education, Federal Capital Territory, ZUBA Abuja

[2] Departmentof Library,Federal Capital Territory, Zuba Abuja

[1]Email:madalikwu@gmail.com[1]Tel:+2348030843168 [2]Tel:+2347039303125

Abstract

This study investigated the "Effects of Computer Drill, Practice and Demonstration Strategy on Junior Secondary Student's Basic Science and Technology Retention in Abuja." The study employed a quasi-experimental pretest, post test non randomized non-equivalent group research design. A purposive sampling technique was employed to select three schools in Abuja Municipal Area Council (AMAC). 220 (38 male and 44 female), (28 male and 48 female). (28 male and 34 female) were selected as sample for both experimental and control group respectively. Computer drill, practice instructional Package and Basic Science and Technology Achievement test were used as Data Collection Instruments. The reliability index of each of the instrument using Pearson Product Moment Correlation Co-efficient test was 0.72. Three research questions and three corresponding hypotheses were formulated to guide the study. The hypotheses were tested at 0.05 level of significant. The statistical, Analyses were done using Analysis of Variance (ANOVA), Descriptive statistic, Analysis of Covariance,(ANCOVA), Shefes Poc Hoc and independent t-test. The result of the major findings show significant difference exists F(2,216) = 73.939,P <0.05) The p-value was 0.05) between students taught Basic Science and Technology using computer drill and practice, Demonstration strategy and those taught using control groups. Also, there was no significant difference in the mean retention scores of male and female students taught Basic Science and Technology using computer drill and practice (CDP). t = 0.34, df = 80 and P>value was 0.12 and Demonstration Strategy (DS). t = 0.74 ,df 74 p-value was 0.88. Based on the findings, it was recommended among others, that Computer, drill practice were effective for Basic Science and Technology teaching and should be used to complement the teaching of Basic Science and Technology to improve the achievement of student.

Keywords: *Computer Drill and Practice, Demonstration Strategy, Basic Science and Technology, Retention, Students.*

Introduction

It is impossible to overstate the significance of science and technology in all facets of life. This is evident in a country's social, political and economic life, but it is most prominently seen in the global educational system (Rebecca, 2021). It is a path forward for all developing nations to reach their goals in every area of human endeavor (Adeboye, 2015). In the modern world, science and technology are integral components of human customs. Consequently, any nation that rejects these advancements in science and technology is destroying the future and vision of her youth (Igweh, 2015).

The use of computer technology in education has improved the quality of teaching and learning and has been recommended for instructional delivery (Titus, Sylvester & Friday, 2020). These innovative technologies can be used to complement the teaching of Basic Science and Technology in Junior Secondary School (Satilehin, Olubumi & Okoye, 2024).

Basic Science and Technology is one of the core subjects taught at the upper basic education level (JSSI-JSS3) (FRN, 2014). The curriculum was planned to enable students excel in the areas of scientific research, discoveries both inside and outside the classroom (NERDC & Odugbumi, 2015). Despite the importance of technology in teaching and learning, some Basic Science and Technology teachers are still teaching using the conventional method without adequate instructional materials to illustrate the lesson's content, and some of them do not pay attention to innovative instructional strategies that are trending in this contemporary time (Onyeka, 2023). Furthermore, a lack of acceptance of the use of ICT in teaching and learning by some Basic Science teachers has also resulted in a persistently low student retention rate (Jerusha & Mangut, 2022). Thus, in addition to the use of instructional materials, it is necessary to emphasize on the quality of instructional strategy in the teaching and learning of Basic Science and Technology, with a focus on Basic Science and Technology at the junior secondary school level of education. This raises the question of whether activity - based strategies like computer drill, practice and

demonstration strategy could be useful teaching tools that can be used to help students retain the material they have learned in both primary and secondary education.

Computer drill and practice is an automated and repetitive teaching tool that can be used in presenting subject matter in teaching - learning process either with a programmed text or with a computer (Laleye & Ogunboyede, 2023). In these teaching strategies, students are given small, organized learning units that allow them to work through the pre-programmed materials on their own or progress through a unit of study at their own pace, checking their own answers and moving on once each question has been answered correctly by them (Adalikwu 2020). When students correctly answer a question, they move on to the next lesson and receive reinforcement (Rebecca, 2021). In the event that a student does not pass the question, the computer will direct them to review the previous unit in order to improve their chances of receiving reinforcement in the future (Isijola, 2015).

One exceptional feature of this technology is that it helps students' behavior to become more structured, stronger, and more likely to repeat positive behavior (Skinner, 1963). Computers, drills and practice have the drawback of allowing for constant criticism of both correct and incorrect answers (Adalikwu, 2020). This learning strategy is based on the idea that students learn by making mistakes in addition to correctly answering questions. Here learning weaknesses is taken away by correcting wrong answers which helps them enhance their learning outcomes.

Another teaching method that is suggested in the teaching-learning process is the demonstration strategy (Titus & Friday 2020). It is the act of presenting, exhibiting or displaying something (Giridharan & Ramasamy, 2016). In a demonstration learning strategy, a process or event is displayed, and either the teacher or the students perform activities in front of the class while providing explanations along the way (Onyeka, 2023). Kabir (2019) asserted that it helps students to listen attentively as well as become familiar with how tools are used. The integration of these instructional strategies into the teaching of Basic Science and Technology has the potential to improve students' retention of newly learned concepts.

Retention is another aspect to consider in students learning. It is the ability to retain learned information or remembers what has been taught after certain period of time (Jerusha & Mangut, 2022). Most often people equate retention with cramming (Adalikwu, 2020). This perception has confine students to the idea of reading to pass exam alone. Retention is boost by both the action of the teacher and the learner (Doris, 2019). Despite the importance attached to teaching of Basic Science and Technology, poor learning environment, lack of instructional materials and poor methods of teaching among others has led to poor retention of students (Adalikwu, 2023). Also gender discrepancy constitutes a major challenge especially when these subjects are thought without instructional materials to illustrate the content of the lesson (Doris, 2019).

Therefore, little research has been carried out in computer drill, practice and demonstration strategy in other areas such as social studies, agriculture, fabrication and engineering but none has been done using these strategies to teach Basic Science and Technology in Abuja Municipal Area Council, Federal Capital Territory. Therefore the researcher has fill a gap in this study by using computer, drill, practice and demonstration strategy to teach students Basic Science and Technology to find out the one that will have better effects on students retention in teaching and learning. It is against this backdrop that the researchers investigated effects of computer, drill practice and demonstration strategy on junior secondary school student's retention in Basic Science and Technology in Abuja Municipal Area Council, FCT Abuja.

Aim and Objectives of the Study

The aim of this study is to investigate the effects of computer drill, practice and demonstration strategy on junior secondary student's Basic science and Technology retention in Abuja Municipal Area Council. FCT. Specifically, the objectives of the study are to:

1. determine the influence of computer drill and practice, demonstration strategy and conventional lecture method on retention of students in Basic Science and Technology;
2. examine the influence of computer drill and practice on retention of male and female students in Basic Science and Technology;
3. determine the influence of demonstration strategy on retention of male and female students in Basic Science and Technology;

Research Questions

The following research questions were raised to guide the study

1. What is the difference in the mean retention score of students taught Basic Science and technology

concept with computer drill and practice, demonstation strategy and conventional lecture method in Abuja Municipal Area Council?

2. What is the difference in the mean retention score of male and female students taught Basic Science and Technology using computer drill and practice in Abuja Municipal Area Council?
3. What is the difference in the mean retention score of male and female students taught Basic Science and Technology using demonstration strategy in Abuja Municipal Area Council**?**

Research Hypotheses

HO_1 There is no significance difference in the mean retention score of students taught Basic Science and Technology concept with computer drill, practice and demonstration strategy in Abuja Municipal Area Council;

HO_2 There is no significance difference in the mean retention score of male and female students taught basic Science and Technology using computer drill and practice in Abuja Municipal Area Council;

HO_3 There is no significance difference in the mean retention score of male and female students taught basic Science and Technology using demonstration strategy in Abuja Municipal Area Council;

Literature Review

Badmus (2018) investigated on the effect of computer Tutorial mode (CTM) with demonstration method on student's achievement and attitudes in selected skills in woodwork practicals. The research employed quasi- experimental pre- test, post-test design. 20 students each was randomly selected among 200 level students of two NCE technical education making a total of 40 students used as experimental and control group respectively. Computer instructional leaning package, learner's achievement test, (LAT) and questionnaires on student's attitude towards technical education was used. Mean scores, standard deviation and t-test was used for data analysis. The result of the study proved that students expose to tutorial computer mode perform better than those expose to practical demonstration method.

Uhumuavbi and Mmamudu (2019) Investigated on relative effects of programmed instruction and demonstration method on student academic performance in science. The study adopted a quasi-experimental research design. Two intact classes were used for the study. The instrument used was test of performance level in science TOPLS The result showed a significance difference in the academic achievement of the two groups of students. Students expose to program instruction achieve better than those expose to demonstration method.Silwood (2020) investigated on the effect of traditional lecture-demonstration V.S modular self pace computer instruction in technology education in middle school. The objective of the study was to compare the performance of the students who were taught a technology education unit by traditional methods with the performance of students taught the same information by self pace computer modular learning situation. The subjects were eight grade boys and girls at the Burlinton middle school. The control group was the seventh hour class, made up of 19 students taught by traditional method. The eight hour class which is the experimental group consisted of 24 students taught with modules; both groups were taught a unit on bridge construction and were subjected to the same final test. The result of the findings proved there was no significance difference between the two groups.

From the literature reviewed studies has been carried out in different aspect of science related courses. Most studies carried out by different researchers have pointed out some of the factor that has led to poor performance of students in teaching and learning different subject

Therefore the need to carry out this study in Basic science at the junior secondary school becomes very important. Above all it is expected that the use of these two teaching strategies in our junior secondary school aside the conventional lecture will increase student's achievement and retention in Basic science teaching and other related subject in Nigeria.

Research Methodology

The study employed a quasi- experimental pre-test, posttest non- randomized, non- equivalent group research design. The population for this study constituted the entire JSS II student's from 53 junior secondary schools with a total population of 7,782 in Abuja Municipal Area Council of 2023/2024 academic session. The target populations were junior secondary school Basic Science 11 students. The choice of JSS II classes as the target was based on the fact that they already have the background knowledge of Basic Science in JSS 1 and the concept to be taught fell under their syllabus and scheme of work.The

sample for the study constituted 220 students of the JSS II students in the selected schools. A purposive sampling technique was adopted to select three co- educational Junior Secondary Schools in Abuja Municipal Area Council (AMAC). These schools are Junior Secondary School Airport road, Gosa and Lugbe. The reason for purposively selecting three schools was based on the availability of computer facilities, electricity and other ICT facilities. The three schools selected were randomly assigned into experimental Group I (Demonstration Strategy), Experimental Group II (Computer Drill and Practice) and control group (conventional lecture method) respectively using simple random sampling. The subject of these classes were considered as having the same characteristic with the target population for the study and are also believed to share in the same environment condition, class sizes, population, teachers, curriculum and routine.**The instruments used for the study are treatment instruments which are** Computer drill, practice **and test Instrument which is the Basic Science Achievement Test (BSAT).** Basic Science Achievement Test (BSAT) consist of 40 multiple-choice questions develop by the researchers and drawn from the concept taught. The BSAT was made up of five optional answers A-E with only one correct answer. The students are expected to tick the correct answer that matches the question. The BSAT was administered to the experimental groups and control group as pre-test, post - test and post delayed test. To reduce the retest effect, the BSAT was rearranged and re-ordered and administered in different random order so that the students will not easily recognize the instrument in the retention test as something they have seen before in the pretest and post - test. 1 mark each was awarded for each right answer in the multiple choice items and 0 for wrong answer as scoring in the multiple choice items**. Computer drill and practice instructional package was validated** by two experts in Educational Technology in FCT College of Education Zuba and one Senior Lecturer from the Department of Educational Technologist) Federal University of Technology (FUT), Minna. Suggestions were considered and corrections were effected to ensure that the teaching instruments measured what it was designed for taking into cognizance, the content to be taught. The instructional delivery medium was also shown to Educational Technologist to confirm its availability and suitability as well as determine the effectiveness of the package making sure it is visible, clear and simple for student during instruction. **40 questions of JSS II BSAT** were given for validation. Two Basic Science teachers in FCT Junior secondary school and one senior lecturer in the Department of Science Education Federal University of Technology (FUT) Minna validated the BSAT to check if these instruments cover the content to be focused mentioned earlier and also check if the language of the test is simple enough for their level and understanding. The observations made by the validators were taken and confusing items were removed. None of the questions were dropped.**The reliability of the BSAT was tested using a random of 30 students from Model Junior secondary school Maitaima who were part of the population but not part of the study sample for a trial study. Test retest method was used to analyze the data. Pearson Product Moment Correlation Coefficient test was used to obtain the reliability coefficient of BSAT. The reliability index was 0.72 showing that the instrument was ok for the study.** The data gathered from the study was analyzed using Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA). Independence t-test statistics was used to analyze the data using statistical package for social Sciences (SPSS) version 20.0 and the significance of the statistical analysis was ascertained at 0.05 alpha level of significance. Where there was differences, Schefes post hoc was used to determine where the differences lies.

RESULTS AND DISCUSSION

The table below presents the results of the analysis of data obtained

Research Question One:

Is there any significant difference in the mean retention scores of Junior Secondary School students taught Basic Science and Technology using Computer Drill, Practice (CDP), Demonstration Strategy (DS) and those taught using the Conventional Lecture Method.

Table 1: Mean and Standard Deviation of Posttest and Retention Score of Experimental I, II and Control Groups

Group	N	Post-test		Post-Posttest		Mean Difference
		Mean (□)	SD	Mean (□)	SD	
Experimental I	82	74.41	7.49	65.79	9.92	8.62
Experimental II	76	85.14	6.62	76.66	8.41	8.48
Control III	62	70.05	5.68	58.65	8.56	11.40

Table 1 shows the mean and standard deviation of post-test, retention scores and mean gain for all the three groups as observed in the achievement scores of the students The control group had the higher mean gain score of 11.40, followed by experimental group I with mean gain scores of 8.62 while the experimental group II had a mean gain score of 8.48.

Hypothesis One (HO_1)
There is no significant difference in the mean retention scores of Junior Secondary School students taught Basic Science and Technology using Computer Drill, Practice (CDP), Demonstration Strategy (DS) and those taught with the Conventional Lecture Method.

Table 2: Summary of ANCOVA Analysis of the Mean Retention Scores of Experimental Groups I, II and Control Groups.

Treatment	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	14748.477[a]	3	4916.159	73.374	.000
Intercept	35277.211	1	35277.211	526.515	.000
Covariate (Pretest)	3274.474	1	3274.474	48.872	.000
Treatments	9907.984	2	4953.992	73.939	.000
Error	14472.301	216	67.001		
Total	1032541.000	220			
Corrected Total	18371.382	219			

*: Significant at 0.05 level
Table 2 shows the ANCOVA results of mean retention scores of Experimental group I, Experimental group II, and Control groups with F (2,216) =73.939 and P-value = 0.05. Since, P < 0.05, hypothesis one was rejected. Therefore, there is a significant difference between the mean retention scores of junior secondary school students taught with computer drill and practice, demonstration strategy and control groups. To find out where difference lies, Scheffes post-hoc summary test was carried out.

Table 3: Schefes Post hoc Test on Mean Scores of Students' Retention Using Demonstration Strategy, Computer Drill, Practice and Lecture Method

	Demonstration	Computer Drill/Practice	Lecture
Demonstration Strategy	_	-10.87*	7.15*
Computer Drill and Practice	-10.87*	-	18.01*
Lecture	7.15*	-18.01*	_

***Significant at P< 0 0**
Table 3 shows that demonstration compared with computer drill and practice is significant. Also demonstration with lecture method is significant in favour of computer drill and practice.

Research Question 2
Is there any significant difference in the mean retention scores of male and female junior secondary school students taught Basic Science and Technology using Computer Drill, Practice (CDP).

Table 4: Mean Gain of Retention Scores of Male and Female Junior Secondary School Students Taught Basic Science and Technology using Computer Drill, Practice (CDP)

Group	N	Pretest Mean (□)	SD	Posttest Mean (□)	SD	Mean Gain Score
Male	28	37.34	11.39	63.97	9.32	26.63
Female	48	36.45	9.56	67.36	10.26	30.91

Table 4 shows the mean and standard deviation of post-test retention- test scores, and means gain scores of male and female as observed in the retention scores of the students. Female students had the higher mean gain of 30.91 as against male students with mean gain of 26.63.

Hypothesis two (HO_2)
There is no significant difference in the mean retention scores of male and female junior secondary school students taught Basic Science and Technology using Computer Drill, Practice (CDP).

Table 5: t-test Comparison of Post-Posttest Mean Retention Scores of Male and Female Junior Secondary School Students Taught Basic Science and Technology using Computer Drill, Practice (CDP)

Group	Variable	N	Df	x̄	SD	t-value	P-value
	Male	28		63.97	9.32		
Post-Test			80			0.34^{NS}	0.12
	Female	48		67.36	10.26		

NS: Not Significant at 0.05 level

Table 5 reveals the t-test Comparison of retention mean scores of male and female junior secondary school students taught basic science using Computer Drill, Practice (CDP). t = 0.34,df =80 and P>value was 0.12. Since p>0.05), hence hypothesis two is retained. Therefore, there is no significant difference between the mean retention scores of male and female junior secondary school students taught Basic Science and Technology using Computer Drill and Practice (CDP).

Research Question 3

Is there any significant difference in the mean retention scores of male and female junior secondary school students taught basic science using Demonstration Strategy (DS).

Table 6: Mean Gain of Mean Retention Scores of Male and Female Junior Secondary School Students Taught Basic Science Using Demonstration Strategy (DS)

Group	N	Pretest Mean (x̄)	SD	Posttest Mean (x̄)	SD	Mean Gain Score
Male	38	43.14	10.59	76.86	8.67	33.72
Female	44	42.54	10.49	76.54	8.34	34.00

Table 6 shows the mean and standard deviation of post-test, retention –test scores, and mean gain scores of male and female as observed in the retention scores of the students. Female students had a higher mean gain of 34.00 as against male students with mean gain of 33.72.

Hypothesis Three (HO_3)

There is no significant difference between the mean retention scores of male and female junior secondary school students taught basic science using Demonstration Strategy (DS).

Table 7: t-test Comparison of the Post-Posttest Scores of Male and Female Junior Secondary School Students Taught Basic Science and Technology using Demonstration Strategy (DS)

Group	Variable	N	Df	x̄	SD	t-value	P-value
	Male	38		76.86	8.67		
Post-Test			74			0.74^{NS}	0.88
	Female	44		76.54	8.34		

NS: Not Significant at 0.05 level

Table 7 shows the t-test Comparison of mean retention scores of male and female junior secondary school students taught Basic Science and Technology using Demonstration Strategy (DS). t = 0.74 ,df 74, p-value = 0.88. Since p>0.05, hence hypothesis three is retained. Therefore, there is no significant difference between the mean retention scores of male and female junior secondary school students taught basic science using demonstration strategy (DS).

Summary of Major Findings

1. The results show that there is a significant difference between the mean retention scores of junior secondary school students taught Basic Science and Technology with computer drill and practice, demonstration strategy and control groups.
2. The result indicated that there is no significant difference between the mean retention scores of male and female junior secondary school students taught Basic Science and Technology using Computer Drill and Practice (CDP).
3. The result show that there is no significant difference between the mean retention scores of

male and female junior secondary school students taught Basic Science and Technology using Demonstration Strategy (DS).

Discussion of Result

The result of the findings of this study on the mean retention scores of students taught Basic Science and Technology using computer drill and practice, demonstration strategy and conventional lecture method reveals that there is no significant difference in the mean retention scores of student taught Basic Science and Technology with the three teaching strategy. Thus the null hypothesis one which states there is no significant difference between the mean retention scores of students taught Basic Science and Technology with CDP, DS and CLM is rejected.

The study is in corroboration with the study of Umeh (2015) on effects of Computer assisted instruction on individualized and co- operative learning of social studies in junior secondary school Niger state. The study revealed that when pupils are exposed to computer assisted instruction in teaching and learning information is better retained. The study is also in agreement with the study of Gambari (2015), on physic instructional packages and co-operative learning who revealed that the use of computer instructional packages for instruction improves retention of student of different ability levels.

The t-test result on the retention mean achievement Scores of male and female Junior Secondary School Students Taught Basic Science and Technology using Computer Drill, Practice (CDP) indicated that there was no significant difference between the mean retention scores of male and female students. Thus, hypothesis 2 which states that there is no significant difference between the mean retention scores of male and female students taught Basic Science and Technology using CDP is retained. This finding is in agreement with the findings by Oludipe (2014) who examined the influence of gender on junior secondary school student's retention in Basic Science and Technology when co-operative teaching strategy was used. The result of the study showed that there was no significant difference in the academic achievement of male and female student at the pre-test, post - test and retention test. The study concluded that more women should be encouraged to study pure science and science oriented courses by making science related occupations more exciting for girls.

The t-test result on the mean retention Scores of male and female Junior Secondary School Students Taught Basic Science and Technology using Demonstration Strategy (DS) reported that there was no significant difference between the mean retention scores of male and female students Thus, hypothesis 3 which states that there is no significant difference between the mean retention scores of male and female junior secondary school students taught Basic Science and Technology using Demonstration Strategy (DS) was retained. The result of the findings is in agreement with the study by Daluba (2015) who observed that there was no significant difference between the mean retention scores of male and female students taught with computer aided learning package. The study however, does not agree with the study by Uhumuavbi and Mmamudu (2009) who investigated on relative effects of programmed instruction and demonstration method on student academic performance in science. The result showed a significance difference in the academic achievement of the two groups of students. Students expose to program instruction achieve better than those expose to demonstration method.

From the discussion above, it can be concluded that demonstration Strategy and Computer drill, practice increases student interest and understanding and also promotes high retention rate. The results of the hypothesis revealed that the mean retention scores of the different groups of students taught with the different teaching strategies DS,CDP,and CLM differed significantly. The test score recorded by students depended on the various teaching strategy employed by the Basic Science and Technology teacher.

Conclusion

The use of Computer drill, practice and demonstration strategy in Basic Science and Technology has convincing evidence to enhance junior secondary school students' retention compared to using conventional lecture method. Based on these findings, the use of computer drill, practice and Demonstration strategy should be employ in teaching other science related courses like chemistry, biology, agricultural science among others.

The utilization of computer drill and practice mode also enables students to learn at their own pace without the teacher involving much. It can also complement basic science teaching as well as serve as substitute for conventional classroom instruction where schools don't have enough Basic Science teachers and are well equipped with ICT gadgets.

Recommendations

The following recommendations are made from the findings of these studies

1. Computer drill and practice mode and demonstration strategy should be adopted in teaching Basic Science as a supplement to other traditional instructional strategy.

2. Government should enlightened teachers through workshop/seminars on the availability of different computer based- instructional (CBI) strategies that can yield better results in teaching and learning of Basic Science.

3. Government should provide Constant power supply in schools for effective utilization of computer drill and practice as a medium of instruction in school.

4. Computer programmer and developers should develop significant computer instructional Packages in Basic Science and other related subject.

REFERENCES

Adalikwu, M. T. (2020). *Effect of computer, drill, practice and demonstration strategies on junior secondary school students basic science achievement in Abuja Nigeria*. (Unpublished Master's Thesis, Federal University of Technology Minna).

Adalikwu, M. T. (2023). *Effect of VoiceThread modes on learning outcomes in computer Science among Colleges of Education students in North- central Nigeria* (Unpublished PhD Thesis, Federal University of Technology Minna).

Adeboye, O. J. (2015*)*. Facts about the field of educational technology. *Mokola- Ibadan. His Lineage.*

Badmus, A. M. (2018). Effect of practical demonstration method (PDM) and computer tutorial mode (CTM) on student's achievement and attitudes in some selected skills in technical education.unpublished Master thesis, university of Ibadan, Nigeria.

Ajai, J. T., & Imoko, I. I. (2015). Gender differences in mathematics achievement and retention scores: a case of problem-based learning method. *International Journal of Research in Education and Science (IJRES),* 1 (1), 45 – 50.

Daluba, N.E, (2015). Effects of Demonstration Method of teaching on students achievement in Agricultural Science*: journal of education 3 (6)*

Doris, B. & Mohammed, J.A.(2019). efects of demonstration methods and Discussion on senior secondary school students academic achievement and retention in Biology in Mubi Educational Zone Adamawa state: International *Journal of Research and scientific innovation 6(12),45-58*

Giridharan, K., & Ramasamy, Y.M (2016) Impact of Teaching Strategy-, Demonstration and Lecture Teaching Strategies and impact of Teacher on Senior Secondary School Achievement in Engineering Education: International *Journal of educational Sciences 14 (3) 174- 186*

Federal Republic of Nigeria (2014). National policy on education lagos, NERDC PRESS

Gambari, A. I. (2015). Effects of computer supported co-operative learning strategy on Gambari, A. I. (2010) Effects of computer supported co-operative learning strategy on performance of senior secondary students in physics in Minna Nigeria Unpublished PH.D Thesis, University of Ilorin

Giridharan, K., & Ramasamy, Y.M (2016) Impact of Teaching Strategy-, Demonstration and Lecture Teaching Strategies and impact of Teacher on Senior Secondary School Achievement in Engineering Education: International *Journal of educational Sciences 14 (3) 174- 186*

Igweh, A. (2015). Combined effects of computer tutorial and drill on senior secondary school students achievement, interest and retention in Basic Electronics in Lagos State. Unpublished PhD Thesis University of Nigeria Nsukka.

Isijola, O.M (2015). Effects of Computer Assisted Instructional package on student's performance in basic science in Ondo west Local Government Area of Ondo State, An Unpublished PhD Thesis Adekunle Ajasin University Akungba Akoko.

Jerusha, P. D., & Mangut, M. (2022). Effects of Demonstration Strategy on senior secondary school students Achievement and retention in chemistry in Taraba State Nigeria: Bushwealth Academic Journal 1 (3), 69-74.

Kabir, H. (2019). Effect of Demonstration and Collaborative Teaching Methods on Senior Secondary School Achievement in Biology *Journal of educational research and Technology (1) 19-29*

Laleye, A.M., & Ogunboyede, C.O (2023). Effects of drill Practice instructional package on Junior

secondary school performace in Mathematics in ondo states, Nigeria *European journal of Education and pedagogy 4 (1),26-30*

National Policy on Education, (2014). Lagos, NERDC PRESS Federal Republic of Nigeria.

NERDC, (2015). Teacher Handbook for 9 year Basic Education Curriculum PRESS Federal Republic of Nigeria.

Odugbumi, (2015). Basic Science and Technology curriculum. Universal Education Act.

Oludipe, D. (2014). Gender Difference in Nigeria junior secondary school students

academic Achievement in Basic Science: Journal of educational and social Research 2(1), 1 - 6.

Onyeka, E.C (2023). Effectiveness of demonstration Teaching methods on students academic achievement in Mathematics in rivers State: Nigerian African journal of Education management, teaching and Entrepreneurship studies 8 (2) 1-6

Rebecca U. E. (2021). Comparative tutorial and drill practice strategies on senior secondary school students academic Achievement on energy transformation in Nature, Uyo Nigeria: International journal for innovative Education and Research, 9 (7), 3230

Satilehin, J.A., Olubumi, M.O., & Okoye, K.R.E (2024). Comparative Effects of CAI on Achievement, retention in Radio Televisionand electronic Works in Technical Colleges: International *journal of Advanced in Engineering and Management 6 (7) 95-102.*

Silwood,(2000) Effects of traditional –demonstration Method and computer self pace modular learning situation on student achievement. Burliton high school.

Silwood,(2020) Effects of traditional –demonstration Method and computer self pace modular learning situation on student achievement. Burliton high school.

Skinner, (1963). cited in Nicholas, Aubrey & Richard, (2014) Using computer Based- Programmed Instruction to train Goal- Directed System. *Journal of science and technology 4 (3)*

Titus, I., Sylvester, C.O., & Friday, I.N (2020). Effectiveness of Computer Tutorial Model, Drill and practice on students' Academic Achievement and Retention in Fabrication and welding Technology in Technical Colleges : J*ournal of Education Studies 7(10) 60-64.*

Umeh, A. (2015). Effects of computer Assisted instruction on Individual and co-operative learning of social studies in junior secondary school Niger state Nigeria .Thesis submitted for the award of Ph.D Federal University of Technology Minna.humuavbi, P.O., & Mammudu, J.A.(2019). *College students Journal Publisher: Project Innovation (Alabama)* performance of senior secondary students in physics in Minna Nigeria Unpublished PH.D Thesis, University of Ilorin

Enhancement of Adaptive Pedagogies in Academic Institutions through Librarians' Proficiency in Evaluation of Open Educational Resources (OER) in South-East Nigeria

By

Dr., Lucy Ndidiamaka OKONKWO (CLN)
lnebeolise@noun.edu.ng +2348033613301
National Open University of Nigeria
University Village, Plot 91,
Cadastral zone, Nnamdi
Azikiwe Express Way, Jabi, Abuja

Abstract

The integration of Open Educational Resources (OER) into academic curricula has become a pivotal strategy for promoting inclusive, flexible, and cost-effective learning in higher education. In South-East Nigeria, where educational institutions are increasingly adopting digital and open learning models, the role of librarians in evaluating and curating quality OER is more critical than ever. This study investigates Librarians' Proficiency in Evaluating Open Educational Resources (OER) to Enhance Adaptive Pedagogies in Academic Institutions of South-East Nigeria. Three research questions guided the study. Populations for the study consist of 201 librarians from eleven (11) universities in the South - East. Sample sizes of 109 librarians were using Multistage sampling technique. The study employed quantitative approach and structured questionnaire to analyse data collected. The findings reveal a moderate level of awareness and utilization of OER among librarians, with notable gaps in evaluation skills, especially in areas such as licensing, accessibility, pedagogical alignment, and digital quality assessment. Furthermore, institutional barriers such as inadequate training, lack of policy frameworks, and limited technological resources were identified as key challenges. The study recommends a strategic capacity-building model focused on continuous professional development, inter-institutional collaboration, and policy-driven support systems to enhance librarians' roles in OER evaluation. By equipping librarians with the necessary competencies, academic institutions in the region can more effectively implement adaptive pedagogies, thereby improving learner engagement, personalization of learning experiences, and academic success. This research contributes to the discourse on the evolving roles of librarians in digital education and provides a roadmap for leveraging OER in transforming teaching and learning in Nigerian higher education.

Introduction

In the evolving landscape of education, the integration of Open Educational Resources (OER) has emerged as a transformative approach to improving access, equity, and quality in teaching and learning (UNESCO, 2019). Open Educational Resources—freely accessible, openly licensed materials that can be used for teaching, learning, research, and other purposes—are increasingly reshaping instructional practices globally (Wiley & Hilton, 2018). Their growing adoption in higher education institutions aligns with the push toward inclusive and adaptive pedagogies that cater to diverse learners' needs (Lee, Lin, & Bonk, 2022). Adaptive pedagogy refers to instructional approaches that respond to the varied learning styles, preferences, and backgrounds of students, thus promoting personalized learning experiences. In this context, librarians play a pivotal role as knowledge curators, digital resource managers, and instructional support agents. Their proficiency in evaluating, organizing, and promoting the use of OER is critical for ensuring that educators and students can effectively utilize these resources to support adaptive learning (Cox, Masuku, & Willmers, 2020).

South-East Nigeria, comprising several prominent academic institutions, has witnessed a gradual embrace of digital education strategies. However, the successful integration of OER in these institutions is highly dependent on the competencies of information professionals, particularly librarians. Librarians are no longer confined to traditional roles of book lending and cataloguing; they are now central to the digital transformation of education. Their ability to evaluate the quality, relevance, licensing, and pedagogical value of OER determines the extent to which such resources can enhance teaching and learning (UNESCO, 2019). As facilitators of information literacy and digital scholarship, librarians must possess a high level of proficiency in assessing OER for academic use. This includes understanding copyright and open licensing (such as Creative Commons), ensuring content alignment with curricular goals, and recommending appropriate resources that support differentiated and adaptive instruction.

Despite the increasing relevance of OER, limited empirical studies have been conducted to examine the preparedness and proficiency of librarians in South-East Nigeria in evaluating these resources. Issues such as inadequate training, infrastructural challenges, limited awareness of OER evaluation frameworks, and institutional policy gaps hinder effective librarian engagement with open resources. These challenges raise critical questions about the capacity of academic librarians to contribute meaningfully to adaptive pedagogies through informed evaluation and dissemination of OER **(Obi, B. O., & Okiki, O. C., 2018).**
This study seeks to investigate theenhancement of adaptive pedagogies in academic institutions through librarians' proficiency in evaluation of open educational resources (OER) in south-east Nigeria. It also aims to explore how their competencies impact the adoption and application of adaptive pedagogical practices. By identifying skill gaps and institutional constraints, the study will offer strategic recommendations for enhancing librarian training, policy development, and resource support. Ultimately, it underscores the strategic importance of equipping librarians with the necessary tools and knowledge to champion the integration of OER in academic environments—thereby advancing student-centered learning and academic excellence in the digital age.

Statement of the Problem
The global shift towards open access knowledge and inclusive education has led to a growing reliance on Open Educational Resources (OER) as cost-effective and flexible tools for enhancing teaching and learning (Okonkwo, 2022). In academic institutions, particularly in developing regions like South-East Nigeria, OER hold significant potential to transform pedagogical practices by enabling adaptive, learner-centered approaches. However, the effective integration of OER into academic curricula largely depends on the ability of librarians—traditionally gatekeepers of information to identify, evaluate, and curate high-quality resources that align with institutional goals and learners' diverse needs. Despite the increasing availability of OER, many academic institutions in South-East Nigeria continue to face challenges in their utilization. Preliminary observations and anecdotal reports suggest a gap in librarians' proficiency when it comes to evaluating OER based on pedagogical relevance, quality standards, copyright licensing, cultural adaptability, and technological integration. This shortfall may stem from a lack of structured training, institutional support, and strategic involvement of librarians in instructional design processes. Consequently, the opportunities to use OER to foster adaptive pedagogies—those that personalize learning pathways, accommodate varied learning styles, and integrate dynamic content delivery, is significantly undermined. Moreover, there appears to be limited empirical research assessing the current level of librarians' competencies in OER evaluation within the specific socio-educational context of South-East Nigeria. This creates a knowledge gap regarding the readiness and effectiveness of librarians as enablers of innovative teaching practices through OER. Without a clear understanding of their proficiency levels, training needs, and institutional challenges, efforts to promote adaptive pedagogies through OER may remain superficial and unsustainable. This study, therefore, seeks to critically investigate the extent to which librarians in academic institutions of South-East Nigeria are proficient in evaluating OER and how their competencies influence the implementation of adaptive pedagogies. The findings will inform policy, capacity-building initiatives, and collaborative strategies aimed at maximizing the educational potential of OER in transforming teaching and learning in the region.

Research Questions:
The following research questions have been formulated to guide the study:-

1. What is the current level of Librarians' proficiency in evaluation of Open Educational Resources for enhancement of adaptive pedagogical practices in South-East Nigeria?
2. What roles do librarians played in supporting the integration of OER into adaptive pedagogical practices in South- East Nigeria?
3. What challenges do librarians face in evaluating and promoting the use of OER for adaptive learning in South-East Nigeria?

Literature Review
Conceptualizing Open Educational Resources (OER)
Open Educational Resources (OER) refers to teaching, learning, and research materials in any medium that reside in the public domain or have been released under an open license, permitting no-cost access, use, adaptation, and redistribution (UNESCO, 2019). OER includes textbooks, curricula, syllabi, lecture notes, assignments, tests, projects, audio, video, and animation. The global push for educational access, equity, and quality has heightened the relevance of OER in both formal and informal learning environments (Hilton, 2016). The African Virtual University and OER Africa have contributed significantly to the development of OER in Africa, although uptake remains uneven across regions (Mays, 2017).

Librarians' ability to evaluate OER is essential for ensuring that educational resources meet quality standards, are contextually relevant, and align with institutional goals. Proficiency in evaluating OER encompasses skills in metadata creation, copyright literacy, digital literacy, instructional design, and subject matter evaluation (Okike& Adebayo, 2022). Studies suggest that while many librarians in developed countries possess moderate to high proficiency in these areas, gaps remain in developing contexts due to inadequate training and infrastructural limitations (Nkiko& Yusuf, 2021).
In the Nigerian context, Onyancha (2020) highlights that many academic librarians lack the technical skills required to assess the pedagogical and technological aspects of OER. Furthermore, proficiency often correlates with access to professional development opportunities and institutional support (Eya & Anunobi, 2021). In addition, the study conducted by Ezema and Ugwu (2019) in South-East Nigeria revealed that librarians might have exhibited a moderate level of awareness and proficiency in evaluating Open Educational Resources (OER). This limited proficiency potentially might have impedes their effective participation in critical stages of the OER lifecycle, including peer review, quality assurance, and adaptability assessments.

Roles of Librarians in Supporting OER Integration into Adaptive Pedagogies
Librarians play a pivotal role in curating, evaluating, and promoting the use of OER. Their traditional roles in information organization, metadata creation, and content dissemination have evolved to include digital curation and advocacy for open access (Okonkwo&Onyenania, 2020). As information professionals, librarians are strategically positioned to guide faculty and students in discovering, assessing, and integrating quality OER into pedagogy (Corrall, 2015). In Nigeria, particularly in academic libraries, librarians are gradually embracing these emerging responsibilities, though significant gaps in training and institutional support persist (Ezeani& Eke, 2011).
Librarians play multifaceted roles in the integration of OER into teaching and learning. As information professionals, they curate, organize, and promote access to high-quality OER. They also serve as instructional partners, collaborating with faculty to design learning experiences that leverage OER to support adaptive pedagogies (Pomerantz& Peek, 2016).
Adaptive pedagogy refers to instructional methods that are responsive to the needs, abilities, and learning styles of individual students. OER provides the flexibility required for such personalized learning approaches. Librarians contribute to this process by guiding educators in selecting OER that are pedagogically sound and adaptable (Atenas, Havemann, &Priego, 2015). In Nigeria, Anunobi and Ukwoma (2019) observe that librarians are beginning to take on more proactive roles in instructional design and digital literacy initiatives aimed at supporting OER usage.
Moreover, librarians in South-East Nigeria academic institutions have been involved in OER awareness campaigns, faculty workshops, and resource development projects. Their involvement is instrumental in promoting the sustainability and scalability of OER integration (Okonkwo &Afolabi, 2022). However, the extent of their involvement varies significantly across institutions, often depending on administrative support and availability of professional development.

Evaluation of Open Evaluation Resources
Effective evaluation of OER requires librarians to apply a combination of information literacy, digital literacy, and pedagogical skills. Evaluation criteria typically include accuracy, relevance, accessibility, licensing, pedagogical effectiveness, and technical quality (Clements &Pawlowski, 2012). Mastery of Creative Commons licensing and knowledge of platforms such as OER Commons, MERLOT, and OpenStax are essential. However, studies reveal that many librarians, particularly in developing countries, lack structured training in these areas (Atenas&Havemann, 2014). In Nigeria, Abubakar and Idris (2021) identified a gap in librarians' ability to evaluate and recommend OER due to limited professional development opportunities and infrastructural constraints. Moreover, librarians often struggle with assessing the instructional design quality of resources, which is critical for their pedagogical adaptation.

Adaptive Pedagogies and the Use of OER
Adaptive pedagogy is an instructional approach that uses learner-centered, flexible strategies tailored to individual needs, learning styles, and feedback. OER are inherently adaptable and allow instructors to modify materials to suit diverse learner profiles and contexts (Wiley & Hilton, 2018). When properly evaluated and integrated, OER support differentiated instruction, promote inclusivity, and align with constructivist learning theories (Butcher & Moore, 2015).
Librarians who are proficient in evaluating and repurposing OER can contribute significantly to adaptive teaching strategies by collaborating with faculty in instructional design, curriculum development, and the integration of multimedia content (Trotter, 2020). In the South-East Nigerian context, this potential remains

largely underutilized due to inadequate synergy between librarians and academic staff (Nwosu&Udo-Anyanwu, 2023).

Challenges Librarians Encounter in Evaluating and Utilizing OER

Despite their potential roles, librarians in academic institutions face several challenges that limit their effectiveness in evaluating and utilizing OER. Key among these are limited access to capacity-building programs, lack of institutional policies on OER, inadequate technological infrastructure, and resistance from faculty (Eya&Anunobi, 2021). A study by Oladokun and Aina (2020) found that many Nigerian librarians are unaware of existing frameworks and tools for OER evaluation, such as the Achieve OER Rubrics or the Kirkpatrick Evaluation Model. This knowledge gap results in inconsistent evaluation practices and undermines the credibility of OER adopted for instructional use.

Furthermore, librarians often encounter difficulties related to copyright and licensing issues, which can be complex in the context of open access resources (Mtebe&Raisamo, 2014). Without adequate legal and policy guidance, librarians may struggle to advise faculty and students effectively.

Infrastructural limitations, including unreliable internet connectivity and lack of access to digital repositories, also pose significant barriers (Ezema, 2020). These challenges are more pronounced in public institutions in South-East Nigeria, where funding for libraries remains inadequate. Several studies point to structural, institutional, and capacity-related barriers hindering the effective evaluation and use of OER in the South-East region. These include:

a. Low digital literacy levels among librarians and educators (Echezona&Uzoigwe, 2020).
b. Lack of institutional policies promoting OER adoption and collaboration.
c. Infrastructural challenges, such as inconsistent internet access and inadequate ICT tools (Aguolu&Aguolu, 2002).
d. Limited awareness and advocacy, which impede both the demand and supply sides of OER usage.
e. Despite these challenges, academic libraries in universities like NnamdiAzikiwe University and the University of Nigeria, Nsukka have shown promising initiatives, including training workshops and digital repository development (Okonkwo&Ogbuiyi, 2022).

Strategic Approaches to Capacity Building

a. Scholars suggest targeted capacity-building programs to enhance librarians' OER proficiency. These include:
b. Integration of OER modules in library and information science curricula (Nkiko& Yusuf, 2019).
c. Continuous professional development through workshops, webinars, and online certifications.
d. Institutional collaboration between libraries and teaching faculties.
e. Policy frameworks that incentivize OER engagement and creation (Omoike&Adeleke, 2021).

Methodology

The study employed a quantitative method and a descriptive survey design to investigate librarians' proficiency, roles, and challenges in evaluating and promoting Open Educational Resources (OER) within academic institutions in South-East Nigeria. The target population comprised 201professional librarians working in university libraries across South-East Nigeria. A Multistage sampling technique was adopted to draw a sample size of **109 respondents**–with prior knowledge of engagement with OER and related services. Data were collected using a **structured questionnaire** consisting of three sections aligned with the three research questions as stated above. The first step included sending the online survey to a total of 109 librarians, and 109 librarians responded to the online questionnaire, giving a response rate of 99.1%. It was validated using Face and content validity testing conducted by experts in measurement, evaluation and Library and Information Science, ensured the questionnaire's appropriateness for the study and piloted among 10 librarians (excluded from the main study). The instrument's reliability was confirmed yielding a Cronbach's Alpha of 0.84. The questionnaire was administered both physically and electronically over four weeks. Ethical approval was obtained, and participation was voluntary. Data were analyzed using **descriptive statistics**: frequencies, percentages, and cross-tabulations using SPSS (Version 25). Tables were used to present the findings per research question.

Data Analysis

1. Research Question1: What is the current level of Librarians' proficiency in evaluation of Open Educational Resources for enhancement of adaptive pedagogical practices in South-East Nigeria?

Table 1:Current Level of Proficiency in Evaluating OER

Proficiency Area	Highly Proficient	Moderately Proficient	Low Proficiency	Not Proficient	Total (n=109)
Identifying high-quality OER	20 (21.08%)	50 (54.5%)	30 (32.07%)	10 (10.9%)	109
Assessing the authority, accuracy, credibility of OER authors	18 (19.62%)	52 (56.68%)	28 (30.52%)	12 (13.08%)	109
Understanding licensing (e.g., Creative Commons)	15 (16.35%)	40 (43.6%)	35 (38.15%)	20 (21.08%)	109
Technical evaluation of OER platforms	10 (10.9%)	30 (32.7%)	40 (43.06%)	30 (32.07%)	109
Integration of OER in library services	22 (23.98%)	48 (52.32%)	25 (27.25%)	15 (16.35%)	109

Table1 assesses five key areas of proficiency among 109 librarians. In **the proficiency of Identifying High-Quality OER**, **75.58%** (High + Moderate) can identify good OER, indicating a decent awareness of what quality looks like in open resources while **42.97%** are not confident in doing this—this suggests a training need for critical evaluation skills. In the proficiency of **Assessing the Credibility of OER Authors,** there was combined **76.03%** reported being highly or moderately proficient, which aligns with traditional librarian skills in vetting sources while Still, over one-third (43.06%) struggle here, especially given that anyone can publish OER. In the proficiency of **Understanding Licensing (e.g., Creative Commons),** a significant gap: **50%** have low or no proficiency, indicating **serious limitations** in understanding intellectual property and usage rights and this could expose institutions to misuse of resources or copyright violations. In the proficiency of **Technical Evaluation of OER Platforms,** this is the **weakest area**, with **76.3%** showing low or no proficiency and this reflects limited ICT skills or training in digital platform navigation, which affects their ability to guide users effectively. In the proficiency of **Integration of OER in Library Services**, about **76.30%** can somewhat integrate OER into services, a promising sign while **43.60%** still lack this ability, potentially due to institutional barriers or skill deficits.

Research Question 2: What roles do librarians played in supporting the integration of OER into adaptive pedagogical practices?

Table2: Roles in Supporting OER Integration into Adaptive Pedagogies

Roles Played by Librarians	Yes	No	Total (n=109)
Assisting faculty in sourcing subject-specific OER	70 (76.03%)	40 (43.03%)	109
Organizing OER training workshops for staff/students	40 (43.03%)	70 (76.03%)	109
Embedding OER in institutional repositories or LMS	45 (49.05%)	65(70.85%)	109
Advocating OER adoption through institutional policy development	38 (41.42%)	72 (78.48%)	109
Customizing OER to suit students' learning needs	30 (32.07%)	80 (87.2%)	109

Table 2 identifies how librarians are involved in adaptive OER-based educational support. In the following roles played by librarians, in the role of **assisting Faculty in Sourcing OER,** there was **76.03%** affirming this role, it's clear that librarians are recognized partners in content discovery and this is a core strength they can build on to further contribute to pedagogy. In the role of **Organizing Training Workshops,** Only **43.03%** participate in training efforts—this is low and this suggests either lack of initiative or institutional

support, and reveals a gap in librarians' outreach to faculty/students. Looking at the role of **Embedding OER in Institutional Systems (LMS, Repositories)**, only **49.05%** are involved, highlighting a limited role in system-level integration and this may reflect IT or policy constraints or a lack of collaboration between librarians and ICT units. In the role of **Advocacy in Policy Development,** only **41.42%** reported participating in policy advocacy and this indicates that librarians are not yet seen as strategic stakeholders in shaping OER policy as a major missed opportunity. In this lowest role of **Customizing OER for Adaptive Learning,** only **32.07%** are actively customizing OER to meet learner needs and this is critical because **adaptive learning** requires tailoring content—a skill area librarians need to embrace more actively.

Research Question 3: What challenges do librarians face in evaluating and promoting the use of OER for adaptive learning?

Table3: **Challenges Faced in Evaluating and Promoting OER**

Challenges	Strongly Agree	Agree	Disagree	Strongly Disagree	Total (n = 109)
Limited training in OER evaluation	60 (65.04%)	30 (32.07%)	15 (16.35%)	5 (5.45%)	109
Lack of institutional support or recognition	55 (59.95%)	35 (38.15%)	15 (16.35%)	5 (5.45%)	109
Inadequate internet access and digital infrastructure	40 (43.6%)	40 (43.06%)	20 (21.08%)	10 (10.09%)	109
Poor awareness of Creative Commons licensing	45 (49.05%)	42 (45.78%)	15 (16.35%)	8 (8.72%)	109
Resistance from faculty to adopt OER	50 (54.05%)	38 (41.42%)	15 (16.35%)	7 (7.63%)	109

Table 3 reveals what obstacles librarians are facing in the following challenges. In the first challenge, Limited **Training in OER Evaluation, there was** a combined **98.1%** (Strongly Agree + Agree) say they haven't been adequately trained and this stands as a major bottleneck that affects their confidence and effectiveness. In the challenge of **Lack of Institutional Support,** 98.10**%**of librarians reported that their institutions don't prioritize or reward their efforts in OER work and this suggests systemic issues which indicated that librarians are **not empowered or recognized** as key OER stakeholders. In **Inadequate Digital Infrastructure**, around **86.66%**librarians acknowledge that poor internet access or digital tools hinder their work and this reinforces the digital divide and infrastructural disparities in Nigerian institutions. In the hindrance of **Poor Awareness of Licensing,** a total of **94.83%** agree that licensing knowledge is low and this reflects earlier proficiency results and indicates that **legal literacy** should be a training priority. Finally, **Faculty Resistance to OER as the last challenge on this table, indicated that**95.47**%** of librarians acknowledged faculty resistance, this point to a **cultural or attitudinal barrier** and this might prompt Librarians to find it hard to promote OER without buy-in from lecturers or academic leadership.

Discussion of Findings

The findings presented in Tables 1 to 3 provide critical insight into the current state of librarians' proficiency, their roles, and the challenges librarians' face in evaluating and promoting Open Educational Resources (OER) for adaptive learning in academic institutions across South-East of Nigeria. The findings reveal important insights into the preparedness and involvement of librarians in supporting emerging educational technologies, particularly OER.

Table 1: Current Level of Proficiency in Evaluating OER

The analysis revealed that while a majority of librarians (over 70%) reported moderate proficiency in identifying quality OER and evaluating authorship credibility, a significant number (over 35%) demonstrated low or no proficiency in essential areas such as licensing awareness and technical evaluation. Particularly concerning is the finding that 59% lacked sufficient understanding of Creative Commons licensing, and 75% were weak in assessing the technical suitability of OER platforms. These gaps suggest that while foundational information literacy skills exist, librarians have not been adequately equipped to handle the unique and evolving demands of OER evaluation—particularly in legal and digital contexts.

This limitation could hinder the quality assurance process in institutions adopting OER and poses risks related to copyright infringement and the use of unreliable resources. Therefore, structured training programs on OER licensing, metadata, and digital platform usage are urgently needed.

Table 2: Roles in Supporting OER Integration into Adaptive Pedagogies

The study found that librarians are involved in supporting faculty in sourcing OER (76.03%), which aligns with their traditional roles in resource provision. However, their strategic involvement in pedagogical integration remains limited. Only 43.03% were involved in training users, 49.05% in system integration, only **41.42%** reported participating in policy advocacy and this indicates that librarians are not yet seen as strategic stakeholders in shaping OER policy as a major missed opportunity and a mere 32.07% in customizing OER to meet learner needs. This highlights a missed opportunity: adaptive learning thrives on the ability to align resources with individual learner profiles. Librarians, with their knowledge of user behavior and content curation, are well-positioned to lead or co-lead this process. Their limited engagement suggests structural or institutional gaps—such as lack of inclusion in academic planning teams, insufficient collaboration with ICT units, and minimal recognition of librarians as pedagogical partners. Institutions must expand the roles of librarians beyond collection management to active contributors to adaptive curriculum development, especially as Nigeria advances its digital and open learning agendas.

Challenges in Evaluating and Promoting OER

Librarians face substantial challenges that undermine their ability to champion OER integration. Over 90% cited inadequate training and lack of institutional support, highlighting a critical need for professional development and organizational change. Additionally, 87.2% pointed to weak digital infrastructure, especially poor internet access and outdated systems, which severely hampers access and evaluation of OER. Licensing knowledge was also flagged as a major gap, with above 90% acknowledging weak awareness of Creative Commons and other open licenses. This not only affects evaluation but also affects advocacy efforts and policy compliance. Finally, faculty resistance to OER adoption—noted above 90% of respondents—suggests a cultural barrier that goes beyond librarians' control. This underscores the need for interdepartmental collaboration and sensitization programs to shift academic mindsets.

Implications of the Study

These findings carry important implications. First, academic institutions must recognize librarians as integral to the digital transformation of education. Their roles should evolve from passive support staff to strategic partners in curriculum delivery and adaptive learning design. Second, continuous capacity-building programs should be institutionalized, targeting legal, technical, and pedagogical aspects of OER. Finally, institutional policies must be revised to empower librarians with the tools, recognition, and collaborative space to thrive in their expanded roles. These findings highlight a clear disconnect between librarians' perceived roles and the skills required to fulfill them effectively. While moderate levels of proficiency exist, critical areas like licensing, technical evaluation, and pedagogical customization remain weak. Additionally, institutional and infrastructural challenges compound the issue, limiting the potential for librarians to become transformative agents in adaptive learning environments.

There is an urgent need for:

- Targeted professional development on OER evaluation, licensing, and integration.
- Institutional policies that empower librarians through recognition and involvement in OER governance.
- Infrastructure improvement to support digital access.
- Increased collaboration between librarians and faculty to overcome resistance and promote a culture of openness.

Conclusion

The literature reveals that while librarians hold a strategic position in enhancing adaptive pedagogies through the evaluation and integration of OER, their proficiency levels in South-East Nigeria remain suboptimal. To fully leverage their potential, targeted training programs, institutional policy frameworks, and infrastructural investments are needed. Strengthening the roles of librarians will be key to the sustainable adoption of OER and the advancement of inclusive, adaptive educational practices. Enhancing librarians' proficiency in evaluating OER is not just a professional imperative but a strategic necessity to foster adaptive pedagogies and democratize access to knowledge. This study has demonstrated that while librarians in South-East Nigeria exhibit moderate levels of proficiency in evaluating OER, significant gaps

remain in critical areas such as licensing knowledge, platform evaluation, and pedagogical customization. Their current roles are largely supportive rather than strategic, and multiple barriers—ranging from inadequate training and institutional support to digital infrastructure challenges and faculty resistance—continue to undermine their full participation in adaptive pedagogical reforms. To fully harness the potential of OER and adaptive learning technologies, librarians must be empowered, trained, and strategically positioned as key actors in academic innovation. Only through a holistic, institution-wide commitment to capacity building, policy reform, and technological investment can librarians meaningfully contribute to global academic excellence and more inclusive, responsive education in Nigeria.

Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance librarians' proficiency, engagement, and effectiveness in evaluating and promoting Open Educational Resources (OER) for adaptive learning in South-East Nigerian academic institutions:

1. **Capacity Building and Professional Development**

Institutions should organize regular workshops, short courses, and certification programs focusing on: OER evaluation frameworks and tools, Creative Commons licensing and copyright compliance, Technical evaluation of OER platforms and Customization of OER for diverse learner needs. Most librarians are moderately proficient in identifying and evaluating OER, but there are significant gaps in technical and licensing aspects. While most librarians have a moderate base-level competence, the technical and legal aspects of OER need urgent attention. Professional development initiatives and workshops could bridge this skills gap.

2. **Awareness Campaigns and Faculty Engagement**

Librarians, in collaboration with academic leaders, should lead sensitization programs to educate faculty on the benefits and proper use of OER, address misconceptions or resistance related to OER adoption and romote a culture of sharing and openness in educational practices. While many librarians support faculty in sourcing OER, fewer are actively involved in customizing or embedding them into adaptive systems—suggesting an opportunity for professional development. This showed that librarians are still playing a supportive, rather than proactive or strategic role in adaptive pedagogies. Empowering them through formal roles in instructional design, tech platforms, and curriculum teams can elevate their contribution.

3. **Integration of Librarians into Curriculum and Instructional Design Teams**

Librarians should be formally included in course development teams, especially in open and distance learning settings. This will enable them to contribute meaningfully to:Adaptive content curation, Learning experience personalization and OER selection and instructional alignment

4. **Policy Advocacy and Strategic Inclusion**

Academic institutions should develop or revise policies to explicitly define and promote the role of librarians in OER integration. Institutional frameworks should recognize librarians as OER champions and pedagogical partners, encourage cross-departmental collaboration (library–ICT–academic units) and Include OER in institutional repositories with librarian oversight.

5. **Infrastructure and Technological Support**

To overcome infrastructural barriers, Libraries should be equipped with high-speed internet and relevant digital tools, Institutions should invest in learning management systems (LMS) that are OER-friendly and Mobile-accessible platforms should be considered to support both librarians and users.

References

Abubakar, B. M., & Idris, A. (2021). Assessment of Nigerian librarians' knowledge and use of Open Educational Resources. *Library Philosophy and Practice*, 1–17. https://digitalcommons.unl.edu/libphilprac/5331

Aguolu, C. C., &Aguolu, I. E. (2002). Libraries and Information Management in Nigeria. Maiduguri: Ed-Linform Services.

Anunobi, C. V., &Ukwoma, S. C. (2019). Open Educational Resources (OERs): Challenges and roles of librarians in Nigerian academic libraries. *Library Philosophy and Practice*, 1-13.

Atenas, J., &Havemann, L. (2014). Questions of quality in repositories of open educational resources: A literature review. Research in Learning Technology, 22(1), 1–13.

Atenas, J., &Havemann, L. (2014). Questions of quality in repositories of open educational resources: A literature review. *Research in Learning Technology*, 22.

Atenas, J., Havemann, L., &Priego, E. (2015). Open data as open educational resources: Towards transversal skills and global citizenship. *Open Praxis*, 7(4), 377–389.

Butcher, N., & Moore, A. (2015). Understanding Open Educational Resources. Commonwealth of Learning.

Clements, K. I., &Pawlowski, J. M. (2012). User-oriented quality for OER: Understanding teachers' views on re-use, quality, and trust. Journal of Computer Assisted Learning, 28(1), 4–14.

Corrall, S. (2015). Developing the roles of librarians in learning and teaching. New Review of Academic Librarianship, 21(1), 1–3.

Cox, G., Masuku, B., & Willmers, M. (2020). Open educational resources and the role of academic librarians. *IFLA Journal*, 46(1), 62–69. https://doi.org/10.1177/0340035219893382

Echezona, R. I., &Uzoigwe, C. U. (2020). Challenges of digital information literacy skills among academic librarians in South-East Nigeria. Library Philosophy and Practice.

Ezema, I. J. (2020). Building sustainable open access in African academic libraries: Implications for knowledge sharing. *Information Development*, 36(2), 147–156.

Ezeani, C. N., & Eke, H. N. (2011). Transformation of Web 2.0 into Lib 2.0 for driving access to knowledge by academic libraries in Nigeria. Library Philosophy and Practice.

Eya, N. M., &Anunobi, C. V. (2021). Academic librarians' readiness for OER implementation in Nigerian universities. *Library Philosophy and Practice*, 1-19.

Hilton, J. (2016). Open educational resources and college textbook choices: A review of research on efficacy Ezema, I. J., &Ugwu, C. I. (2019). Awareness and use of open educational resources by academic librarians in South-East Nigeria. *Journal of Librarianship and Information Science*, 51(4), 1108–1118.

Eya, N. M., &Anunobi, C. V. (2021). Academic librarians' readiness for OER implementation in Nigerian universities. *Library Philosophy and Practice*, 1-19.

Lee, M. M., Lin, M. F. G., & Bonk, C. J. (2022). OER and personalized learning: The impact of open resources on adaptive pedagogy. *Education and Information Technologies*, 27(1), 385–404. https://doi.org/10.1007/s10639-021-10684-z.

Mays, T. (2017). Addressing the disconnect between the curriculum and OER availability: A South African perspective. South African Institute for Distance Education.

Mtebe, J. S., &Raisamo, R. (2014). Challenges and instructors' intention to adopt and use open educational resources in higher education in Tanzania. *International Review of Research in Open and Distributed Learning*, 15(1), 249–271.

Nkiko, C., & Yusuf, F. (2019). The role of academic libraries in the implementation of OER in Nigeria. Journal of Library and Information Science, 5(2), 15–27.

Nkiko, C., & Yusuf, F. (2021). Developing OER competencies in African libraries: A case study of Nigerian academic institutions. *African Journal of Library, Archives and Information Science*, 31(2), 133–147.

Nwosu, M. N., &Udo-Anyanwu, A. J. (2023). Librarian-academic staff collaboration for OER integration: Evidence from Nigerian universities. African Journal of Library, Archives and Information Science.

Obi, B. O., & Okiki, O. C. (2018).*Awareness and Use of Open Educational Resources among Librarians in Selected Universities in Nigeria.Information Impact: Journal of Information and Knowledge Management,* 9(3), 79–88.

Okike, B. I., & Adebayo, O. (2022). Competency requirements for effective OER management by academic librarians in Nigeria. *International Journal of Library and Information Science*

Studies, 8(2), 23–39.

Omoike, D., &Adeleke, A. A. (2021). Institutional policies and OER adoption in Nigerian universities. Nigerian Journal of Educational Technology.

Okonkwo, L., &Afolabi, M. (2022). Strategic competencies for digital librarians in an OER-driven environment. *Journal of Applied Information Science and Technology*, 15(1), 55–66.

Okonkwo, L. N. (2022). Awareness and Utilization of Library E-Resources by Undergraduates in the case of National OpenUniversity of Nigeria, Awka Study Centre. MAJORLIS: Madonna Journal of Research in Library and Information Science. Vol. 4(4) 56 – 78.

Okonkwo, L., &Ogbuiyi, S. U. (2022). Academic libraries and OER support services: A survey of practices in South-East Nigeria. Journal of Nigerian Library Association, 55(1), 22–35.

Okonkwo, L., &Onyenania, G. O. (2020). Repositioning academic libraries for OER initiatives in Nigeria. Library and Information Science Digest.

Oladokun, O. S., &Aina, L. O. (2020). Evaluation of OER adoption and application in Nigerian academic institutions: Librarians' perspectives. *Journal of Academic Librarianship*, 46(5), 102221.

Onyancha, O. B. (2020). Open educational resources in Africa: A bibliometric study. *Information Development*, 36(1), 44–56.

Trotter, H. (2020). Evaluating pedagogical adaptation in OER use. University of Cape Town, Centre for Innovation in Learning and Teaching.

UNESCO. (2019). *Recommendation on Open Educational Resources (OER)*. Retrieved from https://unesdoc.unesco.org/and perceptions. Educational Technology Research and Development, 64(4), 573–590.

Wiley, D., & Hilton, J. (2018). Defining OER-enabled pedagogy. International Review of Research in Open and Distributed Learning, 19(4), 133–147.

Equipping Libraries and Information Science Professionals with Skills for Optimum Production in the 5th Industrial Revolution

By
Dr. EUNICE UCHECHI EDOM CLN.
PROF. G. M. UMEZURIKE LIBRARY
IMO STATE POLYTECHNIC, OMUMA
euniceedom@gmail.com
&
PROF. BASIL ONYEOZIRI EDOM CLN.
DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE
IMO STATE UNIVERSITY, OWERRI
onyeoziriedom@gmail.com

Abstract

The fifth Industrial Revolution (5IR) is already here with us. Equipping libraries and library professionals with the necessary technological facilities and professional skills because of the changes and challenges introduced in the 5th industrial revolution is enormous. Library professionals should as a matter of urgency, equip themselves with the necessary skills and knowledge to adapt very well and interact harmoniously with the technological devices introduced for library operations and services in the 5th IR, while libraries should equally be equipped with the 21st century technological devices that can match the needs of 5t IR. This paper explained in details the concepts of industrial revolution, historical development and challenges as well as the types of preparations the libraries and library professionals should make to work effectively in this revolution. The paper presented some plausible ways of preparing libraries and library professionals for optimum production in the 5th IR. Some of the challenges like non-possession of technological skills, inadequate electronic and digital infrastructure, funding, etc. which libraries and library professionals experience were equally highlighted. The paper made some recommendations on the various ways to overcome these challenges. To function effectively in 5th IR, the paper concluded that libraries of all types and sizes are strongly required to be equipped adequately, while, library professionals should acquire the necessary skills to enable them function optimally and provide their patrons with the 21st global library services.

Key words: *Libraries, Library professionals, industrial revolution, Professional skills, Library technologies, Optimum production.*

Introduction

Libraries of all types, both big and small are very reliable institutions that cannot be relegated to the background in the 5th Industrial Revolution (IR). The 5th IR ushers in a type of change where library professionals and machines will work hand-in-hand to achieve greater successes in the library sector of the economy. This is because according to Ekwueme. et al (2024), in the library service domain, 5th industrial revolution represents collaboration between humans and machines to enhance the efficiency of information service delivery to library users. Nwobu, et al (2024), assert that the 5th IR is characterized by the integration of digital technologies, artificial intelligence and the Internet of Things (IoT) and this will make both libraries and librarians to undergo significant transformation. This transformation will position them strategically to function effectively in the 5th industrial revolution. This era according to Fox (2021) involves the adoption of cyber physical systems and emerging disruptive technological breakthroughs like robotics, Artificial Intelligence (AI), nanotechnology, quantum computing, biotechnology, the Internet of Things (IoT), internet of systems, 3 dimensional printing technology and autonomous vehicles. All these technological devices will unlock great potentials for libraries and library professionals in the 5th industrial revolution.

In the 5th industrial revolution, man and machine will unarguably work harmoniously to provide technologically oriented services to library patrons. For libraries and librarians to still be very relevant in this era, Adigun, Ajani and Enakire (2024), assert that libraries must adapt to the changing dynamics of the digital world while still preserving the core principles. Consequently, it becomes very important that libraries must be adequately and solidly equipped in all ramifications to be relevant in the 5th industrial revolution.

Again, the libraries cannot function effectively without properly equipping it with modern facilities while skilled library professionals must be available to operate these technological devices and use them to provide strategic services to library patrons. The caliber of library professionals needed to work in libraries in the 5th industrial revolution should be highly skillful in the use technological devices. Librarians will acquire these skills through training and re-training to make them very conversant with Information and

Communications Technology (ICT) facilities. To effectively prepare library professionals to occupy their pride of place and function effectively in the 5th industrial revolution, librarians' training should focus more on digital literacy, technological integration and continuous learning which will enable them leverage new technologies for enhanced library services and knowledge dissemination since the 5th industrial revolution has taken us into an era of very strong remarkable technological advancements and societal transformation (Ajani et al, 2022).

Efforts should be made by library managers to prepare their staff through training to acquire the necessary technological skills needed for optimum production in the 5th IR. Since there is already a paradigm shift in the position and status of librarians as well as their roles which have shifted from traditional practices to digital status, preparing them with the relevant skills to function effectively. Every library professional should as a matter of necessity, acquire digital skills to enable him/her participate actively in the 5th industrial revolution library services. This paper reviewed librarian's skills possession and libraries' preparedness for optimum production in the 5th industrial revolution.

Brief history industrial revolution

Industrial revolution commonly called IR is a period in history that is marked by change process from agrarian and handicraft economy to the economy dominated by industry and machine manufacturing. According to Edom and Edom (2021), Industrial Revolution (IR) clearly showcased a period in history that is characterized by an overhaul in global economy from agrarian and manual economy to mechanical methods of production. Continuing, the authors stated that it is a period in human existence characterized by enormous socio-economic changes in England, America and other developed countries of the world. Industrial revolution is equally seen as a period of global transition of human economy towards more efficient and stable manufacturing process.

The first industrial revolution began in England (Mohajan, 2019). The author further stated that this IR was one of the most distinguished turning points in human history when human and animal labour gave way for machine technology. According to Clark (2010), before the first industrial revolution, the British people lived in small villages, people travelled by foot or horse through small path; sickness was common among people and there was inadequate food, poor hygiene, use of polluted water and non-existence sewage system. The main significant changes brought by the 1st IR were that manual work was replaced by industrial factory, the rail road was invented, the steam boat was introduced, good roads and canals were constructed, the springing up of private investments, massive production of goods, reduction in the cost of production and labour, etc.

The second industrial revolution began in the United States (US) and it is remarkable for its great breakthrough in technology which brought electricity, the chemical industries, alloys, petroleum and other chemicals, electrical communications and running water (Mohajan, 2020). Although the second IR brought in lots of positive changes in both individual and societal lives, yet it has its shortcomings which include harsh working conditions, income inequalities as well as environmental degradation which brought in labour reforms and regulatory measures.

The third industrial revolution began in 1950s and it is marked by sharp drift from mechanical and analogue electronic technology to full digital technologies. The 3IR brought about tremendous changes and spread of development to all parts of the world (Mohajan, 2021). According to Roberts (2015), the third IR triggered the development of the internet and it is global in nature, thus leading to many technological advances in manufacturing, distribution and energy factors. Similarly, Rifkin (2011) stated that the 3rd IR opened the doors of space exploration, research and biotechnology using the new technologies.

The 4th IR also called industrial 4.0 began in the 21st century. According to Zhou as cited in Hamad and Jawad (2012), industrial 4.0 introduced the use of electronic physical systems in industrial manufacturing. Leyh et al (2016) are of the opinion that industrial 4.0 brought in reformation from centralization to decentralization in production, which is characterized by self-control and flexibility and the digitization of production, processing and products to allow the sharing and distribution of information along the value chain. Edom and Edom (2021) stated that the 4th IR is characterized by the fusion of technologies in the lines of physical, digital and biological spheres. Similarly, Hussain (2019), stated that the 4th IR brought new level of organization and control over the entire value chain of products. Man and Man (2019) equally assert that the 4th IR ushered great digitization, high connection between physical things and virtual world, the development of genetics, artificial intelligence and hyper connectivity.

The 5th IR is improving on the provisions of the 4th IR. It has brought in another unstoppable super high-way in technological inventions. The 5th IR is a fusion of physical, digital and biological technologies with focus on human-electricity, sustainability and collaboration between human and machines to achieve greater successes. The 5th IR has ushered in strong emphasis on personalization and craftsmanship and introduced

Artificial Intelligence (AI), robotics and Internet of Things (IoT).This revolution focuses on integration of human ingenuity and creativity with advanced technologies. According to Noble et al. (2022), the 5th IR encompasses the notion of harmonious human-machine collaborations with specific focus on the well-being of the multiple stake-holders such as the society, companies, employees and customers (library clients).

Preparing library professionals for optimum production in the 5th industrial revolution

The 5th industrial revolution is a period in the history of mankind that lays much emphasis on collaboration or fusion between humans and machines to achieve optimum production in every facet of human existence. The 5th IR is characterized by remarkable technological advancements and digital metamorphosis hence the roles of library professionals will also undergo some transformation (Oseji, 2020). Most of the functions and services provided by library professionals will be performed using machines and other electronic devices in the 5th IR if nothing is done by library professionals to improve their skills technologically. As a result of this, preparing library professionals through training and re-training to make them active participants in the 5th IR becomes non-negotiable. Therefore, library professionals should upgrade their skills to enable them adapt to the changes and challenges that 5th IR brought (Affum & Dwomoh, 2023).

Library professionals should engage in continuous learning, technological integration, collaboration and networking to be very productive in the 5th IR (Noble et al, 2022). Again, Nwobu et al. (2024) assert that possession of technology use skill and effective communication skills are very imperative for library professionals. Tell et al. (2023) are equally of the opinion that library professionals should be knowledgeable and proficient in Meta data handling to function effectively in this era. For library professionals to be relevant in the 5th IR, Noble et al (2022) opined that the only way to prepare them to fit in properly and perform their functions and services in this era is through:

1. **Mastering digital tools:** Library professionals need to be proficient in the use of various digital tools and technologies to enable them manage information, provide library services and engage users in their libraries. This is because library practice in the 5th IR is completely transformed and if librarians should remain relevant in their work places, they need to be conversant with the use of digital technologies.
2. **Continuous learning and professional development:** The 5th IR requires librarians to engage in serious commitment to continuous learning and professional development through in-service training, attendance to conferences, workshops and even professional association activities to be updated with the latest technologies and trends in library and information science field.
3. **Facilitating knowledge creation:** Library and information science professionals can leverage new technologies to enhance their positions as facilitators of knowledge and dissemination.
4. **Personalized services:** This involves training library professionals to equip them with the skills to provide personalized services in libraries by leveraging on data analytic and artificial intelligence to attend to users' needs
5. **Enhancing engagement:** Library professionals can use innovative methods and technologies to enhance users' engagement with library resources and services. Giving them training that focuses on this area is very important.
6. **Experimentation and innovation:** Librarians should be encouraged to explore new ideas, imbibe or foster a culture of experimentation and innovation that will enhance their provision of effective library services.
7. **Collaboration and networking:** Library professionals should be trained to collaborate among themselves and other stakeholders, researchers and technology experts to expedite innovation in library operations and services (P.201).

Important skills requirements for the 5th industrial revolution

Library professionals are expected to possess reasonable technologically-based skills to enable them perform effectively and efficiently in the 5th IR. Some of these skills include:

Digital skills: Digital skill is the ability to use technological devices such as computers, laptops, tablets, notebooks, cell phones and their software applications, digital devices and computer hardware effectively. Librarians should be very conversant with the use of technological devices in the provision of services to library clients. Their use of these devices effectively in their daily functions and services is an indication that they have acquired digital skills.

Innovation skills: Innovation skills are the knowledge and abilities that can enable one to create and adapt to changes. Innovation skill is the ability to generate ideas that create values and improve processes from inventing machines to finding a faster route to work. The 5th IR requires that librarians should possess innovative skills in order to excel in their functions and provision of adequate services in line with the changes introduced by this revolution. Librarians should be on the fast thinking lane in order to provide prompt answers/solutions to users' queries.

Social networking skills: Social networking skill is the ability to form connections in persons or online. In today's parlance, social networking skill means the ability to interact on the internet or online effectively. Library professionals should acquire this skill to enable them cope with the changes brought by the 5th IR. Possession of this skill will enable them to connect with other professional colleagues and library institutions across the globe.

Web designing skills: This simply means the ability to conceptualize and design a website in a way that is functional and offers a good user experience. According to Friday and Onuh (2022), librarians should acquire web designing skills to enable them practice effectively in the 21st century. Librarians should as a matter of necessity acquire technological skills that will enable them to design their own personal and official websites so as to create visibility for themselves and their libraries. This skill will enable them to create wider visibility for themselves and their libraries.

Adaptability skills: Possession of adaptability skills means that one can easily adapt to changes that may come up at any time especially in work places. Possession of adaptability skill is very important for librarians to excel in the 5th IR. This is because the 5th IR presented many sophisticated changes and challenges; hence librarians should be flexible cope with these changes without difficulty.

Equipping libraries for the 5th industrial revolution

Libraries should be adequately prepared to function effectively in the 5th IR. Libraries of all types should be properly equipped with the state of the art technological devices. Library building designs should be conveniently enough to accommodate these technological facilities introduced by 5th IR. Library managers should acquire Artificial Intelligence (AI) and machine learning equipment for their libraries. These technologies according to Chaturvedi and Verma (2023) are instrumental in revolutionizing cataloguing, information retrieval and user interactions.

Similarly, Kraft-Terry and Brown (2023) assert that librarians should harness the power of data analytics and big data to gain deeper insight into user behavior, resource utilization and collection development. Possession of these technological facilities according to these authors will enable library professionals to take informed decisions, enhance their operational efficiency and resource allocation. Library professionals should make use of block chain technology to boost their security, transparency of transactions particularly, in the management of digital assets and intellectual property. Block chain immutable ledger is used to verify the authenticity of digital resources as well as ensuring the integrity of library collection. Tella and Ajani (2022) opined that libraries should incorporate robotic automation to streamline operational tasks like book retrieval and shelving.

Librarians should have in their possession Fifth Generation of cellular technology for network communication (5G network) to enhance network connectivity in their libraries. This will enable such libraries to enjoy very high-speed connectivity in their internet usage. Five G network will empower libraries to offer faster access to digital resources and enhanced user engagements (Adigun et al, 2024).

Libraries should also be equipped with advanced security technological devices like Radio Frequency Identification (RFID) that will help them monitor the activities of staff and users in the libraries. Possession of good computers, printers, scanning machines 3 dimensional printing (3printing) and uninterrupted power supply equipment are necessary if libraries should function to full capacity in the 5th IR. In Nigeria where public power supply is not guaranteed all the time, library managers should install solar energy devices to provide constant power supply in their libraries. Library managers should equip their libraries with these technological devices to enhance their efficiency in the 5th industrial revolution.

Challenges of equipping libraries and preparing library professional in the 5th industrial revolution.

As expected, there are myriads of challenges that confront the preparations of both libraries and library professionals to function effectively in the 5th IR. Some of these challenges include:

Funding: Libraries are not well funded in Nigeria and other developing countries and this is affecting their functions and services. It is likely that this particular issue will still affect the functions and services of libraries both big and small in the 5th industrial revolution if nothing is done to mitigate on this challenge. Public libraries in Nigeria are the worst hit by this non-funding culture and it is affecting their operations. As libraries are being prepared for effective operations in the 5th industrial revolution, they should be adequately funded by their parent institutions/agencies.

Adequate training for library professionals: It is sad to state that at this era, most library professionals do not engage in professional trainings to update their knowledge and keep themselves abreast with the current trends in the profession. Most of them do not attend professional conferences and workshops in Nigeria or elsewhere outside Nigeria to update their knowledge and acquire the necessary technical skills needed to function effectively on their work schedules. This will definitely affect their roles as information managers and disseminators in the 5th industrial revolution.

Government apathy: The government at all levels in Nigeria is apathetic to library development and this may thwart the roles of libraries and library professionals in the 5th industrial revolution. In most cases, government as the owner and sponsor of most library institutions do not fund it adequately, employ professional staff nor repair and furnish the libraries with state of the art technological facilities. This level of neglect will definitely affect the roles of libraries and library professional in the 5th industrial revolution.

Non-possession of technical skills: This perhaps is another serious challenge that will confront library professionals in the 5th industrial revolution. According to Edom and Edom (2021), library professionals are expected to improve themselves by acquiring requisite skills and knowledge needed to operate sophisticated technological devices needed to work with in the 5th IR. Most library professionals do not possess the technical skills needed to function effectively in this era because they do not engage in any other form of training after their employment. This will be a serious setback for the professional practice in the 5th industrial revolution.

Technophobia: According to Runguta (2016), technophobia is the extreme and irrational fear of technology. The author further stated that technophobia relates to irrational fear of computers, robots, artificial intelligence, digital facilities and other such things which seem advance in scientific thought. Oleson (2019) asserts that technophobia is the constant and persistent fear of technology and the feeling of severe anxiety associated with using anything technologically advanced. Most library professionals are highly technophobic and there is no point pretending about it. The 5th industrial revolution is replete with technological appliances which humans are expected to work with in their offices to produce effective results. If any library professional is caught in this technophobic web, how can the librarian work with this sophisticated technological equipment in the 5th IR? It is therefore a serious problem that should be solved immediately.

Inadequate infrastructure: Nigerian libraries have recurring problem of lack or inadequate provision of infrastructures. Poor infrastructures will definitely contribute to the problems of library and information practice in the 5th industrial revolution. Such infrastructure according to Agbo as cited in Edom and Edom (2021) include; inadequate bandwidth and non-availability of appropriate antivirus and other necessary software which can frustrate both library professionals and reduce optimum utilization of Information and Communications Technology (ICT) facilities. Other infrastructural facilities that maybe needed in libraries for effective integration in the 5th IR according to Kalbande and Chavan (2017) include; high speed computers, tablets, servers, printers, scanners, barcode readers, e-book readers, digital copiers, close circuit television monitors, etc. A cursory look in our libraries both big and small will attest that these facilities are grossly lacking and will affect library practice in this revolution.

Conclusion

The 5th industrial revolution is no doubt around the corner. Therefore, libraries and library professionals should be properly equipped to occupy their pride of place in this era. Every 21st century library and library professionals should be adequately equipped in order to operate at full capacity for optimum results. Library professionals should prepare themselves through training and re-training particularly in the use of information and communications technology facilities which is extensively needed in the 5th IR. The owners and sponsors of different types of libraries in Nigeria as a policy should fund these libraries adequately in order to put in place all the necessary ICT facilities needed for the 5th IR library practice. It is only when these measures are adequately taken care of that we can boldly state that libraries in Nigeria are prepared to embrace the changes that came with the 5th industrial revolution.

Recommendations

In view of the changes and challenges that library professionals and their libraries experience in equipping themselves adequately for optimum production in the 5th industrial revolution, the following recommendations are made:

1. The owners and sponsors of different types of libraries should provide adequate funds for library development. Adequate, prompt and consistent funding of libraries will enable it to acquire the relevant ICT equipment needed for library operations and services in the 5th industrial revolution.
2. Library professionals must prepare themselves to function effectively in the 5th IR by undergoing some training particularly in the use of ICT and other related technologies. This is very imperative because in the 5th IR, mechanical operations in libraries is gradually replacing manual operations and services in all types of libraries, particularly, the academic and special libraries. Library professionals should improve themselves skillfully through constant training particularly, in the area of ICT.

3. **T**he government and other agencies that own libraries should include library development in their scheme of things. These include recruitment of professional staff and consistent payment of their salaries and other financial entitlements as well as provide all the working apparatuses and equipment needed to work with. The government at all levels should show interest and serious commitment in things that concerns library development particularly now that the 5th IR has introduced some technological changes to enable libraries and library professionals fit in properly and function effectively in this era.
4. Library professionals on their own part should strive to arm themselves with all the technical skills they need to have in order to remain relevant in the 5th IR. They should update themselves through trainings either through institutional or self sponsored trainings to acquire the necessary technical skills and knowledge needed to navigate successfully in the 5th industrial revolution.
5. Library professionals should be exposed to the use of ICT equipment early in their libraries to enable them become conversant with it. Library operations and services not already digitized should be digitized without further delay and library professionals encouraged to adopt these ICT facilities in their everyday operations and services in the libraries. This will help them to suppress the technophobic tendencies in them. Through this strategy, the affected library professionals will become conversant with the use of ICT devices in their everyday official activities.
6. Library managers should make effective use of the meager financial resources allocated to them by the owner/sponsor parent bodies to provide adequate digital infrastructure for their libraries. Academic and public libraries should leverage Tertiary Education Trust Fund (TETFund) sponsorship or other donor agencies to obtain most of the library infrastructure they may need to cope with the changes and challenges that 5th industrial revolution brought.

References

Adigun, G.O., Ajani, Y.A. & Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the 5th industrial revolution. Retrieved from https://www.degruter.com on 15/4/25

Affum, M.Q. & Dwomoh, O.K. (2023). Investigating the potential impact of artificial intelligence in librarianship. *Library Philosophy and Practice*. Retrieved from: https://www.digitalcommon,unl.edu/libphilprac/7520 on 21/4/25.

Ajani, Y.A., Tella, A., Salawu, K.Y. & Abdullahi, F. (2022). Perspectives of libraries on awareness and readiness of academic libraries to integrate artificial intelligence for library operation and services in Nigeria. Retrieved from: http://doi.org/10.1080/10875301.2022.2086196 on 15/4/25

Chaturvedi, R. & Verma, S. (2023). Opportunities and challenges of AI-driven customer service. Retrieved from: https://doi.org/10.1007/978-3-031-33898-4_3 on 23/4/25

Clark, G. (2010). The macroeconomics aggregate for England, 1209-2008. *Research in Economic History.* 27:51-140

Edom, B.O. & Edom E.U. (2021).Library and information practice in the fourth industrial revolution. In Udo Nwokocha and Samuel Ibenne (eds.) *Dynamics of Library and Information Practice in the 21st Century.* Lagos: Zeh Communications.

Ekwueme, L. O., Oluwaseun,B. O., Ajie, I. A., Ofodu, P. N. & Ambrose, S. M. (2024). Empowering libraries in the fifth industrial revolution: Navigating skills, challenges and strategies for effective library services in open and distance learning. *Lokoja Journal of Information Science Reasearch*.2(1):79-94

Fox, L. (2021).The fourth industrial revolution and the future of work. Retrieved from: https://includeplatform.net on 21/3/25

Friday, J.E. &Onuh, N.S.(2022). Acquisition of librarianship skills by librarians in public universities in Bayelsa and Rivers states, Nigeria. *Library Philosophy and Practice.* Retrieved from: https://digitalcommonsunl.edu/libphilpract/7265 on 22/4/25

Hamad, B.M. & Jawad, M. K. (2012). The fourth industrial revolution: A historical and conceptual review. *Journal of Economics and Administrative Science on* 30(141): 154-172.

Hussain, A. (2019). Industrial revolution 4.0: Implications to libraries and librarians. Retrieved from from: https://www.researchgate.net/publication/336157559_industrial_revolution_4.0_implications_to_libraries_and_librarians on 21/4/25

Kalbande, D.T. & Chavan, P. (2017). ICT infrastructure facilities in agricultural college libraries in Maharatitra: a study. Retrieved from: www.ijodls.in/uploads/3/6/03/3603729/ on 12/4/25

Kraft-Terry, S.D. & Brown, J. (2023).Data-informed planning and decision-making. Retrieved from:https://www.taylerfrances.com/chapters/edit/10.4324/9781003437598-19/data-iformed-planning-decision-making-stephanie-kraft-terry-jennifer-crown on 21/4/25.

Leyh, C., Bley, k.,Schaffer, T., & Forstenhausler,S. (2016).Proceedings of international conference on intelligent manufacturing and automation(ICIMA). Retrieved from: https://ebin.pub on 13/2/25

Man, G. & Man, M. (2019). Challenges of the forth industrial revolution. *Land Forces Academy Review.*

XXIV(4): 96-102
Mohajan, H.K.(2019). The first industrial revolution: creation of a new global human era. *Journal of Social Science and Humanities.* Retrieved from: htt://www.aiscience.org/journal/jssl on 4/4/25
Mohajan, H.K. (2020). The second industrial revolution has brought modern social and economic developments. *Journal of Social Science and Humanities.* 1(6): 1-14
Mohajan, H.K.(2021). Third industrial revolution brings global development. *Journal of Social Science and Humanities.* 4(7):239-251. Retrieved from:http://aiscience.org/journal/jssl. On 5/4/25.
Noble, S.M., Mende, M., Grewal, D. & Parasuraman, A. (2022). How harmonious human-machine collaboration is triggering retail and service revolution. *Journal of Retailing* 98(2): 199-208
Nwobu, B.K.,Dumbiri, R. Ibia, M.J. & Oladokun, B.D.(2024). Libraries in the 5th industrial revolution: skills and knowledge required in preparing libraries for an uncertain future. In U.C.Udofot et al (eds.) *Digital Technologies and Library Management in Higher Institutions of learning in Nigeria.* Port Harcourt: Chadik Printing Press
Oleson, J. (2019). Fear of technology, phobia-technophobia. Retrieved from: https://www.fearof.net/fear-of-technology-phobia-technophobia on 15/4/25
Oseji, N.A (2020). Training of librarians for service delivery in the digital age in federal university libraries in North-Central, Nigeria. *Niger Delta Journal of Library and Information Science.* 1(1):59-69
Rifkin, J.(2011). The third industrial revolution: How lateral powers is transforming energy, the economy and the world. Retrieved from: https://www/mpra.ub-uni-muenchen.de on 15/4/25.
Roberts, B.H. (2015). The third industrial revolution: implications for planning cities and regions. Retrieved from: https://www.researchgate.net/publication/27861121_the_third_industrial_revolution on 15/4/25
Runguta, A. (2016). Technophobia and how to overcome. Retrieved from: https://www.indusnet.co.in/what-is-technophobia-and-how-to-over-come on 22/4/25
.
Tella,A. Bamidele, S.S.,Olaniyi, O.T.& Yusuf, A.A.(2023). Library and information science graduates skills needed in the fourth industrial revolution. Retrieved from: https://www.degruyter.com on 23/4/25

Evaluation of Impact of Internet of Things (IoTs) on Utilization of Libraries by Postgraduate Students at the National Open University of Nigeria

Hassana IBRAHIM MLS, CLN
National Open University of Nigeria (NOUN)
hibrahim@noun.edu.ng
07061290717
&
Dr. Angela Ebele OKPALA, CLN
National Open University of Nigeria (NOUN)
aokpala@noun.edu.ng
08052495259

Abstract

Access to information is essential for enhancing user experience in academic libraries. This study evaluates the impact of Internet of Things (IoT) technologies on promoting sustainability and improving user experience, with a focus on postgraduate students at the National Open University of Nigeria (NOUN). Adopting quantitative research design, the study explored students' perceptions across three key areas: access to library resources, contribution to sustainability, and the overall library user experience. A total of 250 questionnaires were distributed using stratified random sampling across the Abuja and Kaduna Study Centres. Out of these, 243 were completed and returned, representing a high response rate of 97.2%. Data were collected through structured questionnaires using a 5-point Likert scale and analysed using descriptive statistics such as frequencies, percentages, and mean scores. Findings revealed that over 70% of respondents agreed that IoT technologies improve access to library materials by enhancing efficiency and reducing time spent searching for resources. Additionally, more than 60% of students affirmed that IoT contributes to sustainability by reducing paper use and supporting energy-efficient practices. Over 65% also perceived IoT as enhancing their library experience through personalization and convenience. However, perceptions were less favourable regarding IoT-enabled remote access, suggesting a need for improved implementation and awareness. Based on these findings, the study recommends strengthening remote access infrastructure, increasing awareness of IoT's role in sustainability, and investing in user-centered IoT features. These measures will help maximize the potential of IoT in transforming academic library services, especially in open and distance learning environments like NOUN.

Keywords: Internet of Things (IoT), Libraries, Postgraduate Students, Sustainability, User Experience

Introduction

Libraries have historically played a central role in knowledge preservation, dissemination, and lifelong learning. As the information needs of users evolve in the digital age, academic libraries are embracing modern technologies to enhance service delivery, improve user satisfaction, and promote environmental sustainability. Among the array of emerging technologies, the Internet of Things (IoT) stands out as a major driver of change in library management and user engagement. Ifijeh, & Yusuf, (2023) wrote that in the 21st century, the integration of emerging technologies in libraries has reshaped traditional services and transformed user expectations, one 0f such transformative technology is the Internet of Things (IoT), which refers to a network of physical devices embedded with sensors, software, and connectivity that enable them to collect and exchange data. Atzori, Iera, & Morabito, (2010) postulated that IoT applications in libraries have the potential to enhance sustainability by optimizing resource consumption and improve user experience through personalized and efficient service delivery. Oyelude, (2022) stressed that IoT has begun to play a pivotal role in modernizing library environments by improving operational efficiency, promoting sustainability, and creating a more interactive and personalized user experience. Libraries, especially in academic institutions, are under increasing pressure to offer sustainable and smart services that align with environmental goals and digital transformation strategies. According to Alhassan & Adam, (2022) IoT technologies such as smart lighting, temperature control systems, RFID-enabled book tracking, digital kiosks, and occupancy sensors are being adopted in libraries worldwide to reduce energy consumption, automate repetitive tasks, and enhance user comfort. These innovations not only support green practices but also improve the way users access information and interact with library resources.

As sustainability becomes a global priority, academic institutions are exploring green technologies and sustainable practices to reduce their ecological footprint. Libraries, as critical hubs within universities, are key players in this movement. The implementation of IoT tools aligns with the United Nations Sustainable Development Goals (SDGs), particularly those related to quality education (Goal 4), innovation and infrastructure (Goal 9), and climate action (Goal 13). UNESCO (2023) supported that through smart

energy management and waste reduction; libraries can demonstrate institutional leadership in environmental responsibility. At the same time, user expectations of library services are changing rapidly, today's postgraduate students who are often digital natives expect convenient, tech-driven services that align with their academic needs and lifestyle. IoT-enabled libraries offer features such as real-time availability of study spaces, smart shelves for easier book retrieval, automatic check-in/check-out, and personalized information delivery, all of which enhance the overall user experience.

In the Nigerian context, however, the adoption of IoT in academic libraries is still in its infancy. While universities in developed countries are increasingly becoming "smart campuses," many Nigerian institutions face infrastructural, financial, and policy-related challenges that hinder full-scale implementation of IoT systems. Nonetheless, institutions like the National Open University of Nigeria (NOUN) are making strides toward digital transformation as the largest open and distance learning institution in the country, with distance learning model and emphasis on digital access to make it a prime candidate for the integration of IoT-based services. Understanding how these technologies are being adopted and how postgraduate students perceive their impact is essential for assessing their effectiveness and guiding future investments. Omeluzor, & Anyaoku (2024) pointed out that despite the global progress in smart library systems, there is a lack of empirical research examining how IoT influences library sustainability and user satisfaction within the Nigerian context, there is a notable gap in empirical research on its specific applications and outcomes in Nigerian libraries, particularly concerning sustainability and user satisfaction. This study, therefore, seeks to bridge this gap by evaluating the impact of IoT technologies on both sustainability efforts and user experiences in NOUN's library services. By focusing on the perceptions of postgraduate students, the study provides valuable insight into how well IoT solutions are meeting their needs and expectations.

In doing so, this research contributes to the broader discourse on the digital transformation of academic libraries in developing countries and offers practical insights for library administrators, ICT policy makers, and educational stakeholders who seek to leverage IoT technologies for institutional improvement and student-centered services to support 21st-century learning goals.

Statement of the Problem

The integration of Internet of Things (IoT) technologies in academic libraries has emerged as a promising approach to modernizing library operations, enhancing user satisfaction, and promoting environmental sustainability. Globally, libraries are leveraging IoT tools such as smart lighting, RFID systems, occupancy sensors, and automated service points to optimize energy use, reduce human error, and improve the user experience. However, the implementation and effectiveness of these technologies in the context of developing countries, particularly in Nigerian academic libraries, remain underexplored. At the National Open University of Nigeria (NOUN) a pioneering institution in open and distance learning in Nigeria the need for innovative, technology-driven library services is even more critical. With thousands of postgraduate students relying heavily on digital platforms and remote access to learning resources, there is growing pressure on the institution to adopt smart technologies that support seamless and sustainable library operations. Yet, it is unclear to what extent IoT has been adopted in NOUN's library systems, how effectively these technologies are being utilized, and whether they are yielding the intended benefits in terms of sustainability and enhanced user experience. However, there is limited empirical evidence on the perceptions and experiences of postgraduate students who interact with IoT in the study area. Without a clear understanding of the impact of IoT on sustainability and user experience, library administrators and policymakers cannot justify investments, scale up adoption, or make informed decisions about the future direction of library services. Therefore, this study seeks to investigate the actual impact of IoT technologies in the NOUN library context, with specific focus on how they influence sustainability outcomes and postgraduate student experiences. The findings will help fill a critical knowledge gap and guide strategic improvements in the deployment of smart technologies in academic libraries across Nigeria and other similar settings.

Research Question

The following are the research questions in this study:

1. How do postgraduate students perceive the impact of IoT on their access to and use of library resources in NOUN libraries?
2. In what ways does the use of IoT contribute to promoting sustainability practices within the libraries of NOUN?
3. How do postgraduate students at NOUN perceive the impact of IoT technologies on their library user experience?

Objectives of the Study

The following objectives guide this study:

1. To examine postgraduate students' perceptions of the impact of IoT on their access to and utilization of library resources in NOUN libraries.
2. To assess the procedures through which IoT technologies contribute to the promotion of sustainability practices within NOUN libraries.
3. To evaluate postgraduate students' overall perceptions of how IoT influences their user experience in the library environment**.**

Literature Review

The following section presents a review of related literature in this study. It is presented as follows:

Internet of Things (IoT) in Libraries

The Internet of Things (IoT**)** refers to a system of interconnected digital devices that collect and exchange data through the internet. In the context of libraries, IoT enables the automation of services, intelligent resource management, real-time tracking, and personalized user interactions. Ali & Bilal, (2022) also define Internet of Things (IoT) as the interconnection of computing devices embedded in everyday objects, enabling them to send and receive data over the internet. Libraries globally are increasingly integrating IoT to improve operational efficiency and to deliver value-added services to users. Patil & Patil, (2021) supported that IoT technologies facilitate the automation of operations, intelligent resource tracking, user personalization, and sustainable infrastructure management. IoT applications in libraries include RFID-enabled smart shelves for book tracking, Smart energy systems for reducing power consumption, beacons and sensors for indoor navigation, automated check-in/check-out stations, and environment monitoring systems (for temperature, humidity). These technologies not only improve user experience and resource access, but also contribute to sustainability by optimizing space, energy, and labour.

Sustainability in Library Services

Sustainability in academic libraries extends to energy management, resource optimization, and digital transformation. IoT technologies such as smart lighting, temperature control, and automated inventory systems contribute to reducing resource consumption Bansode & Kulkarni, (2020) wrote that In Nigerian universities, including open and distance learning institutions, sustainability challenges often relate to energy use, system inefficiencies, and manual workflows. Aina & Adigun, (2023) buttressed that smart library systems using IoT can support eco-friendly initiatives by enabling energy-efficient infrastructure and reducing physical resource dependency.

Enhancing User Experience Through IoT

User experience (UX) in libraries is increasingly defined by personalization, accessibility, and the ease of interaction with information services. IoT-enabled systems such as smart shelves, RFID tracking, and interactive kiosks enhance UX by providing users with seamless navigation, real-time book availability, and automated check-in/check-out. According to Rahmat & Mohd, (2022) In open and distance learning environments like NOUN, the ability to remotely access library services and receive personalized support is especially critical, given the geographically dispersed student population.

Adoption of IoT in Nigerian Academic Libraries

Despite the transformative potential of IoT, Nigerian libraries have faced significant barriers to adoption, including poor infrastructure, limited digital literacy, funding constraints, and lack of institutional readiness. While pilot projects have shown promise, systematic implementation remains scarce. Ogbebor & Adebayo, (2023) stated that NOUN, as Nigeria's premier open and distance learning institution, stands to benefit greatly from the scalable and remote capabilities that IoT solutions offer. However, empirical studies examining the real-world impacts on postgraduate students who typically rely more intensively on academic resources are limited. **Postgraduate Students and Library Technology Use**

Postgraduate students are often more tech-savvy and research-oriented, making them ideal participants in the adoption of advanced library technologies. According to Eze and Nwankwo (2022), postgraduate students in Nigeria demonstrate high readiness to engage with digital tools, but their access to intelligent systems like IoT-enabled services is minimal. Investigating how IoT impacts their learning efficiency, satisfaction, and engagement with library resources can provide critical insights for institutional development.

The literature suggests that IoT has significant potential to transform academic libraries by enhancing sustainability and user experience. However, the implementation in Nigerian libraries, particularly in open and distance education settings like NOUN, remains underexplored. This study seeks to fill that gap by evaluating how IoT affects postgraduate students' interaction with library services in terms of environmental impact and service satisfaction.

Methodology

This study adopted a quantitative research design to evaluate the impact of Internet Things (IoT) technologies on promoting sustainability and enhancing user experience in academic libraries. The design allowed for the collection of numerical data to assess patterns, relationships, and perceptions among postgraduate students. The population comprised postgraduate students across various faculties at the Abuja and Kaduna Study Centres of the National Open University of Nigeria (NOUN). A stratified random sampling technique was employed to ensure proportional representation across faculties. A total of 250 questionnaires were distributed, and 243 were successfully completed and returned via WhatsApp and email, representing a high response rate of 97.2%. Data was collected using a structured questionnaire designed to capture information on: Awareness and usage of IoT technologies, Perceived impact of IoT on library access and services, Sustainability practices enabled by IoT and Challenges associated with IoT adoption. The questionnaire consisted of closed-ended items measured on a 5-point Likert scale, The questionnaire was administered electronically via WhatsApp and email to ensure accessibility and convenience for participants, given the distributed and flexible nature of NOUN's academic structure. Collected data were analysed using descriptive statistics (frequencies, percentages). These analyses were used to determine relationships between IoT usage and variables such as sustainability practices and user satisfaction.

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	138	56.8%
	Female	105	43.2%
Age Group	[illegible]	76	31.3%
	31–40 years	102	42.0%
	41–50 years	50	20.6%
	51 years and above	15	6.1%
Study Centre	Abuja	128	52.7%
	Kaduna	115	47.3%
Faculty	Agricultural Sciences	6	2.5%
	Arts	25	10.3%
	Computing	28	11.5%
	Education	51	21.0%
	Health Sciences	34	14.0%
	Law	0	0.0%
	Management Sciences	39	16.0%
	Science	30	12.3%
	Social Sciences	30	12.3%
Level of Study	Postgraduate Diploma (PGD)	115	47.3%
	Master's Degree	122	50.2%
	PhD	6	2.5%

Findings:

Section A: Demographic

The demographic data shows a balanced gender distribution, with male respondents accounting for 56.8% and female respondents 43.2%. A significant portion of respondents are between the ages of 31–40 (42.0%), indicating that most postgraduate students at NOUN are mature adults, likely balancing education with professional or personal responsibilities. Study Centre representation is relatively balanced, with a slight majority from Abuja (52.7%). Faculty distribution shows the highest participation from the Faculty of Education (21.0%), followed by Management Sciences (16.0%) and Health Sciences (14.0%), with no representation from the Faculty of Law. Regarding the level of study, master's degree students make up the majority at 50.2%, followed closely by Postgraduate Diploma students at 47.3%. PhD students constitute a small fraction (2.5%), indicating that most responses reflect the experiences and perceptions of students at lower postgraduate levels. This suggests that IoT adoption and usage may be more relevant or visible to students engaged in coursework-based programs rather than research-intensive ones.

Section B.

Table 2: Perception of Postgraduate Students on the Impact of IoT on Access to and Use of Library Resources in NOUN Libraries

S/N	Item	SA (%)	A (%)	N (%)	D (%)	SD (%)
1	IoT has improved my access to library materials.	40.7	34.2	10.3	9.5	5.3
2	IoT makes locating books and materials easier.	38.3	36.6	11.1	9.1	4.9
3	I use library services more efficiently because of IoT.	33.7	40.3	12.8	8.2	5.0
4	I access library resources remotely through IoT-based systems.	28.4	32.5	16.5	13.2	9.5
5	IoT reduces the time spent searching for materials.	35.8	38.7	11.9	7.8	5.8

Decision rule for Table 1: Positive Perception: If (SA + A) ≥ 60%, then the perception is positive. Neutral Perception: If (SA + A) is between 40% and 59%, then the perception is neutral/moderate. Negative Perception: If (SA + A) < 40%, then the perception is negative.

Table 2: indicates that postgraduate students at NOUN generally have a strong positive perception of the impact of IoT on their access to and use of library resources. Over 70% agreed that IoT enhances access, ease of locating materials, service efficiency, and timesaving. However, perceptions were less favourable regarding remote access, with only 60.9% agreement and a higher rate of negative responses. This suggests that while IoT is viewed as beneficial overall, improvements are needed in its remote access functionality.

Section C:

Table 3: Contribution of IoT to Sustainability Practices in NOUN Libraries

Key: SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree.

S/N	Item Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)
1	IoT reduces paper usage through digital access.	41.2	39.1	9.5	6.2	4.0
2	IoT helps in reducing electricity via smart systems.	29.6	35.0	14.8	12.7	7.8
3	Smart sensors help manage lighting and AC efficiently.	30.5	33.3	17.7	11.5	7.0
4	IoT supports long -term environmental sustainability.	32.9	36.2	15.2	9.1	6.6

The data from Table 3 indicates that postgraduate students at NOUN generally perceive IoT as contributing positively to sustainability practices in the library. Each item received over 60% agreement (SA + A), with the highest being 80.3% for reducing paper usage through digital access, reflecting strong awareness of IoT's role in minimizing print material. Other items, such as reducing electricity consumption (64.6%), managing lighting and air conditioning efficiently (63.8%), and supporting long-term environmental sustainability (69.1%), also show favourable responses. Although the overall perception is positive, the slightly lower agreement levels compared to Table 1 suggest that IoT's sustainability features may be less visible or emphasized than its role in improving access to library resources.

Section D
Table 4
Perception of IoT Technologies on Library User Experience at NOUN

S/N	Item	SA (%)	A (%)	N (%)	D (%)	SD (%)
1	IoT improves the quality of library interactions.	34.6	37.0	13.6	9.5	5.3
2	IoT makes services more personalized/responsive.	31.3	34.6	16.9	10.7	6.6
3	My overall library experience has improved with IoT.	35.4	36.2	13.2	9.1	6.2
4	IoT enhances convenience in library use.	38.7	35.0	11.1	8.2	7.0

The data from Table 4 shows that postgraduate students at NOUN generally have a positive perception of how IoT technologies enhance their library user experience. In all four items, the combined percentage of respondents who strongly agreed or agreed (SA + A) exceeds 65%, indicating widespread satisfaction. Specifically, 71.6% believe IoT improves the quality of library interactions, 65.9% feel that it makes services more personalized and responsive, 71.6% agree that their overall library experience has improved with IoT, and 73.7% believe it enhances convenience in library use. These high percentages reflect a strong positive perception of IoT's role in enriching the library experience, particularly in terms of quality, personalization, and convenience.

Summary of the Findings

This study revealed that postgraduate students at NOUN have a generally positive perception of the impact of IoT on library services. In terms of access and use of library resources, over 70% of respondents agreed that IoT has improved their ability to locate materials, enhanced service efficiency, and reduced the time spent searching for resources. Similarly, students acknowledged the contribution of IoT to sustainability practices, with over 60% agreeing that it reduces paper usage, electricity consumption, and supports environmental sustainability, although these features were slightly less recognized compared to access benefits. Regarding user experience, more than 65% of respondents indicated that IoT enhances the quality of interactions, personalization of services, and overall convenience. These findings suggest a strong acceptance and appreciation of IoT technologies among postgraduate students, with strengths in access and user experience, and moderate awareness of sustainability-related applications.

Conclusion

The findings of this study demonstrate that IoT technologies have a significant and positive impact on the library services used by postgraduate students at NOUN. Students perceive IoT as a valuable tool that enhances their access to library resources, improves the efficiency and convenience of their interactions, and contributes to a more personalized and responsive user experience. While the sustainability benefits of IoT are also acknowledged—particularly in reducing paper usage and energy consumption, they are slightly less emphasized compared to access and usability. Overall, the integration of IoT in NOUN libraries is well-received and plays a crucial role in transforming library services to meet the evolving needs of postgraduate users.

Recommendations

Based on the findings of this study, the following recommendations are provided:

1. NOUN libraries should strengthen and expand remote access platforms. This could include optimizing digital catalogs, remote authentication systems, and mobile-friendly interfaces to ensure seamless and equitable access to resources from any location.
2. The management of NOUN library should increase awareness through user education campaigns and visible implementation of smart systems such as energy-saving sensors and paperless service processes to highlight the environmental benefits of IoT within the library.
3. NOUN library should continue to invest in user-focused IoT technologies that enhance service personalization and responsiveness. This can include smart reservation systems, interactive help desks, and AI-powered recommendations to further improve user satisfaction and engagement.

References

Ali, S. M., & Bilal, M. (2022). *Internet of Things (IoT) in libraries: Trends, applications, and future directions*. Library Hi Tech, 40(4), 1125–1141. https://doi.org/10.1108/LHT-09-2021-0305

Aina, T. A., & Adigun, J. T. (2023). *Smart technologies and sustainable library development in Nigeria: A framework for green information services*. Journal of Information Science and Technology, 9(1), 35–48.

Alhassan, I., & Adam, I. O. (2022). *Digital transformation and sustainable development in African libraries: The role of emerging technologies*. Library Hi Tech, 40(3), 602–618. https://doi.org/10.1108/LHT-03-2021-0072

Atzori, L., Iera, A., & Morabito, G. (2010). *The Internet of Things: A survey*. Computer Networks, 54(15), 2787–2805. https://doi.org/10.1016/j.comnet.2010.05.010

Bansode, S. Y., & Kulkarni, P. G. (2020). *Environmental sustainability and smart library technologies: A systematic review*. Library Philosophy and Practice, 4829. https://digitalcommons.unl.edu/libphilprac/4829

Eze, P. I., & Nwankwo, A. N. (2022). *Digital transformation readiness of postgraduate students in Nigerian universities: A focus on smart library tools*. Nigerian Journal of Library and Information Science, 20(1), 59–74.

Ifijeh, G., & Yusuf, F. (2023). *Smart libraries and Internet of Things (IoT): Opportunities for enhancing library services in Nigeria*. Information Development, 39(1), 5–14. https://doi.org/10.1177/02666669221084679

Ogbebor, O. A., & Adebayo, T. A. (2023). *Barriers to IoT adoption in academic libraries in developing countries: A Nigerian perspective*. African Journal of Library, Archives and Information Science, 33(1), 52–67.

Omeluzor, S. U., & Anyaoku, E. N. (2024). *Technological innovation and library service delivery in Nigerian academic institutions: The impact of IoT and automation*. International Journal of Library and Information Science, 16(2), 76–89.

Oyelude, A. A. (2022). *Digital libraries and sustainability in the Nigerian context*. Library Management, 43(5/6), 410–423. https://doi.org/10.1108/LM-02-2022-0017

Patil, S., & Patil, A. (2021). *Role of Internet of Things (IoT) in transforming libraries into smart libraries*. International Journal of Library and Information Studies, 11(1), 65–71.

Rahmat, N., & Mohd, N. H. (2022). *Smart libraries and IoT: Improving user engagement and service efficiency in academic environments*. Journal of Academic Librarianship, 48(2), 102491. https://doi.org/10.1016/j.acalib.2022.102491

UNESCO. (2023). *Smart and sustainable libraries: Guidelines for digital infrastructure in developing countries*. Retrieved from https://unesdoc.unesco.org/

Evaluation of Information Governance Implementation in Nigerian Academic Libraries: Adherence to Information Management Standards

[1] **Jika Saidu Muhammad PhD** [2]**Yakubu Attahiru Liman PhD,** [3]**Modibbo Umar Muhammad** [4]**Shuaibu Umar** [5]**Mathias Hussaini** [6]**Abubakar Umar**
1 Department of Library and Information Science, Gombe State University +2348039662599 msaidujika@gmail.com2Federal College of Education (Technical), Keana, Nasarawa State +2348061531042 yakubuattahiruliman@gmail.com3,4,5,6 Department of Library and Information Science, Gombe State Universitymodibbogombe@gmail.com +2348070725039.
babanfarukdazainab@gmail.com, **mathiashussaini@gmail.com**, abbankawu@gmail.com

Abstract
Information governance (IG) refers to the framework, policies, procedures, and controls implemented by organizations to manage and ensure the security, privacy, integrity, and accessibility of their information assets. The objective of this study is to evaluate the implementation of information governance in Nigerian academic libraries with a focus on adherence to information management standards. The study adopted the Information Governance maturity model ARMA to survey the level of compliance of Academic libraries in Nigeria towards implementing IG standards for improved information delivery and services. The model assists organisations in achieving business objectives, minimises the risk posed by sub-standard information handling practices and facilitates compliance with external requirements; and also helped to identify different facets of information disciplines and the responsible oversight mechanism for IG implementation in Nigerian Academic Libraries. The study relied on data obtained through content analysis of policy documents, legislative frameworks, and literature review regarding the identified facets of IG in Nigeria. The study found that, that the implementation of Information Governance in Nigerian academic libraries is at infant stage, characterized by low awareness, weak policy presence, and limited adherence to international standards. The study recommended for creating awareness about IG through training of librarians, and establishing a robust IG framework for effective information management, among other things in the libraries.
Keywords: *Information Governance, Academic libraries, Information management, ISO.*

Introduction
In the digital era, the management and governance of information have become crucial for institutions, particularly in academic environments where knowledge creation and dissemination are core functions. Information governance (IG) refers to the strategic framework that ensures information is managed effectively, securely, and in compliance with relevant policies and standards. Within academic libraries, IG encompasses policies, procedures, and technologies that regulate data quality, privacy, security, accessibility, and ethical use of information.Nigerian academic libraries play a pivotal role in supporting research, learning, and administrative functions. They serve as repositories of knowledge, housing vast collections of both physical and digital resources. As these libraries transition towards digital information systems, the need for robust information management standards becomes imperative. However, challenges such as inadequate infrastructure, lack of skilled personnel, inconsistent policies, and weak regulatory enforcement pose significant barriers to effective IG implementation.
Globally, various information management standards, such as ISO 27001 (information security management), ISO 30301 (records management); while the Open Archival Information System (OAIS) framework, guide institutions in structuring their information governance practices. Compliance with such standards ensures that academic libraries maintain the integrity, confidentiality, and availability of information resources. Despite the relevance of these standards, Nigerian academic libraries often struggle with full implementation due to systemic and institutional constraints.
This study aims to evaluate the level of adherence to information management standards in Nigerian academic libraries by assessing the effectiveness of IG implementation. It seeks to identify existing gaps, challenges, and best practices that can enhance information governance frameworks. By examining the degree to which these libraries comply with global IG standards, the study will provide insights into policy recommendations and strategic interventions necessary for improving information management in Nigerian academic institutions.

Statement of the Problem
Effective information governance (IG) is essential for academic libraries to ensure the proper management, security, and accessibility of information resources. In Nigerian academic libraries, the implementation of information governance frameworks is often challenged by factors such as inadequate policies, lack of

compliance with international standards, insufficient technological infrastructure, and limited staff awareness of best practices.Despite the increasing demand for structured information management, there is a lack of comprehensive evaluation regarding the extent to which Nigerian academic libraries adhere to established information management standards such as ISO 27001, ISO 15489, and other relevant frameworks. The absence of such evaluations raises concerns about data security, privacy, and the efficient organization of information resources.

This study seeks to assess the level of implementation of information governance in Nigerian academic libraries, identify gaps in adherence to information management standards, and provide recommendations for improving IG practices. Understanding these challenges will contribute to the development of more effective policies and strategies for strengthening information governance in academic institutions.

Research Objectives

The study aims to evaluate the implementation of information governance in Nigerian academic libraries with a focus on adherence to information management standards. Specifically, the objectives are to:

1. Assess the level of implementation and compliance of information governance frameworks in Nigerian academic libraries.
2. Examine the extent to which Nigerian academic libraries adhere to established information management standards (e.g., ISO 27001, ISO 15489).
3. Identify the challenges hindering effective implementation of information governance in these libraries.
4. Evaluate the impact of information governance practices on the efficiency, security, and accessibility of library resources.
5. Propose strategies for improving information governance compliance and effectiveness in Nigerian academic libraries.

Research Questions

1. To what extent have Nigerian academic libraries implemented information governance frameworks?
2. How well do Nigerian academic libraries adhere to recognized information management standards?
3. What are the key challenges affecting the implementation of information governance in these libraries?
4. What impact does information governance have on the management, security, and accessibility of library resources?
5. What strategies can be adopted to enhance adherence to information governance standards in Nigerian academic libraries?

Literature Review

Information governance (IG) is a comprehensive framework that encompasses policies, procedures, and standards designed to manage an organization's information assets effectively. In Nigerian academic libraries, the implementation of IG is crucial for enhancing service delivery, safeguarding information resources, and aligning with global information management standards.

Implementation of Information Governance in Nigerian Academic Libraries

Recent studies have explored the adoption of IG frameworks within Nigerian universities. A notable investigation by Jika, Isa, Shamsuddin and Miah (2021) examined the essential components of an IG framework suitable for Nigerian universities, highlighting the necessity for tailored strategies that address the unique challenges faced by these institutions. The study emphasized the importance of integrating comprehensive policies, robust technological infrastructures, and continuous staff training to foster effective IG practices.

Further research by Jika, Isa, Shamsuddin and Miah(2020) identified critical factors influencing the successful implementation of IG in Nigerian universities. Their findings underscored the significance of top management support, clear communication channels, and the establishment of dedicated IG teams to oversee the deployment and maintenance of governance structures. These elements were deemed essential in overcoming resistance to change and ensuring the sustainability of IG initiatives. Recent studies highlight a growing focus on information governance in Nigerian academic libraries as these institutions transition from basic ICT implementations toward integrated, policy-driven digital environments. For example, research on the implementation of library and information policies in Delta State underscores the need for formally documented frameworks to guide digital service delivery and enhance operational efficiency (Anyira, 2021). Similarly, the study on the implementation of information technology in academic libraries, published in early 2024, outlines both the benefits and persistent challenges—such as

funding deficits, unreliable power, and low digital literacy—that continue to impede progress (Uchechukwuka, 2023).
Moreover, investigations into critical factors for effective information governance in Nigerian universities stress that upgrading technological infrastructure, establishing clear policies, and investing in continuous professional development are essential steps to bridge existing gaps (Jika, Isa, Shamsuddin and Miah, 2020). The provision of digital information resources, as examined in a 2022 study, further reveals that while many university libraries have adopted digital platforms, the lack of robust management software and specialized training still hampers the delivery of real-time services (Igbo, Ibegbulam, Asogwa, & Imo, 2022). Most recently, emerging evidence suggests that the adoption of advanced technologies such as artificial intelligence holds promise for revolutionizing cataloguing and access services, indicating a significant potential for further enhancements in information governance (Agboke & Oladokun, 2025).

Adherence to Information Management Standards
Adherence to information management standards in Nigerian academic libraries is crucial for ensuring efficient information handling, compliance with regulations, and the effective delivery of library services.Recent studies have explored various aspects of this adherence, highlighting both the progress made and the challenges faced by these institutions. Compliance with established information management standards, such as ISO 27001 and ISO 15489, serves as a benchmark for assessing the maturity of IG practices. A study focusing on the maturity analysis of the Information Governance Model Matrix in Nigerian academic environments revealed a pressing need for the implementation of standardized IG practices to enhance archive management and administrative efficiency. Similarly, Omaji (2023) evaluated the implementation of library and information policies in Delta State libraries, revealing that many institutions lacked explicit information policy statements.Instead, they operated based on unwritten guidelines, resulting in an average level of policy implementation.
Challenges identified included opposition from stakeholders, insufficient skilled personnel, inadequate funding, and lack of compliance monitoring.The study recommended enforcing policy adoption and providing regular staff training to enhance adherence to information management standards. The research highlighted that adherence to international standards not only improves information security but also streamlines processes, leading to better service delivery in academic libraries.
.
Challenges in Implementing Information Governance in Nigerian Academic Libraries
Despite the recognized importance of IG, Nigerian academic libraries encounter several obstacles in its effective implementation. Uchechukwuka (2023) identified challenges such as inadequate funding, insufficient technological infrastructure, and limited staff proficiency in information technology. These factors collectively impede the adoption of comprehensive IG frameworks, as financial constraints affect the acquisition of necessary technologies and the provision of training programs for library personnel.
Moreover, the dynamic nature of information technology necessitates continuous professional development. Studies have shown that on-going training and capacity building are essential for librarians to stay abreast of emerging trends and best practices in IG, thereby enhancing their ability to manage digital resources effectively. Implementing Information Governance (IG) in Nigerian academic libraries faces several persistent challenges that hinder its effectiveness. A major obstacle is **inadequate funding,** which limits the acquisition of modern technologies and infrastructure essential for IG (Amadi, 2023). **Technological limitations**, including unreliable power supply, poor internet connectivity, and outdated equipment, further complicate the adoption of digital information systems (Amadi, 2023).
Additionally, the **absence of comprehensive policy frameworks** results in inconsistent practices and lack of standardization in information management (Nworie et al., 2023). **Human resource constraints**, such as a shortage of skilled personnel and limited training opportunities, also impede successful implementation (Amadi, 2023).
Furthermore, **security concerns** regarding data protection and unauthorized access highlight the need for robust security protocols (Oguedoihu&Adinchezor, 2022). Addressing these challenges requires strategic investments in funding, technology, policy development, capacity building, and security infrastructure to ensure effective and sustainable IG practices in Nigerian academic libraries

Impact of Information Governance on Library Services
The implementation of robust IG practices has a profound impact on the efficiency, security, and accessibility of library resources. Effective IG ensures that information assets are systematically organized, easily retrievable, and securely maintained, thereby enhancing the overall user experience. Additionally, adherence to IG principles fosters transparency and accountability, which are crucial for maintaining the trust of library patrons and stakeholders.

The impact of IG implementation in libraries was noticed through roadmap implementation for IG which has streamlined library processes notably through AI integration; through which cataloguing and metadata management are enhanced thereby reducing human error and increased efficiency in service delivery to library users (Jika, Shamsuddin, and Miah (2021). Similarly, Isa (2009) was of the view that, robust IG practices is vital for safeguarding library assets through the implementation of cyber security measures and training of librarians ; thereby reducing cyber threats.

Research Methodology

Research Design

This study adopts a **descriptive survey research design**. The design is appropriate for evaluating the level of implementation of Information Governance (IG) in Nigerian academic libraries, particularly in terms of their adherence to recognized Information Management Standards (IMS). This approach enables the collection of quantifiable data from a sample population, allowing for generalizations and in-depth analysis of current practices and challenges.

Population of the Study

The population consists of **professional librarians and records/information management officers** in Nigerian academic libraries, specifically from federal, state, and private universities in Gombe State. The total population of the study is 58 (Federal University of Kashere 26, Gombe State University 27, and North-Eastern University 5. This group is targeted because they are directly involved in developing, implementing, or managing information governance practices.

Sample and Sampling Technique

A multi-stage sampling techniquewill be employed:

Stratified sampling to select universities based on ownership type (Federal, State, and Private). Also, simple random sampling within selected institutions is used to choose individual respondents for this study.A total of 45 respondents (15 from each university type) will be surveyed to ensure a balanced representation.

Research Instruments

The primary instrument for data collection is a structured questionnaire, divided into 5 sections. The questionnaire will include both Likert-scale itemsandopen-ended questions to allow for quantitative and qualitative analysis.

Validity and Reliability of Instrument

The questionnaire has undergonecontent validation by three experts in library and information science, and information systems governance. To test reliability, a pilot study was conducted in two academic libraries outside the main study sample. Cronbach's Alpha coefficient was used to assess internal consistency, aiming for a value of 0.70 or higher.

Data Collection Procedure

Permission was sought from university library management and ethics committees. The questionnaire was distributed electronically (via email or Google Forms). A period of four weeks was allocated for data collection, with follow-ups conducted to increase the response rate.

Data Analysis

Quantitative data will be analysed using the **Statistical Package for the Social Sciences (SPSS):**

- Descriptive statistics (mean, frequency, percentage) for general trends
- Inferential statistics (Chi-square and ANOVA) to determine significant differences in IG implementation across institutions Qualitative responses from open-ended questions will be analysed thematically.
- Ethical Considerations

Participants were informed about the **purpose of the study** and assured of **confidentiality and anonymit**y; with voluntary Participation, and informed consent was obtained before administering the questionnaire.

Data Analysis and Interpretation

Awareness and Understanding of Information Governance (IG)

Respondent's familiarity with the concept of IG. When asked if they were familiar with the concept of information governance, only 12 (29.3%) answered “Yes”, while 29 (70.7%) said “No”. This shows that a majority of library professionals lack familiarity with the core concept, highlighting a critical barrier to implementation.

How did you first learn about IG?
When asked how did the respondents first lean about information governance, 11 (26.8%) answered they learn it from workshops/seminars and formal education, while 19 (31.7%) said they learnt it on the job. This shows that a majority of the respondents learnt about information governance on the job.

Does your Institution have a Formal IG Policy?
Furthermore, only 13 (31.7%) reported that their institution has a formal IG policy, 10 (24.4%) said no policy exists, and 15 (36.6%) were unsure. This ambiguity in policy presence points to weak institutional communication or absence of IG integration into strategic frameworks. The lack of clear and widely disseminated policies makes structured IG practices difficult to enforce.

Rate you understanding of IG Principles

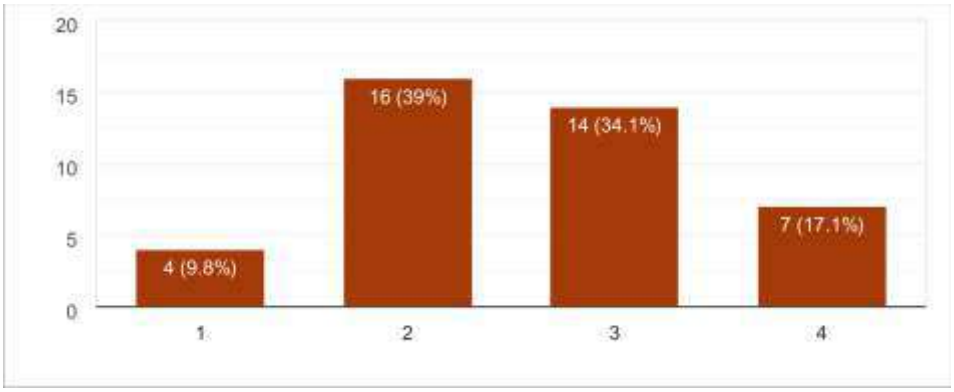


Fig. 8: Respondents response of understanding of IG principles

On a scale of 1 to 4, respondents rated their understanding of IG principles as follows: 4 (9.8%) rated it "Level 1" (low), 7 (17.1%) chose "Level 2", 14 (34.1%) picked "Level 3", and 16 (39.0%) rated themselves at "Level 4" (high). While 73.1% rated themselves at levels 3 or 4, this contrasts with the earlier finding that 70.7% were unfamiliar with the term "information governance." This discrepancy may suggest confusion between IG and other related concepts like information management or records management, indicating the need for clearer definitions and targeted training.

Implementation of Information Governance
To what Extent is IG Implemented in your Library?

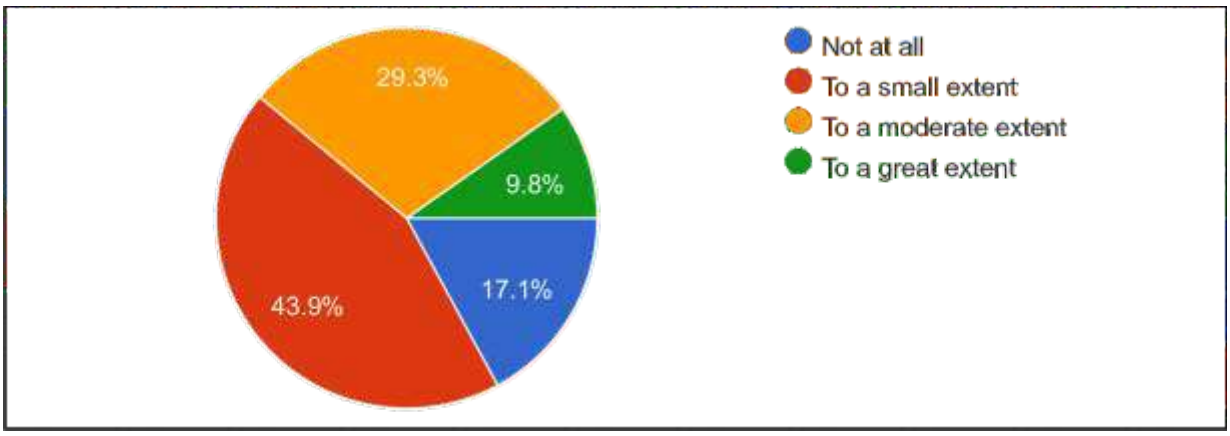


Fig. 9: Response on extent of IG implementation in libraries

From the figure above the respondents were asked to rate the extent of IG implementation in their libraries. 12 (29.3%) said IG was not implemented at all, 7 (17.1%) said to a small extent, 18 (43.9%) indicated moderate extent, and 4 (9.8%) said to a large extent. These figures suggest that IG is still in its developmental stages in most Nigerian academic libraries, with less than 10% reporting full or substantial implementation. This reflects gaps in both strategy and practice, possibly due to inadequate policy frameworks, training, or institutional mandates.

What aspects of IG are implemented in your Institution?

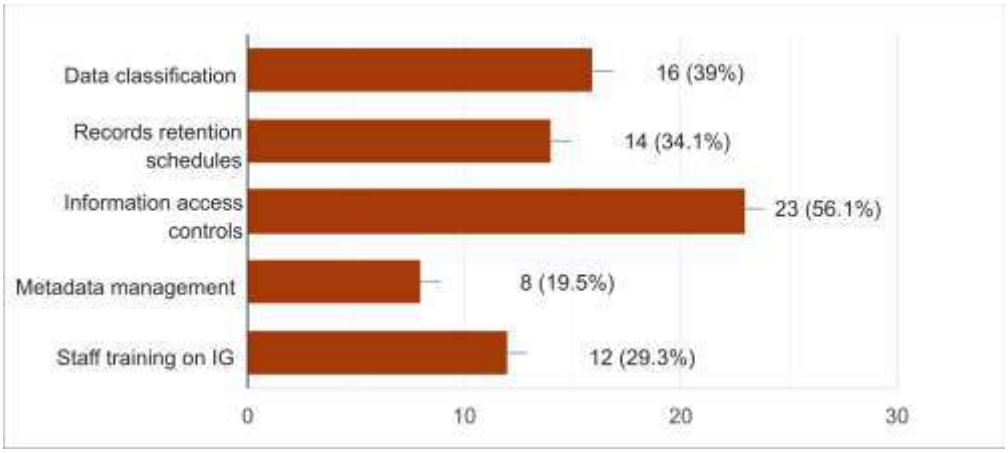


Fig. 10: Response of respondents on what aspects of IG are implemented in their institution

The figure above reflects varied implementation levels of key IG components across institutions of the respondents. A large number of respondents reported the presence of information access control (56.1%) and data classification (39%). Other aspects like records retention schedules (34.1%) and staff training on IG (29.3%) are moderately implemented. However, areas such as metadata management, is less commonly in place (19.5%). This suggests that while some foundational IG elements are being adopted, more advanced and structured components are still lacking in many institutions.

Who is Responsible for Overseeing IG in your Library?

The response of respondents IG oversight responsibilities vary across institutions. The majority of respondents (53.7%) stated that the Library management is responsible for IG in their library, while 22% identified the ICT Unit are responsible. A smaller percentage (19.5%) said there is no one responsible, and 9.8% reported an officer is assigned to the role. This distribution indicates that IG duties are often integrated into existing administrative or ICT roles, and in some cases, may lack clear assignment, potentially leading to fragmented or inconsistent IG implementation.

Adherence to Information Management Standards

Are you aware of any information Management Standards (e.g., ISO 1589, ARMA, COBIT) being used in your Library?

It was revealed that 29.3% of the respondents are aware of Information Governance, while 43.9% are not and 26.8% are not sure of their awareness. This demonstrates that although a majority have some familiarity with IG, a notable proportion still lack awareness, suggesting the need for broader sensitization and capacity-building efforts on the concept

Which of the following standards is your library aligned with?

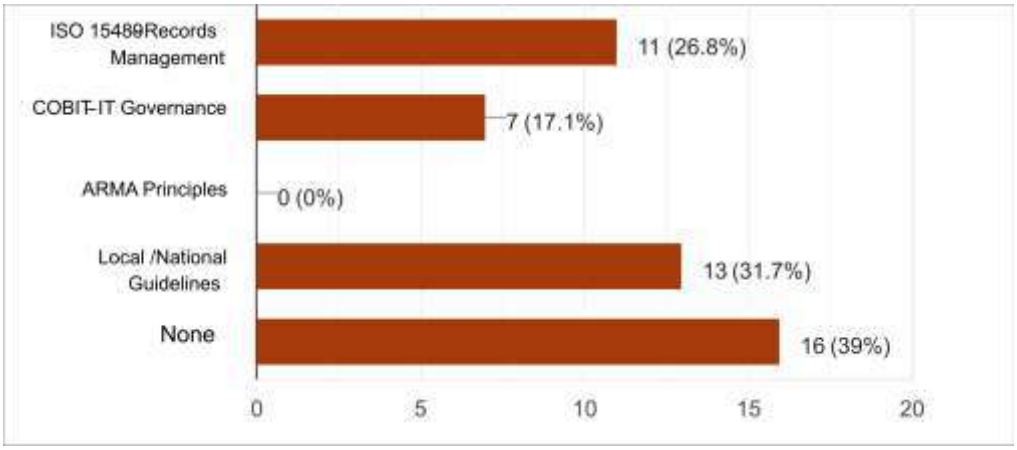


Fig. 13: Respondents responses on which of the following standards is their library aligned

From the above figure 11 (26.8%) respondents responded that the IG-related standards in their library are ISO 15489, COBIT, or ARMA, while 18 (43.9%) were not aware, and 12 (29.3%) were unsure. Regarding specific standards in use, 11 (26.8%) mentioned ISO 15489, 7 (17.1%) cited COBIT, 0 (0%) indicated ARMA, 13 (31.7%) used local or national guidelines, and 16 (39.0%) reported using no standards at all.

These figures show a general lack of alignment with international best practices in information governance. The reliance on informal or localized standards (or none) significantly reduces the ability of institutions to benchmark or validate their IG practices effectively.

Rate the level of adherence to these standards in your Institution?
When asked to rate their institution's level of adherence to any information management standards, 3 (7.3%) said "Very Low", 20 (48.8%) said "Low", 8 (19.5%) said "Moderate", 8 (19.5%) said "High", and 2 (4.9%) said "Very High". These results clearly show that only 10 (24.4%) of institutions claim high or very high adherence. Additionally, 18 (43.9%) reported that their institution conducts regular audits or evaluations to ensure compliance, while 23 (56.1%) said no such measures exist. Without formal mechanisms to monitor compliance, adherence to IG standards where they do exist is likely superficial.

Are there regular audits or evaluations to ensure compliance?
It was found that 43.9% of respondents indicated they don't know if their institutions conduct regular audits or evaluations to ensure compliance with Information Governance (IG) policies, while 29.3% reported that there are regular audits or evaluations to ensure compliance of IG. However, 26.8% said no, which means there is no regular audits or evaluations to ensure compliance. This suggests that more than half of the institutions lack formal mechanisms to monitor and enforce IG practices, which may lead to superficial compliance and a higher risk of regulatory violations or data mismanagement.

Challenges and Recommendation
What challenges hinder the implementation of IG in your library?

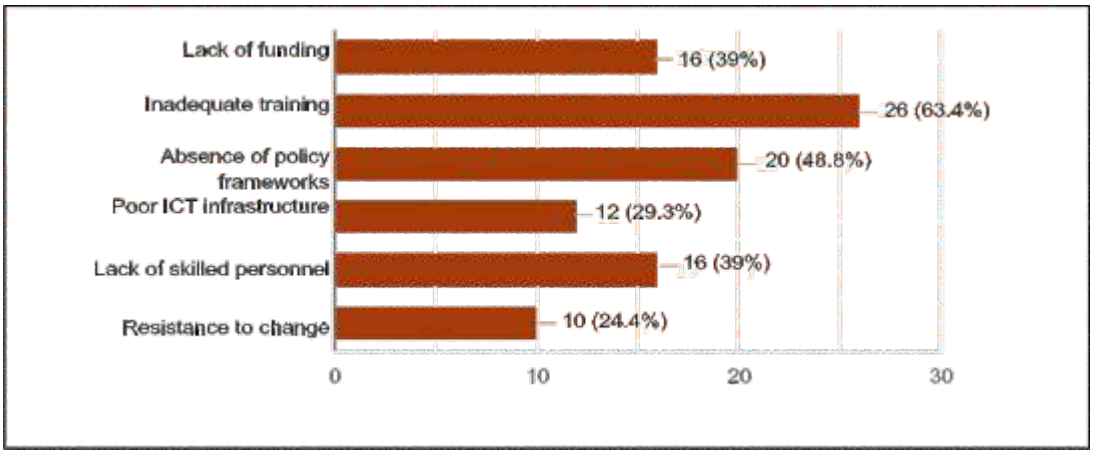


Fig. 16: Respondents response on challenges that hinder IG implementation in their Library

From the figure above Respondents identified several challenges affecting IG implementation. The most cited was inadequate training, mentioned by 26 (63.4%) respondents. 20 (48.8%) noted the absence of policy frameworks, while 16 (39.0%) cited both lack of funding and lack of skilled personnel. 12 (29.3%) pointed to poor ICT infrastructure, and 10 (24.4%) mentioned resistance to change. These results underscore both human and institutional barriers. While the professional qualifications of staff are generally high, the lack of formal training, support structures, and resources significantly hampers implementation.

Suggest way to Improve IG Implementation in your Institution
To improve IG practices, the respondents suggested several actionable strategies. These include organizing seminars, workshops, and training sessions to build staff capacity; formulating and disseminating formal IG policies; and enhancing ICT infrastructure to support digital governance. Increased funding and managerial support were also emphasized, including appeals to TETFUND and university management for financial and supervisory backing. Some also called for the inclusion of IG content in library school curricula. These recommendations reflect a strong awareness among practitioners of what is required to move from minimal implementation to sustained compliance.

Additional Comments and Insights from Respondents
In the open comments section, the respondents reinforced earlier points by stressing the urgency of adopting IG practices, the need for increased awareness campaigns, and training. Several called on university administrators and policy-makers to prioritize IG and provide resources and strategic direction. Others warned that without immediate action, the growing volume of digital information would become

unmanageable and insecure. These remarks emphasize that the call for IG implementation is not merely academic but a practical necessity for information control, access, and institutional efficiency. This is in line with Kpler (2017) and Hobb (2028) who found that, an IG framework is needed by universities to determine what information the university has; which party is held responsible for the information; the location of the information; and the time for retaining information.The purpose of the policy is to put in place the appropriate framework, tools and processes to ensure that the information necessary to support the research carried out by clinical school participants is properly collected and stored in compliance with all current legislation and guidelines (ICO, 2018).

Discussion of Findings

The study revealed that many staff in Nigerian academic libraries are not familiar with the concept of Information Governance (IG), despite their professional qualifications. This approves Jika, Isa, Shamsuddin and Miah (2021) who emphasized in their study the importance of integrating comprehensive policies, robust technological infrastructures, and continuous staff training to foster effective IG practices.

The findings showed that there is limited implementation of IG practices across libraries, with few institutions having formal policies or frameworks in place. Most libraries do not follow recognized international standards such as ISO 15489 or COBIT, and awareness of these standards is generally low. This aligns with Anyira, (2021) statement that that many institutions lacked explicit information policy statements.Instead, they operated based on unwritten guidelines, resulting in an average level of policy

implementation.

Additionally, on compliance monitoring through audits or checks the findings showed that it is rarely conducted, which limits accountability and consistent practice. Several challenges hinder the effective implementation of IG, including lack of training, absence of clear policies, insufficient funding, poor ICT infrastructure, and a shortage of skilled personnel. This also aligns with Anyira, (2021) list of challenges in the implementation of standardized IG practices which includes: opposition from stakeholders, insufficient skilled personnel, inadequate funding, and lack of compliance monitoring.The findings from the study recommended enforcing policy adoption and providing regular staff training to enhance adherence to information management standards. The findings also showed that IG is mostly treated as a responsibility of librarians alone, without involvement from other key departments like ICT and records management.

Conclusion

The study concludes that the implementation of Information Governance in Nigerian academic libraries is at a nascent stage, characterized by low awareness, weak policy presence, and limited adherence to international standards. While most library professionals are academically qualified and experienced, they lack the institutional support, training, and strategic guidance necessary to practice IG effectively. The absence of formal policies, poor infrastructure, and minimal audit mechanisms further weaken compliance and accountability structures. Overall, without a deliberate shift toward strategic IG adoption supported by management and regulatory frameworks, the goal of secure, efficient, and accessible information systems in academic libraries will remain elusive.

Recommendations

Based on the findings and conclusion, the following recommendations are made:

1. Academic libraries should prioritize the development of formal Information Governance policies aligned with international standards (e.g., ISO 15489, ISO 27001).
2. Institutions, in collaboration with professional bodies, should organize continuous workshops, seminars, and certification programs to improve librarians' and related staff's understanding of IG principles, tools, and standards.
3. Tertiary institutions should revise LIS curricula to include core modules on Information Governance and related standards to equip future professionals with the required competencies.
4. Regular internal audits and compliance assessments should be established to monitor the implementation and effectiveness of IG practices and adjust strategies as needed.
5. IG should not be the exclusive domain of librarians. Institutions must foster collaboration between librarians, ICT professionals, records managers, and administrators to ensure a holistic and effective approach to governance.
6. Funding bodies such as TETFUND and university management must allocate dedicated funds for IG development, infrastructure, training, and system audits.

References

Agboke, A. A., & Oladokun, A. A. (2025). Emerging technologies and the future of library and information services in Nigeria. Communicate: Journal of Library and Information Science, 27(1), 22–34.

Amadi, H. N. (2023). Challenges and solutions in the implementation of information technology in Nigerian academic libraries. Information Impact: Journal of Information and Knowledge Management, 14(1), 101–112.

Hobb, R. (2015). Information security policy.Oxford University. Retrieved from http://www.admin.ox.ac.uk/card/ Accessed (24 April, 2025).

ICO (2018). Data Protection Audit Report.Cambridge University – Psychometrics Centre. Information Commission Office

Igbo, H.U., Ibegbulam, I.J., Asogwa, B.E., & Imo, N.T. (2022). Provision of digital information resources in Nigerian university libraries. Information Research, 27(3).

Isa, A. M. (2009). Records management and accountability of governance. Unpublished PhD Thesis, Humanities Advanced Technology and Information Institute, University of Glasgow.

Jika, S.M. (2020). Critical factors for implementing information governance in Nigerian public universities: A case study investigation. Unpublished PhD Thesis submitted to the Faculty of Information Management, University Technology Mara, Malaysia.

Jika, S.M., Isa, A.M., Shamsuddin, A. Z. H. & Miah, S. (2021). Investigating importance and key factors for information governance framework implementation in Nigerian universities. Education and Information Technologies, 26, 5101–5123. https://doi.org/10.1007/s10639-021-10817-4

Kopler, H.C. (2017). Report to council by the Deputy Vice- chancellor: strategy and internalization, university Stellenbosch, South Africa.

Nworie, J. C., Dike, V. W., &Enweani, I. (2023). Records and information management practices in Nigerian university libraries: Challenges and prospects. Library Philosophy and Practice. https://digitalcommons.unl.edu/libphilprac/14746

Oguedoihu, C., &Adinchezor, O. (2022). Library and information services and security challenges in two selected academic libraries in Southeast Nigeria.

Uchechukwuka, U. (2023). Implementation of information technology in academic libraries in Nigeria: Challenges and prospects. Information Impact: Journal of Information and Knowledge Management, 12(1), 45–58.

Omaji, S.E. (2023). Information Governance as a tool for knowledge management in the big data era in Nigerian Universities. Retrieved from https://researchgate.net/publication/375792427. Accessed (12 April, 2025).

Evaluation of Library Security Mechanism, Mutilation and Theft of Library Collections in SelectedAcademic Libraries in Oyo State

Jamiu Oladele MUHAMMED (PhD)
Department of Library and Information Science, University of Ilorin, Ilorin, Nigeria
muhammed.jo@unilorin.edu.ng
Abdullahi A. BAKARE (PhD)
Department of Library and Information Science, Kwara State University, Malete, Kwara State
Tobayan2@gmail.com
Adebola Aderemi OLATOYE (PhD)
Nigerian Baptist Theological Seminary, Ogbomosho, Oyo State.
Adebolaadeyemo0108@gmail.com

Abstract

The study assesses security systems at university libraries as well as how often collection materials are stolen or damaged in selected libraries. The selection of 127 library staff members which included security workers and librarians, used both total enumeration sampling and a descriptive survey approach. Respondents were invited using questionnaires distributed in three libraries: the Adekunle Ogunmola Library, the Lead City University Library and the Kenneth Dike Library (all official names are included). Of the 127 forms distributed, 118 were recovered, leading to a total response rate of 92.9%. The findings demonstrated that manual methods are highly important for security. Plenty of respondents (89.8%) said they could see that the airline checked baggage at departure and even more (85.0%) agreed that the security rules were all plainly posted. Also, 96.6 percent of library directors said they teach users how to use library materials rightly. Even so, many employees shared that 3M electronic gates are available to only 49.2% of workers and even fewer or 39.9%, stated the use of RFID technology. A majority (96.6%) undermine the book by removing pages, while a few may dog-ear or fold the pages incorrectly (92.4%) and even deface the material (93.3%). Criminals in this study often caused theft by borrowing library materials using library cards they had stolen (87.2%), bagging items (81%) or hiding them in their pockets (93%). Incredibly, 75.4% of the people questioned witnessed employees helping with the unlawful removal of library materials from the collection. Insecurity professionals report inadequate training (53.4%), outdated or weak workers (80.5%) and either no or malfunctioning technology (75.4%) as key challenges. As a result, effectively looking after library resources becomes more difficult, so it's important to make planned improvements. The study concluded that although human-based security measures are commonly used, they are insufficient to completely prevent theft and mutilation. The study recommended that academic libraries need to switch to automated and technologically advanced methods, increase funding for electronic security infrastructure, frequent user orientation, the deployment of properly trained security personnel, use artificial intelligence and other cutting-edge technologies for monitoring, and rigorous enforcement of penalties for violators—including employees engaged in insider theft—are among the recommendations.
Keywords: *Academic libraries, Library theft, Mutilation, Security mechanisms*

Introduction

Above the secondary school level, academic libraries are those that are a part of educational establishments and meet the requirements of the community, employees, and students in terms of research and instruction. The two complementary functions of this library are to facilitate student research and the curriculum at school. Okiki and Alabi (2024) defined an academic library as one that is founded at a tertiary institution, such as a university, a college of education, or a polytechnic. Higher education institutions create academic libraries to support the academic community's information demands. An academic library is an essential component of every higher education institution and serves as one of its adjuncts or appendages.

Meeting the information needs of university community members and assisting the institution in achieving its goal of fostering study and research are the main goals of every university library. To do this, university libraries often offer a variety of services to satisfy the information requirements of both the university and its community members. Chukwu, Haco-Obasi, Osuji and Okereke (2021) stated that the totality of library activities aimed at facilitating the use of the library and its resources constitutes service delivery in libraries. Answering users' questions and meeting their information requirements is what a librarian at a university library does, both inside and outside of the available resources.

According to Croxton and Moore (2020), library services are the culmination of all library operations that are intended to make the library and its resources easier to use. The capacity of a librarian to look both inside and outside of the resources that are accessible to answer customers' questions and satisfy their general information requirements is known as service delivery (Olanlokun, 2013). Olanlokun went on to list some services provided by university libraries, including user education, interlibrary loan, abstracting, cataloging, reprographic, bibliographic, circulation, reference, and information services. Additionally, Okunlaya, Syed Abdullah and Alias (2022) clarified that information services make up the majority of services offered in university libraries. Service (information) delivery, according to Dai and Liu (2020), is the provision of information on demand which indicates that a user who makes a specific request will be given the response to his question upon request. Additionally, it is the anticipatory delivery of information aimed at keeping users informed and current in their areas of expertise and adjacent fields. For instructors, students, and researchers who depend entirely on the university library for the material they need to further their knowledge, the library's role is to offer reference and information services. As a result, the librarian is

required to have a broad range of intellectual abilities, a passion for helping users, a flare for document organization, the capacity to search literature, **to communicate fluently and have adequate knowledge of the resources.**

According to Igbinovia and Ishola (2023), library materials are also subject to a variety of mutilations. While some people mutilate books to express their personal political, religious, or social beliefs, others simply like to take notes in borrowed books, highlight passages, or annotate texts to aid in their performance. Libraries serve users' informational requirements by offering physical and bibliographic access to information sources in addition to information services. Theft and mutilation are among the collection security issues that university libraries frequently face. This has an impact on achieving its main objective of offering resources for research, education, and learning. According to Adenike and Raliat (2020), book theft is a deliberate act of removing books from the library in an unauthorized manner. Theft and mutilation in university libraries have become a major concern to researchers, information professionals; institutions and society.

Libraries are establishments that serve the educational, cultural, research, recreational, and information needs of their patrons. Their primary goals are to select, acquire, organize, store, and distribute information to their patrons. Opele, Osunrinde and Awwal (2021), academic libraries in particular serve as a hub where users from a wide range of age groups, sociopolitical backgrounds, economic interests, and cultural backgrounds must congregate to utilize all of the resources that are pertinent to their individual needs. Because of this varied use of the materials, these libraries are susceptible to various types of crime and security threats from both the patrons and the library staff. The necessity to arrange information materials and provide them with sufficient security is prompted by the exponential rise of information and information-bearing items, which is a result of the continuous expansion of knowledge. Library management and information specialists must come up with plans that will allow them to offer sufficient security to safeguard the library's information resources to prevent unwanted access. Vyas and Pathak (2020) library resources are information-bearing materials that help the library achieve its mission of satisfying patrons' information demands.

Libraries gather materials of all sizes and formats in an attempt to offer a wide range of resources to satisfy the needs of their patrons. These resources include manifestations of the printed word, audio and video recordings, microforms, visual and electronic resources, and generations of necessary equipment for accessing or listening to data stored on them. These resources make up library collections that assist in meeting the information needs of users. As more and more electronic resources become available, printed resources will not disappear, and most libraries do not permit patrons to bring their bags or briefcases into the library. Despite these precautions, library materials remain unsafe, so librarians must devise very specific physical measures to secure the materials in the library.

Information security is the practice of protecting information and information-bearing materials from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording, or destruction. and to have telecommunication or electronic security systems that will help to provide a safe and secure facility for library resources and equipment. To provide adequate security using telecommunication, electronic systems such as building alarm systems, access control systems, video surveillance, telesurveillance, etc. can be adopted in the library.

Statement of the Problem

Mutilation and thefts in academic libraries have become increasingly alarming as it continues to grow daily. Library collection security has been a major concern of libraries especially academic libraries. To meet the expectation of the user community, there is need to completely eliminate stock losses. This will enable libraries in Nigeria to meet the demands of their users. Theft and mutilation of library materials is a serious problem which affects students' educational development and jeopardize the efficiency of library services to users. Hence, the security management for prevention of incessant thefts and mutilation of information resources in academic libraries in Nigeria is posing a great threat. This had led to loss of valuable materials in the library. Studies have shown that theft and mutilation in academic libraries can be remedied through the use of modern technologies. Despite these research, there is dearth of literature on the use of modern technological security devices to remedy the increasing wave of theft and mutilation in academic libraries. Therefore, the problem of this study is to evaluate the library security mechanism on mutilation and theft of library collections in selected academic libraries in Oyo State.

Research Questions

1. What are the styles of mutilations by the users in the selected academic libraries?
2. What are the types of electronic security gadgets in the selected academic libraries?
3. What are the means through which library materials are been stolen in the selected academic libraries?
4. What are the human security measures put in place in the selected academic libraries?
5. What are the challenges faced by security personnel in the selected academic libraries?

Literature Review

Concept of Mutilation and Theft in Academic Libraries

Vyas and Pathak (2020) The complete removal of library materials from the premises without following the proper protocols, whether by patrons, employees, or both, is referred to as theft. Mutilation and theft of library resources are described by Hampwaye (2022) as the wilful removal of materials from the library without their being

checked or screened by security operatives. Mutilation is the act of breaking, squeezing or eliminating a necessary component of library resources to make them worthless. This can happen by shredding relevant pages, opening volumes back-to-back, bending a corner of paper, or putting pen or related materials in between pages of books, journals, and dictionaries among others.

Additionally, successful unauthorized removal of library materials from the library and failure to return materials to the library are also considered theft of library materials. The silent but pernicious mutilation of their periodical collections not only drains desperately needed financial resources but also frustrates and frequently infuriates their patrons. For this reason, the problem is so serious that any insight that leads to a reduced rate of mutilation would result in significant financial loss, not to mention less frustration and anger on the part of library staff and innocent patrons, (Innocent, 2019).

User delinquency, according to Anyanwu (2019), is defined as intentional acts and behaviours that are considered unlawful and that users engage in that negatively affect the library. These types of user delinquency include things like mutilation, theft, excessive borrowing, book concealing, book tossing out of windows, loudness, and more. Additionally, Ubogu (2019) clarified that delinquency among library users can take many different forms, including purposefully keeping borrowed books past their due date, hiding them on the wrong shelf or to monopolize them, damage books and furniture, talking and upsetting other patrons, eating and sleeping in the library, and more.

The vast majority of people, who don't care about being caught, believe that mutilation is either not a crime or a minor infraction, and they said that the library should be fined as a punishment, (Kim, 2018). This evaluation of students' perceptions paints a picture of them as being mostly indifferent to mutilation; they believe it to be minor and easily fixed, and they are generally ignorant of the significant expenses and work required to address this issue. Books were vandalized during the examination period. Enidiok, Bassey and Olalekan (2019) onducted a study on the prevalence of book theft in academic settings, particularly academic libraries. He assessed the extent of book theft and mutilation in Nigerian university libraries and suggested some solutions for curbing the menace.

Enamudu, Akannam, Odunsi and Olatunji (2021) and Nweke, (2019) conducted a study. According to the authors, the majority of the impacted resources are reference materials and periodicals including newspapers, magazines, and journals have either been stolen or mutilated. The findings of the response analysis indicated that the majority of the academic libraries under investigation concurred that mutilation and book theft are significant issues affecting their holdings. It is impossible to overstate how quickly materials in university libraries are disappearing.

Book theft and mutilation date back to 539 BC in Egypt, when rolls of papyrus were taken from the Library of Ramses II by Persian invaders in 41 BC, (Iheme, Ukpabi, Ejiako and Ogueri 2021). The authors further opined that to deter theft, library books were chain-locked during the Middle Ages. According to Ajani and Daramola (2022), stealing was the most common security issue that their libraries faced, followed by mutilation. Mutilation is the act of damaging or defacing library collections or resources. Selfishness, lack of availability, poverty, and refusal to use books can also lead to theft and mutilation of library items. Yusuf, Omopupa, Sulaiman and Abdullahi, (2022) also found that users become frustrated when they see books that have been damaged. Adenike and Raliat (2020). conducted a study on theft and mutilation at the University of Lagos' College of Medicine Library and found that patrons have come up with several ways to steal from the library, including throwing books through windows, borrowing books legally and using the date due slip to take another book illegally, and stockpiling books from the library to use for clothing. He also found that during periodic or routine stocktaking, there are significant losses due to theft and mutilation.

Horrible behaviours like theft and mutilation, hiding library materials, failing to return overdue borrowed materials, eating and drinking in the library, arson, damaging library collections, disregarding library policies, and various human-caused disasters like floods and fines, among others, have become commonplace in academic libraries, and if they are not stopped, there will be a severe shortage of information materials. This is according to Oyelola, Onakoya and Yusuf (2023), most university libraries in underdeveloped nations, like Nigeria, lack security measures or checks, and patrons are encouraged to engage in such unethical behaviour. Mutilation or vandalism is the deliberate tearing, marking, or destruction of things by users.

Ajidahun (2021) averred that throughout the past 20 years, libraries' book votes have substantially decreased. Every year, the number of students attending Nigerian universities rises, but the number of votes cast for the acquisition of books for their libraries does not. This has thus created a competitive environment for the limited number of books and other resources accessible in the library, which promotes book theft. The author additionally affirmed that highly sought-after publications are vulnerable to theft when there are enough copies available to support their position.

Chander, Dhar and Bhatt (2022) described how a student evaded security measures to steal books from the University Library and resell them on eBay. The majority of the pilfered volumes were highly sought-after literature and recent editions. According to research, the main reasons for library crime in Nigerian university libraries are the libraries' incapacity to manage the growing number of students, the addition of new courses, and the growth of current ones. This was made worse by the federal and state governments' inadequate support (Adewale & Oluwasanmi, 2007).

Libraries' physical layout, social structure, and social circumstances, such as overcrowding and its associated consequences, all contribute to crime and all of its consequences. It is implied that the way most university libraries in Nigeria are set up is, to put it mildly, a significant risk factor for students and other library patrons to steal, plunder, and damage books. The vast number of students presently in Nigerian institutions of higher learning makes

our library congested, which results in the absence of rigorous "search and entry" owing to the manual security framework, among others, (Nnam, Okogwu and Adinde, 2018).

Causes of Mutilation and Theft of Library Collections in Academic Libraries

Many researchers, including Abdulsalami and Esievo, (2023) and Nwalo (2003) have based their arguments on economic depression and insecurity as the primary cause of library material abuse. Others emphasised a major problem encountered in library security is that the security department of the parent body (in the case of academic and special libraries) insists on providing security personnel for the library. This is because users resorted to delinquent behaviour because demand for library materials outstripped supply, which led to competition for resources, which invariably tempts users to steal, mutilate, or engage in illegal borrowing.

These security guards are loyal to the security department rather than the library authority, which makes it difficult for the librarian to maintain control over security issues in his library because his orders may be disregarded, (Robinson & Sequeiros 2019). In addition, the security guards stationed at the library are frequently illiterate and unable to recognise library materials and guard against theft, and they are always naive because library patrons frequently play on their intelligence. The deployment of trained library personnel at the security posts will undoubtedly improve library security. Farid, Warraich and Iftikhar (2023) identifies the lack of needed books (90.9%) and selfishness (81.81%) as the primary causes of book theft and mutilation; however, his study was not conclusive on the abusers.

Farid, Warraich and Iftikhar (2023) concluded that the lack of routine inventory or stock-taking has made it nearly impossible for the libraries to estimate the size of losses. Numerous authors have shared their opinions about the factors that lead to various types of library misuse. Nonetheless, a lot of academics premise their claims that the primary drivers of library resource misuse are economic despair and security. According to Ubogu, (2019), delinquent behaviours include "dragging books and other information resources out of the library without properly charging them out, tearing off pages of books and other information resources, using chemicals to clean off library ownership stamps in books and removing date labels, and throwing out books and other information resources through windows at night during power outages."

In Nigerian higher education institutions, library crime is on the rise and can take many different forms. Recent theoretical and empirical scholarly reports have documented the extent of library crime in Nigeria and beyond, including but not limited to the research of Oyelola, Onakoya, and Yusuf (2023). According to Ekere and Akor (2019), users of university libraries in Nigeria and other developing countries use a variety of methods to steal books, including: throwing books through windows that have no barriers to prevent books from passing through them, borrowing a book lawfully and using the library's date due slip, and female students becoming "pregnant" with stolen books. The study revealed that the most common method of library crime was the hiding of stolen items under clothing such as suits laboratory coats and free flowing or loose dresses.

Another approach taken by students and other library users in committing various forms of crime in libraries going into the library at odd times and the eleventh hour, that is, at the closing time in a particular school library intending to steal. Some students, more frequently than not, seized on uncertainty arising from rush around and a last-minute rush to outwit library porters and unlawfully remove books belonging to the school. According to (Hogan-Bassey, 2008), a student was observed trying to remove certain volumes from a specific university library at closing time. Because he had more than four library books that he had not borrowed and had tried to steal during that busy time, the porter did not accept his reasons.

A search crew was sent to his dorm the next day to look for library books. Sometimes, library employees coerce students into committing this offence. There is plenty of conclusive evidence to support this assertion. According to survey research published by Ajayi and Omotaya (2004), there is a strong correlation between library personnel collusion and material theft.

Every year, theft and mutilation cause libraries to lose between 5% and 10% of their holdings. According to Mansfield (2007), young offenders—mostly male undergraduates—are responsible for the majority of book theft and mutilation. According to Ogbonyomi's (2011) research on security and crime prevention in academic libraries, there are two ways to look at the types of crimes that occur in libraries: crimes brought on by natural phenomena or causes, as well as crimes committed by human actors.

The crime committed by human agents involves the total or partial loss of library resources, which can be either temporary or permanent and renders the contents useless for subsequent library users. This covers non-return of borrowed items, theft, and mutilation. Fire, water, rats, and insects are examples of natural disasters or forces that can harm library items. According to Lawal and Ogunbode (2023), mutilation can take many different forms, such as destroying book covers and pages, cutting out text or images, writing or scribbling on margins, underlining and highlighting text, and removing protective covers, labels, and date due slips. In the Nimbe Adedipe library at the University of Agriculture Abeokuta, Ajani and Daramola (2022) investigated how students perceived and felt about vandalism. They found that the following factors influenced book theft and vandalism in the library: limitations on the use of certain materials; the quantity and length of loans; the lack of copies of recommended textbooks and the unaffordable cost of personal textbooks; the high cost of photocopying; and peer pressure. Thus, theft and mutilation are unlawful removal of books or pages of books from the library (Ogunyade, 2005).

Ogbonyomi and Hassan (2022) conducted a study on the security of information sources in government-owned polytechnic libraries in the southeast states of Nigeria. The study used a questionnaire to collect data, and 33 respondents were chosen at random from the population. The results showed that power outages, inadequate

infrastructure, a lack of security policies, and inadequate funding were the main obstacles to the security of information sources. Among other things, the study suggested that libraries implement user education in the polytechnic curriculum to teach users about the fundamentals of library ethics, the impact of book theft, and the consequences of mutilation and theft; provision of generating plant to supply power.

Yusuf and Olatunji (2022) investigated methods for preventing theft and damage at the University of Agriculture Makurdi's Francis Sulemanu Idachaba Library (FSIL). A sample size of 60 people was chosen from the population using a random selection procedure. The questionnaire was one of the research tools employed. The results showed that reference, graphical (audio-visual), rare, and disc/picture books were among the items most impacted by theft and damage. The high rates of theft and damage were brought on by users' selfishness and laziness as well as security personnel's lack of attention to detail. Providing sufficient and affordable photocopying services, using an electronic detention system to safeguard library items, and raising staff and public awareness were the tactics used to counter the threat.

Among other recommendations were the creation and execution of a policy against theft and vandalism, the provision of detective barcode machines, appropriate shelving and shelve reading, regular security guard patrols within the library, appropriate instruction regarding the location and accessibility of library materials, and severe sanctions for dishonest patrons. In light of the aforementioned research, it is impossible to undervalue the impact that material theft and mutilation have on libraries, organizations, and patrons.

According to Ajayi and Nnadozie (2023), library security threats pose serious barriers to the use and access of information. Such behaviours are significant issues that may cause consumers to become irate. He listed theft and mutilation, intentionally moving materials, vandalism, excessive or past-due borrowing, destruction, and disaster as the main security concerns in libraries. According to research on collection security, when library property is left unguarded, security breaches frequently occur. McIvor and Bakare (2023) argued that keys are stored unsecured, if not in the user's direct line of sight and that libraries lack security mechanisms including patrolling, monitoring, and supervision.

Electronic Security Devices and Library Collections

It is a way of life to be secure. The purpose of security is to protect documents and historical items from both natural and human threats. Staff members' ongoing attention to detail might contribute to the protection of library resources. There are several ways to guarantee that no materials are checked out before leaving the library. In addition to a detection device that is usually found at a library, these systems always include a security device that is put on the materials (such as books, magazines, video cassettes, audio cassettes, CDs, and DVDs). The detecting device needs to be safe for magnetic media and often has visual or audible alerts, with the option to include a spoken alarm if preferred.

Adedeji and Okiki (2023) state that "there are two major methods currently used for detection; electromagnetic and Radio Frequency Identification (RFID) RFID solutions are being designed to improve library operation/efficiency." According to Brown and Patkus, "RFID tags combine book identification and book security into one label, minimizing labelling time and cost." Libraries that use RFID technology can also offer patron self-checkout systems, which allow patrons to process multiple items at once and turn off security devices in a matter of seconds Maidabino (2010) states that university libraries and librarians are becoming increasingly concerned about the issue of collection security. As a result, a wide variety of issues about collection security in university libraries have been extensively covered in the literature. Taking the required steps to guarantee that the resources made accessible for use in the library are maintained in excellent condition and shielded against theft is known as library security management. Collection security management in libraries may be thought to indicate the total method by which collection security policies, programs, processes, or measures are deployed to limit risk and secure access.

According to McIvor and Bakare (2023), closed-circuit television (CCTV) systems and video surveillance are used to record and monitor security, discourage crime, and guarantee safety. According to the author, CCTV may be used by libraries to monitor work areas, identify patrons and staff, discourage theft, and guarantee the safety of the building and its various amenities. Additionally, the system may be utilized to track and document evidence of staff and client misbehaviour. Likewise, Ogbonyomi and Hassan (2022) said that "the use of closed circuit television (CCTV) in libraries can improve the ability to control the theft of books and the tearing off of pages from books and magazines."Theft and book mutilation were among the security breaches at university libraries that Afolabi and Ajegbomogun (2023) discovered. He attributed these incidents to security shortcomings, a lack of necessary resources, and user budgetary restraints. According to Ajani and Daramola (2022), access to collections is crucial since they have bolstered research in the social sciences, humanities, and sciences and continue to be the foundation of intellectual freedom. Similarly , university libraries must provide a setting where primary source materials are valued, handled with care, and put back into the collection undamaged so that they can be examined again in the future. Therefore, patrons should not have access to things that are not intended for their use.

According to Omoniyi and Adebisi (2022), both staff and students frequently participate in collection theft, which may be because they are not aware of how serious the problem is. McIvor and Bakare (2023) emphasized that staff theft of library collections is a real issue that libraries should address and not ignore due to the risk of negative publicity. Holt proposed several strategies to address staff theft, such as installing high-security lock systems, tightening transportation and movement procedures for collections, marking collections to indicate ownership, maintaining good records, and conducting periodic inventories. He also emphasized the need for libraries to foster a

professional culture and behaviour to protect the library's collection and the necessity for library management to take the lead in developing an honest culture with reporting responsibility.

Suleiman and Olayemi (2023) emphasized how crucial it is to establish a culture of shared accountability for the safety and security of library resources. This entails educating patrons and employees about the rules and regulations about library safety and security, particularly those about food consumption, theft, mutilation, and disruptive conduct. They also concentrated on rules-related training of workers to develop an awareness culture. Some examples show that collection security issues were frequently caused by library employees who were tasked with ensuring the confidentiality, accessibility, and integrity of library items (Ajegbomogun 2004). According to this research, while evaluating the security of a library's collection, the human component and security culture are crucial considerations.

The literature also discusses the significance of good governance. A written security policy, the appointment of a security manager, a security survey to evaluate present and future needs, identifying preventive measures, ensuring secure premises during and after business hours, installing a security system, ensuring collection security through routine inventory, designating collections to establish ownership, establishing a tracking system of lost and overborrowed items, managing, educating, and training users and staff are all part of the security plan that Brown and Patkus (2007) proposed. A set of guidelines for the protection of rare books, manuscripts, and special collections was put out by the Association of College and Research Libraries in 2006. To maintain an acceptable level of collection security in libraries, the guidelines recommended that proper governance be established by hiring library security officers who plan and administer security programs, prepare and spearhead written policies, closely monitor the entrances and exits of special collection reading areas, raise staff awareness of collection security issues, train staff in security measures, keep adequate accession records, monitor users in the stacks, reading and reference areas, and facilitate access through proper cataloguing records and finding aids. Based on the published literature, the researchers identified the factors that should be taken into account when evaluating collection security implementations in libraries.

Methodology

Research Design

This study adopted a descriptive survey research design. It adopted a descriptive survey method because it involves the collection of information from a sample of individuals usually through their responses to questions and it is based principally on the views of the respondents in the population of the study. It also affords the researcher to have direct contact with the sample population and to get firsthand information from them on the subject matter. Moreover, survey design is extensive and gives every element in the population of study a chance to be represented.

Population, Sample and Sampling Techniques

The total population of this study is 127 participants. The sample techniques considered total enumeration since the total population still falls within the range of the study sample. This population comprised all the professional librarians, para-professional librarians, and security personnel. The institutions and their libraries include one federal university library, one private university library and one college of education; Kenneth Dike Library, University of Ibadan in Ibadan, Oyo State, Lead City University Library, Ibadan in Ibadan Oyo State and Adekunle Ogunmola Library, Emmanuel Alayande College of Education, Oyo, Oyo State. The sample techniques considered total enumeration since the total population still falls within the range of the study sample.

Table 1: Population and Sample Table

S/N	NAME OF ACADEMIC LIBRARY	YEAR OF ESTABLISHMENT	PROFESSIONAL LIBRARIANS	PARA-PROFESSIONAL LIBRARIANS	SECURITY PERSONNEL	TOTAL
1	Kenneth Dike Library, University of Ibadan, Ibadan	1948	27	48	5	80
2	Lead City University Library, Ibadan	2005	11	0	4	15
3	Adekunle Ogunmola Library, Emmanuel Alayande, University of Education, Oroki, Oyo	1982	19	9	4	32
Total			**47**	**67**	**13**	**127**

Data Presentation Analysis

Table 2. Questionnaire Response Rate

S/N	Name of University Libraries	Copies of the Questionnaire Distributed	Copies of Questionnaire Returned	Return Rate
1	Kenneth Dike Library	80	73	91.25%
2	Lead City University Library	15	15	100%
3	Adekunle Ogunnola Library	32	30	93.75%
	Total	**127**	**118**	

Table 2 shows the questionnaire response rate. The number of questionnaires that were distributed and the number that were returned. The table revealed that Lead City University Library had the highest return rate of 100% while Kenneth Dike Library had the lowest return rate of 91.25%.

Table 3: Demographic Information of Respondents

S/N			Frequency	Percentage (%)
1	Gender	Male	60	50.8%
		Female	58	49.2%
		Total	**118**	**100%**
2	Status	Professional Librarian	49	41.5%
		Para professional Librarian	56	47.5%
		Security Personnel	13	11.0%
		Total	**118**	**100%**
3	Highest Educational Qualification	NCE	11	9.3%
		OND	16	13.6%
		HND	13	11.0%
		B.Sc.	38	32.2%
		M.Sc.	26	22.0%
		PhD	9	7.6%
		Others	5	4.2%
		Total	**118**	**100%**
4	Years of Working Experience	1-5yrs	24	20.3%
		6-10yrs	37	31.4%
		11-15yrs	33	28.0%
		15yrs and above	24	20.3%
		Total	**118**	**100%**

Table 3 shows the demographic distribution of the respondents. Regarding gender, there is a slight domination of the male gender 60(50.8%) over the female gender 58(49.2%). In terms of the status of the respondents, there are more para-professional librarians 56(47.5%) than the professional librarians 49(41.5%) and the security personnel 13(11.0%) in the university libraries. The highest educational qualification reflects that 11(9.3%) of the respondents have NCE as their highest educational qualification, 16(13.6%) have OND as their highest educational qualification, 13(11.0%) of respondents have HND as their highest educational qualification, 36(32.2%) of respondents have B.Sc. as their highest educational qualification, 26(22.0%) of the respondents have M.Sc. as their highest educational qualification, 9(7.6%) of the respondents have PhD as their highest educational qualification and others have 5(4.2%) of the respondents. It was revealed that the majority of the respondents in the university libraries had B. Sc. as their highest educational qualification. Also, represented in the above table is the year of working experience of the respondents, while 24(20.3%) of the respondents' working experience is within the range of 1-5 years, 37(31.4%) of the respondents' working experience is within the range of 6-10 years,33(28%) of the respondents' working experience is within the range of 11-15 years, 24(20.3%) of the respondents' working experience is within the range of 15 years and above.

Table 4: Styles of Human Mutilation of Library Collections

S/N	Statement	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed
1	Users do tear off pages of materials and take them out library	53 (44.9%)	61 (51.7%)	0 (0.0%)	4 (3.4%)
2	Users do remove the book jacket cover in order not to be identified by the security personnel in the library	47 (39.8%)	58 (49.2%)	8 (6.8%)	5 (4.2%)
3	Users do write inks on the materials to identify their reading areas	51 (43.2%)	60 (50.8%)	4 (3.4%)	3 (2.5%)
4	At times, they involved in dog ear/Abnormal folding of library materials	53 (44.9%)	56 (47.5%)	7 (5.9%)	2 (1.7%)
5	They equally deface library materials	54 (45.8%)	56 (47.5%)	5 (4.2%)	3 (2.5%)

For convenience and easy presentation of the results, the researcher considered all the respondents in the response category that strongly agreed and agreed to share one view. In the same way strongly disagreed and disagreed are sharing the same view. So therefore,
Strongly agreed and Agreed = **strongly agreed**
Strongly disagreed and disagreed = **strongly disagreed**

The styles of human mutilation of library collections were showcased in Table 6 as 114(96.6%) respondents strongly agreed that users do tear off pages of materials and take them out library while 4(3.4%) strongly disagreed that users do tear off pages of materials and take them out the library. 105(89%) respondents strongly agreed that users do remove the book jacket cover in order not to identify it by the security personnel in the library while 13(11%) strongly disagreed that users do not remove the book jacket cover in order not to identify it by the security personnel in the library. 111(93%) respondents strongly agreed that users do write inks on the materials to identify their reading areas while 7(5.9%) respondents strongly disagreed that users do not write inks on the materials to identify their reading areas. 109(92.4%) respondents strongly agreed that at times, they were involved in dog ear/Abnormal folding of library materials while 9(7.2%) strongly disagreed that at times, they were not involved in dog ear/Abnormal folding of library materials. 110(93.3%) respondents strongly agreed that they equally deface library materials while 8(9.7%) respondents strongly disagreed that they do not deface library materials.

Table 5: Electronic Security Measures in the Selected Academic Libraries

S/N	Statement	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed
1	Closed Circuit Television (CCTV) Camera are placed in strategic places in the library to monitor and prevent theft and mutilations	67 (56.8%)	48 (40.7%)	2 (1.7%)	1 (0.8%)
2	3M Security Gates are equally available to prevent theft of library materials	17 (14.4%)	41 (34.7%)	43 (36.4%)	17 (14.4%)
3	Radio-frequency identification (RFID) machines are available to detect mutilated and stolen library materials	21 (17.8%)	26 (22.1%)	47 (39.8%)	24 (20.3%)
4	There are also Scanning machines to detect stolen library materials	18 (15.3%)	28 (23.7%)	35 (29.7%)	37 (31.4%)

For convenience and easy presentation of the results, the researcher considered all the respondents in the response category that strongly agreed and agreed to share one view. In the same way, strongly disagreed and disagreed are sharing the same view. Therefore,

Strongly agreed and Agreed = **strongly agreed**
Strongly disagreed and disagreed = **strongly disagreed**

Table 5 explains the electronic security measures in the library. 115 (97.5%) respondents strongly agreed that Closed Circuit Television (CCTV) Camera are placed in strategic places in the library to monitor and prevent theft and mutilations while 3(2.5%) respondents strongly disagreed that Closed Circuit Television (CCTV) Camera are not placed in strategic places in the library to monitor and prevent theft and mutilations. 58(49.2%) strongly agreed that 3M Security Gates are equally available to prevent the theft of library materials while 60(50.8%) strongly disagreed that 3M Security Gates are not equally available to prevent the theft of library materials. 47(39.9%) respondents strongly agreed that Radio-Frequency Identification (RFID) machines are available to detect mutilated and stolen library materials while 71(60.1%) respondents strongly disagreed that Radio-Frequency Identification (RFID) machines are not available.46(39%) there are also Scanning machines to detect stolen library materials while 72(61.1%)respondents strongly disagreed that there are no Scanning machines to detect stolen library materials.

Table 6: Means through which library materials are been stolen in the selected academic libraries?

S/N	Statement	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed
1	Users do hide the library materials in their pocket	71 (60.2%)	38 (32.2%)	6 (5.1%)	3 (2.5%)
2	Users deliberately drop the library materials in their bags to beat the security at the entrance	47 (39.8%)	58 (49.2%)	10 (8.5%)	3 (2.5%)
3	They create confusion and divert the attention of people at the circulation desk	52 (44.1%)	50 (42.4%)	13 (11.0%)	3 (2.5%)
4	Some users hide portable library materials inside their exercise books and beat security at the entrance	48 (40.7%)	60 (50.8%)	5 (4.2%)	5 (4.2%)
5	Some users steal other registered library cards and to borrow books	43 (36.4%)	60 (50.8%)	9 (7.6%)	6 (5.1%)
6	Some securities compromise and assist the users in stealing material from the library	27 (22.9%)	62 (52.5%)	12 (10.2%)	17 (14.4%)
7	Members of staff equally move out library materials for their use, relatives or children without proper channel of borrowing	39 (33.1%)	48 (40.7%)	16 (13.6%)	15 (12.7%)

For convenience and easy presentation of the results, the researcher considered all the respondents in the response category that strongly agreed and agreed to share one view. In the same way, strongly disagreed and disagreed are sharing the same view. Therefore,
Strongly agreed and Agreed = **strongly agreed**
Strongly disagreed and disagreed = **strongly disagreed**

The styles of theft of library materials are revealed in Table 7 above. 109(93%) respondents strongly agreed that users do hide the library materials in their pocket while 9(7.6%) respondents strongly disagreed that users do not hide the library materials in their pocket. 105(81%) respondents strongly agreed that users deliberately drop the library materials in their bags to beat the security at the entrance while 13(11%) respondents strongly disagreed that users do not deliberately drop the library materials in their bags to beat the security at the entrance. 102(86.5%) respondents strongly agreed that they create confusion and divert attention to people at the circulation desk while 16(13.5%) respondents strongly disagreed that they do not create confusion and divert attention to people at the circulation desk.

Furthermore, 110(91.5%) respondents strongly agreed that some users hide portable library materials inside their exercise books and beat security at the entrance while 10(8.4%) respondents strongly disagreed that some users do not hide portable library materials inside their exercise books and beat security at the entrance. 103(87.2%) respondents strongly agreed that some users steal other registered library cards and to borrow books while 15(12.7%) respondents strongly disagreed that some users do not steal other registered library cards and to borrow books. 89(75.4%) respondents strongly agreed that some securities compromise and assist the users to steal material in the library while 29(24.6%) respondents strongly disagreed that some securities do not compromise and assist the users

to steal material in the library. 87(73.7%) respondents strongly agreed that members of staff equally move out library materials for their use, relatives or children without the proper channel of borrowing while 21(26.3%) respondents strongly disagreed that members of staff do not move out library materials for their use, relatives or children without proper channel of borrowing.

Table 7: Human Security Measures Used in Academic Libraries

S/N	Statements	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed
1	Users' bags or folders are thoroughly checked while moving out of the library	53 (44.9%)	53 (44.9%)	8 (6.8%)	4 (3.4%)
2	All security personnel are trained to detect library materials	32 (27.1%)	50 (42.4%)	27 (22.9%)	9 (7.6%)
3	There are enough security personnel manning the entrance of the library	17 (14.4%)	48 (40.7%)	30 (25.4%)	23 (19.5%)
4	Library securities do have regular movement around the library	20 (16.9%)	36 (30.5%)	31 (26.3%)	31 (26.3%)
5	There is Periodic searching of hostels and staff offices	10 (8.5%)	24 (20.3%)	42 (35.6%)	42 (35.6%)
6	Written security policy was placed on the library's general notice boards	35 (29.7%)	60 (50.8%)	19 (16.1%)	4 (3.4%)
7	There is user education on how to handle library materials	43 (36.4%)	71 (60.2%)	3 (2.5%)	1 (0.8%)
8	Librarys do provide cheaper photocopying services to reduce the incidence of theft and mutilation	26 (22.0%)	37 (31.4%)	43 (36.4%)	12 (10.2%)
9	Proper sanctions are being given to people caught	51 (43.2%)	55 (46.6%)	7 (5.9%)	5 (4.2%)

For convenience and easy presentation of the results, the researcher considered all the respondents in the response category that strongly agreed and agreed to share one view. In the same way, strongly disagreed and disagreed are sharing the same view. Therefore,

Strongly agreed and Agreed = **strongly agreed**

Strongly disagreed and disagreed = **strongly disagreed**

The human security measures used in academic libraries in Oyo state are revealed in Table 2 above. The report shows that 106 (89.8%) respondents strongly agreed that users' bags of folders are thoroughly checked while moving out of the library while 12 (10.2%) respondents strongly disagreed that users' bags are not thoroughly checked while moving out of the library. 82 (69.5%) strongly agreed that all security personnel are trained to detect library materials while 36(30.5%) strongly disagreed that all security personnel are not trained to detect library materials. 65 (55.1%) strongly agreed that there are enough security personnel manning the entrance of the library while 53 (44.9%) strongly disagreed that there are not enough security personnel manning the entrance of the library. 56 (47.4%) strongly agreed that library securities do have regular movement around the library while 62 (52.6%) strongly disagreed that library securities do have regular movement around the library. 34 (28.8%) strongly agreed that there is Periodic searching of hostels and staff offices while 84 71.2(%) strongly disagreed with it. 95 (80.5%) strongly agreed that written security policy was placed on the library general notice boards while 23 (19.5%) strongly disagreed that written security policy was placed on the library general notice boards. 114 (96.6%) strongly agreed that there is user education on how to handle library materials while 4 (3.3%) strongly disagreed there is no user education on how to handle library materials. 59 (53.4%) strongly agreed that libraries do provide cheaper photocopying services to reduce the incidence of theft and mutilation while 55 (46.6%) strongly disagreed that libraries do not provide cheaper photocopying services to reduce the incidence of theft and mutilation. 106 (89.8%) respondents strongly agreed that proper sanctions are being given to people caught while 12 (10.1%) proper sanctions are not being given to people caught.

Table 8: Challenges Faced by the Security Personnel in Protecting the Materials of Academic Libraries

S/N	Statement	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed
1	There is no proper training for security personnel	20 (16.9%)	35 (29.7%)	34 (28.8%)	29 (24.6%)
2	Some of the security personnel in the library are aged people	42 (35.6%)	53 (44.9%)	14 (11.9%)	9 (7.6%)
3	Few securities available are not enough to protect library materials from theft or mutilation	55 (46.6%)	45 (38.1%)	15 (12.7%)	3 (2.5%)
4	Some security personnel are poorly remunerated thereby resulting in poor discharge of duties	3 (2.5%)	42 (35.6%)	57 (48.3%)	16 (13.6%)
5	Some staff equally involved in the theft and mutilation of library materials	17 (14.4%)	45 (38.1%)	37 (31.4%)	19 (16.1%)
6	Those who have been caught in the act of theft and mutilation of library materials are left unpunished	6 (5.1%)	10 (8.5%)	56 (47.5%)	46 (39.0%)
7	All electronic gadgets in the library are not working	4 (3.4%)	25 (21.2%)	55 (46.6%)	34 (28.8%)
8	There are no electronic gadgets in my library to detect any theft or mutilation	11 (9.3%)	12 (10.2%)	60 (50.8%)	35 (29.7%)

For convenience and easy presentation of the results, the researcher considered all the respondents in the response category that strongly agreed and agreed to share one view. In the same way, strongly disagreed and disagreed are sharing the same view. Therefore,
Strongly agreed and Agreed = strongly agreed
Strongly disagreed and disagreed = strongly disagreed

Table 8 above shows that majority of the respondents strongly disagreed that those who have been caught in act of theft and mutilation of library materials are left unpunished, 102(86.5%), there are no electronic gadgets in my library to detect any theft of mutilation,95(80.5%), all electronic gadgets in the library are not working, 89(75.4%), some security personnel are poorly remunerated thereby resulting in poor discharge of duties, 73(62.9%), there are no proper trainings for security personnel, 63(53.4%).

Discussion of Findings

This section discusses the findings of this study.

Human Security Breaches in Academic Libraries

The findings from this study reveal that the most significant threat to the security of library materials in academic institutions in Oyo State stems from human activities. Overwhelmingly, 96.6% of respondents agreed that users tear pages from materials, and similar high percentages confirmed related acts of mutilation and theft, including removing book jackets, writing on materials, dog-earing pages, and defacing documents. These findings align closely with the assertion by Al-Muomen and Al-Qallaf (2022), who observed that academic library users frequently engage in destructive behaviors, especially when strict monitoring systems are absent or ineffective.

Chen and Adusei (2023) argue that material vandalism is increasingly being carried out by users under the pressure of academic demands and resource scarcity. They emphasize that poor ethical education among users and lack of deterrent mechanisms contribute to the increasing rate of mutilation. This corresponds with the current findings that human education and sanctions are needed to reduce these incidents.Conversely, Zhao and Nguyen (2022) provide a slightly different perspective, suggesting that digitization and the proliferation of online resources have significantly reduced physical material mutilation in some regions. While this may be true in technologically advanced contexts, it contrasts with the current study's evidence in Oyo State, Nigeria, where physical collections remain in high use and susceptible to misuse.

Electronic and Human Security Measures: Effectiveness and Gaps

The study further reveals mixed results regarding the availability and functionality of electronic security devices in academic libraries. While 97.5% acknowledged the presence of CCTV cameras, only 49.2% affirmed the presence of 3M security gates, and even fewer reported availability of RFID systems (39.9%) or scanning machines (39%). This uneven deployment mirrors the observations by Abubakar and Madu (2023), who report that many Nigerian academic libraries struggle with underfunding, leading to partial or non-functional implementation of modern security technologies.

Aligned with this, Ahmed et al. (2022) argue that although libraries are gradually adopting technologies like RFID and surveillance systems, maintenance and consistent operation remain problematic. These challenges are reflected in the present study, where respondents indicate that a significant number of security gadgets are either not working or entirely absent.Nonetheless, some researchers highlight the growing reliance on AI and machine learning tools to detect and prevent theft in library environments. For instance, Chang and Dutta (2022) found that integrated smart systems significantly reduce the need for physical security and staff surveillance. This approach, while innovative, does not yet reflect the ground realities of Nigerian university libraries as described in this study, where manual checks and basic electronic systems are still primary safeguards.

Theft Tactics and Internal Complicity

The study highlights a variety of theft tactics used by users, such as hiding materials in personal belongings, stealing registered cards, and creating confusion at circulation desks. A notable finding is that 75.4% of respondents acknowledged complicity by library staff and security personnel in the theft of materials. This echoes the findings by Enwere and Ogbonna (2023), who argue that insider threats in library security are often overlooked but play a significant role in the persistence of theft and mutilation.Contrary to this, Kwame and Lartey (2022) contend that while user malpractices are rampant, internal complicity is generally overestimated and lacks strong empirical backing. However, the quantitative results from the present study provide clear evidence that insider threats are a real concern in Nigerian academic libraries.

Security Personnel and Policy Implementations

Another key dimension explored in the study is the role of human security measures and the effectiveness of library security personnel. While there is strong agreement (89.8%) that user education is provided and bags are checked, only 55.1% believe there are enough personnel at library entrances, and only 47.4% report regular movement by security staff inside the library.The perceived inadequacy of human resources is further supported by data showing that many security personnel are either aged, poorly trained, or under-remunerated. These issues were previously identified by Musa et al. (2022), who stressed that aging security staff and lack of continuous training are significant barriers to effective security enforcement in academic libraries.Furthermore, the finding that proper sanctions are typically enforced (89.8%) contrasts with claims in other contexts that offenders often go unpunished due to institutional leniency or legal gaps (Nwachukwu & Aliyu, 2023). In this case, Oyo State libraries appear more proactive in punitive measures than some other African institutions studied in the literature.

Challenges in Library Security Management

The findings also point to systemic issues in library security, including outdated equipment, lack of periodic staff office and hostel searches, and insufficient policy enforcement. While 80.5% agree that written security policies are displayed, only 28.8% agree that periodic searches are conducted—an essential element in deterring theft. This supports the argument by Mbatha and Okeke (2023) that policy visibility without active enforcement renders library security strategies ineffective.In contrast, Tang and Wu (2022) maintain that with adequate digital tracking and surveillance, physical inspections are no longer essential.

However, in the context of this study, where advanced systems are largely unavailable, the importance of manual inspection cannot be overemphasized.This study provides robust evidence that library security in Nigerian academic institutions remains heavily dependent on human vigilance, basic security protocols, and occasional technological aids. Human-induced risks—mutilation, theft, and insider collusion—emerge as persistent challenges. While some authors advocate for automated, tech-driven solutions, the findings here emphasize the need for holistic strategies encompassing human training, ethical education, adequate staffing, and hybrid security systems. Library security must adapt to local realities, balancing innovation with institutional capacity.

Conclusion

It is no saying that information is as old as the age of humanity, hence it is highly vital that the information sourcesshould be adequately secured and preserved for all sphere of human development, 'intellectual, political, social,cultural development etc. and for posterity. Since libraries are charged with the responsibility of acquiring,storing, exhibiting disseminating information on materials that are historical document, there should be strategicplan for long term security and preservation to such materials. The institutions should not only strive to acquire materials but should ensure that the materials so acquired are secured and preserved in a usable condition forgeneration of users. Based on the findings, the study concludes that academic libraries are still using the human security measures (manual mode of security) vehemently and needs to upgrade the security

mechanism from manual to electronic security measures so as to uproot mutilation and theft from library system completely. The findings also conclude that all the means through which library materials are been mutilated and stolen discussed need to be treated with immediate effect and attention and that the aged people who are security personnel should be relieved and more securities should be employed.

Recommendations

1. University libraries should be well funded by their parent institutions and government so that adequate electronic equipment/devices to detect stolen and mutilated materials of the library will be provided and installed in the library.
2. Artificial intelligence tools should be deployed to detect all acts of theft, and mutilation in academic libraries.
3. Proper and regular library orientation should be carried out for library users as this will. Remind them of the rules governing the use of the library (dos and don'ts).
4. There is a need for all academic libraries to adopt total automation to reduce theft in the academic libraries.
5. Students should report immediately any case of stolen or missing library card and it must be recorded by the library staff.
6. Thorough scrutiny should be done for both library staff and users before they are allowed inside and outside of the library.
7. Constant security appraisal of control measures in the library should be paramount to reflectchanging trends in theft and mutilation of collections.
8. The acquisition and deployment of electronic security devices to complement the human effort.
9. Management to support librarians to enforce fines against staff who are culprits and if possible denysuch individuals access to research funds or allowances.
10. The deployment of adequately trained security personnel to the library.

References

Abdulsalami, L. T., & Esievo, L. O. (2023). Lafia Journal Of Library And Information Science. *Editorial Team*, 70.

Abubakar, B. M., & Madu, A. U. (2023). Security challenges and technological limitations in Nigerian academic libraries. *Journal of African Library and Information Science*, 15(1), 45–58.

Adebayo, A. O., & Fatoki, B. O. (2022). Library service quality and resource protection in Nigerian universities. Nigerian Libraries, 55(2), 18–32.

Adedeji, O. A., & Okiki, O. C. (2023). Adoption of electronic surveillance in Nigerian academic libraries: Issues and prospects. Library Philosophy and Practice, 2023, Article 8764.

Adenike, O., & Raliat, A. (2020). Theft, Mutilation and Abuse of Library and Information Materials by Undergraduate of University of Ibadan, Nigeria. *Information Impact: Journal of Information and Knowledge Management*, *11*(2), 1-12.

Adewale, T. O., & Oluwasanmi, H. (2007). Book theft and its prevention in Nigerian academic libraries. *Gateway Library Journal*, *10*(1), 73-84.

Afolabi, M., & Ajegbomogun, F. O. (2023). Delinquent behaviors and academic library usage among undergraduates in Nigeria. Journal of Library and Information Science Research, 5(1), 14–29.

Ahmed, M. O., Oladele, K. O., & Yusuf, M. A. (2022). Evaluation of the effectiveness of electronic security in university libraries in Nigeria. *Library and Information Science Digest*, 8(2), 23–34.

Ajani, O. S., & Daramola, C. T. (2022). Mutilation and theft of library materials: A study of selected university libraries in Nigeria. Journal of Library and Information Science in Nigeria, 3(1), 42–55.

Ajayi, B., & Nnadozie, G. O. (2023). Digital security systems in Nigerian academic libraries: Challenges and adoption strategies. African Journal of Library, Archives and Information Science, 33(1), 89–102.

Ajidahun, C. (2021). The academic status of librarians in the university libraries in Nigeria: Myth or reality. *Library Philosophy and Practice (e-journal)*, *6225*.

Akinola, A. A., & Salawu, M. T. (2022). Human security strategies for curbing delinquency in Nigerian university libraries. International Journal of Information Science, 12(4), 58–68.

Al-Muomen, N., & Al-Qallaf, C. L. (2022). User behavior and material destruction in academic libraries: A case study. *Library Management*, 43(6), 501–514. https://doi.org/10.1108/LM-04-2022-0047

Anyanwu, J. (2019). A Study Of Delinquent Behaviours In Private University Libraries: The Case Of Veritas And Baze University Libraries, Abuja, Nigeria. *Information Technologist*, *16*(1).

Chander, R., Dhar, M., & Bhatt, K. (2022). Bibliometric analysis of studies on library security issues in academic institutions. *Journal of Access Services*, *19*(2-3), 86-104.

Chang, Y., & Dutta, R. (2022). The role of smart surveillance and automation in securing academic libraries. *International Journal of Information Management*, 65, 102511. https://doi.org/10.1016/j.ijinfomgt.2022.102511

Chen, Y., & Adusei, E. K. (2023). Exploring the ethical dimensions of library material mutilation in higher education. *Library Philosophy and Practice*, Article 7075.

Chukwu, S. A., Haco-Obasi, C. F., Osuji, C. E., & Okereke, A. (2021). Strategic Approach to Networking and Promotion of Information Products and Services in Nigerian University Libraries: With Focus to University Libraries in Imo State Nigeria. *International Journal of Library and Information Science Studies*, *7*(1), 25-34.

Croxton, R. A., & Moore, A. C. (2020). Quantifying library engagement: Aligning library, institutional, and student success data. *College & Research Libraries*, *81*(3), 399.

Dai, H., Ge, L., & Liu, Y. (2020). Information matters: an empirical study of the efficiency of on-demand services. *Information Systems Frontiers*, *22*, 815-827.

Ekere, J. N., & Akor, P. U. (2019). The use of ICT for security and theft prevention in two university libraries in Nigeria. *Library Philosophy and Practice*, 1-40.

Enamudu, J. O., Akannam, S. A., Odunsi, C. O., & Olatunji, S. O. (2021). Impact of public library services on educational transformation in Nigeria: Case study of Oyo State Library Board. *Library Philosophy and Practice*, *2021*, 1-19.

Enidiok, M. S., Bassey, A. B., & Olalekan, O. M. (2019). Vandalism and security problems in academic library: A case study of lagos state polytechnic library, Lagos, Nigeria. *Journal of Library Science and Information Technology; 4 (1): 31*, *36*.

Enwere, M. C., & Ogbonna, A. I. (2023). Insider threats to library security in Nigerian university libraries. *Nigerian Journal of Library and Information Science*, 21(2), 74–88.

Eze, B. N., & Akpan, M. E. (2023). Library material mutilation and theft: Causes and consequences in Nigerian tertiary institutions. Library and Information Science Digest, 4(2), 101–115.

Farid, G., Warraich, N. F., & Iftikhar, S. (2023). Digital information security management policy in academic libraries: A systematic review (2010–2022). *Journal of Information Science*, 01655515231160026.

Hampwaye, B. (2022). *Assessment of the security systems in selected libraries of higher learning institutions in Zambia* (Doctoral dissertation, University of Zambia).

Igbinovia, M. O., & Ishola, B. C. (2023). Cyber security in university libraries and implication for library and information science education in Nigeria. *Digital Library Perspectives*, *39*(3), 248-266.

Iheme, P., Ukpabi, R. K., Ejiako, C. C., & Ogueri, E. (2021). Effects Of Book Theft And Mutilation On Resources And Services Of University Libraries In Imo State, NIGERIA. *Information Technologist*, *18*(2).

Innocent, S. I. (2019). Theft and mutilation on the use of library resources in Nigerian academic libraries. *Library Philosophy and Practice, e-journal*, *2691*.

Kim, A. (2018). Overdue fines in the academic library: Undergraduate student and staff perceptions of overdue fines at the UNC Undergraduate Library.

Kwame, J. A., & Lartey, C. N. (2022). Users vs. insiders: Reassessing threats to academic library resources. *Ghana Library Journal*, 9(1), 13–25.

Lawal, R. A., & Ogunbode, O. K. (2023). Theft and mutilation of print collections in academic libraries: A case study approach. Nigerian Journal of Library and Information Science, 22(2), 45–60.

Mbatha, B., & Okeke, C. I. O. (2023). Library security policy and its implementation in selected African universities. *South African Journal of Libraries and Information Science*, 89(1), 15–29.

McIvor, D. O., & Bakare, S. A. (2023). Enhancing library surveillance with AI and smart technologies: Emerging trends in Nigerian academic libraries. Journal of Applied Information Science, 14(1), 33–47.

Musa, S. O., Bakare, K. T., & Olaniyan, R. B. (2022). Human factors and the security of academic libraries in sub-Saharan Africa. *African Journal of Library, Archives and Information Science*, 32(2), 139–153.

Nnam, M. U., Okogwu, F. I., & Adinde, K. U. (2018). Towards crime prevention and control in the Nigerian library system: Old and new perspectives. *International Journal of Criminal Justice Sciences*, *13*(1), 137.
Nwachukwu, V. E., & Aliyu, H. A. (2023). Enforcement of library rules and the fate of offenders: A Nigerian perspective. *International Journal of Library and Information Services*, 9(1), 33–48.
Nweke, A. C. (2019). Effect of theft and mutilation on the use of library collection in an academic library in Lagos State. *Library philosophy and Practice*, 0_1-15.
Ogbonyomi, P. E., & Hassan, T. K. (2022). Utilization of CCTV and RFID technologies in private university libraries in southwestern Nigeria. International Journal of Knowledge Management and Information Science, 11(2), 74–89.

Ogbuiyi, S. U., & Okorie, C. N. (2023). Library material security and preservation challenges in Nigerian federal universities. Journal of Contemporary Library Studies, 7(1), 60–75.

Ojo, A. A., & Ugwulebo, E. O. (2023). The evolving role of academic libraries in Nigeria's knowledge economy. Nigerian Library Link, 19(1), 12–24.

Okiki, O. C., & Alabi, A. O. (2024). Roles of librarians as research data managers in academic libraries. *Samaru Journal of Information Studies*, *24*(2), 297-316.
Okunlaya, R. O., Syed Abdullah, N., & Alias, R. A. (2022). Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. *Library Hi Tech*, *40*(6), 1869-1892.
Olowu, T. A., & Edewor, N. (2022). Internal threats to library resource security: A study of staff complicity in Nigerian academic libraries. Library Philosophy and Practice, 2022, Article 7546.
Omoniyi, S. O., & Adebisi, K. A. (2022). Evaluating collection preservation strategies in academic libraries in Nigeria. International Journal of Library and Information Services, 9(1), 45–58.
Opele, J. K., Osunrinde, A. A., & Awwal, N. T. (2021). Undergraduates' perception of the influence of book mutilation and defacing on library use in the Federal University Library, Oye-Ekiti. *Journal of Library Services and Technologies*, *3*(2), 101-111.
Oyelola, S. O., Onakoya, D. T., & Yusuf, T. I. (2023). Library Security Mechanisms As A Predictor For Combating Book Theft And Vandalism Among Undergraduates In University Libraries In Ibadan, Oyo State, Nigeria. *Library Philosophy & Practice*. Librarianship, 16(1), 66–78.
Robinson, B., & Sequeiros, P. (2019). No holds barred: Policing and security in the public library. *the Library with the Lead Pipe*.
Suleiman, K. A., & Olayemi, B. T. (2023). Challenges facing security personnel in Nigerian university libraries. African Journal of Library and Archival Science, 13(2), 82–97.

Tang, L., & Wu, Z. (2022). Digitization and its implications on library security management in East Asia. *Asian Journal of Information Science and Technology*, 12(3), 112–123.
Ubogu, J. (2019). Causes of delinquent acts among library users: A case study of the Delta State University Library, Abraka. *Library Philosophy and Practice*, 0_1-15.
Ugwulebo, E. O., & Ume, C. I. (2022). Library theft and its implications for academic development in Nigerian institutions. Journal of Library and Information Research, 14(2), 39–50.

Vyas, P. R., & Pathak, S. R. (2020). Theft and mutilation of library resources in University Libraries of India. *Library Philosophy and Practice*, 1-15.
Yusuf, A. M., & Olatunji, R. A. (2022). Patterns and prevention of book mutilation in federal university libraries in Nigeria. Nigerian Journal of Academic Librarianship, 16(1), 66–78.
Yusuf, A. O., Omopupa, K. T., Sulaiman, K. A., & Abdullahi, R. M. (2022). Utilization of Electronic Surveillance System in Curbing Theft and Mutilation of Library Resources at Kwara State University, Malete, Nigeria. *International Journal of Knowledge Processing Studies*, *2*(1), 29-41.
Zhao, M., & Nguyen, T. (2022). Trends in material usage and protection in the era of digital libraries. *Library Hi Tech*, 40(4), 888–905. https://doi.org/10.1108/LHT-06-2022-0229

Exploring Librarians' Readiness of Positioning Academic Libraries for Research Services in the 5th Industrial Revolution (5IR)

Shuaib Agboola OLARONGBE, Ph.D.
The Polytechnic Librarian,
Kwara State Polytechnic,
Ilorin, Nigeria.
Olarongbe.sa@unilorin.edu.ng

Kennedy Arebamen EIRIEMIOKHALE, Ph.D.
Department of Library and Information Science,
Faculty of Information and Communication Technology,
Kwara State University, Malete, Nigeria.
kennedy.eiriemiokhale@kwasu.edu.ng

Aliyu Tsafe GADANGA, Ph.D.
University Library,
Federal University Gusau,
Zamfara State, Nigeria.
aliyutasafe@fugusau.edu.ng

Abdulakeem Sodeeq SULYMAN
Department of Library and Information Science,
Kwara State Polytechnic,
Ilorin, Nigeria.
Sulyman.abdulakeem@obc.ac.uk

&

Hadizat Keji ABDULRAHAMAN
Department of Library and Information Science,
Kwara State Polytechnic,
Ilorin, Nigeria.
Hadizatabdul001@gmail.com

Abstract

The 5th Industrial Revolution (5IR) has necessitated changes in all spheres of human life, with libraries inclusive. Knowing that research is one of the major pathways to knowledge development necessitates it for this study to explore readiness of positioning academic libraries for research services in the 5IR. This study adopted descriptive survey design. The population consisted of 53 professional librarians in University of Ilorin, Kwara State University and Al-Hikmah University, all in Ilorin metropolis, Kwara State, Nigeria. Total enumeration sampling was used to cover all the respondents. A self-developed questionnaire was used to collect data from the respondents. Data collected was analysed and presented in frequencies, simple percentages, mean and standard deviation. Findings revealed that AI tools (3.35 ± 0.82), Internet-of-Things (3.16 ± 0.99) and cloud computing (2.92 ± 0.98) are the emerging technologies librarians are ready to use for research services including research support (3.08 ± 0.98), organising research sessions/workshops (3.05 ± 0.85), scholarly communication (3.00 ± 0.91) and research data repositories (2.97 ± 0.93). Moreso, findings showed that poor awareness of research services to provide (3.35 ± 0.98), insufficient training on research services (3.32 ± 0.82), inadequate technological skills (3.11 ± 1.02) and inadequate budget to support research services (3.03 ± 0.99) hindered librarians' readiness to provide research services. This study concluded that librarians are ready to use the likes of AI tools and Internet-of-Things to provide research services needed for positioning libraries for the 5IR. One of the recommendations of this study is that management of university libraries in Ilorin metropolis should be providing training to orientate their personnel on emerging technologies that can use for various research services that can position their libraries for the 5IR.

Keywords: 5IR, Research services, Tertiary institutions, Academic libraries, Librarians, Readiness.

Introduction

Tertiary institutions are centers established or set-up by government, organisations or individuals to train people on philosophies, ideals and practices of particular disciplines by exposing them to the propositions and doctrines of scholars, in order to shape their thoughts and nurture them for positive impacts on humanity. Also, tertiary institutions can be viewed as academic set-up established with the aim of enriching people's learning experiences by teaching them the norms, skills and ideals that would make them fit into a particular society or system.

The essential role of tertiary institutions in shaping the future of human growth and development in the society they are found places on them the need to conduct research. This is because through research, discoveries would be made and frontiers of knowledge would be expanded, thus providing clarity to people on the gaps in the current body of knowledge. Meanwhile, it is important to state that tertiary institutions may find it difficult to achieve their objectives in the absence of well-equipped libraries. This is to say that a library is one of the elements that is instrumental to tertiary institutions' seamless participation in promoting research.

Perhaps, academic libraries are established in tertiary institutions with the main purpose of serving the special needs of the clienteles including faculties, non-teaching staff and researchers by supporting the teaching, learning, community development and research endeavours of their host institutions. Because academic libraries are established to support the mission of the parent institution to generate knowledge, equip people with knowledge in order to serve the society and advance the well-being of mankind, it is apt to conclude that supporting research is one of the core roles of academic (Ojo et al., 2019).

Logically, academic libraries would onlyexist in names, if there are no personnel working in them to design and facilitate services provision to the users. The acceptable term for the personnel working in the library is "librarian." Librarians are individuals who are professionally trained and equipped with the requisite skills to handle and manage information, harness its values and transform it into knowledge, thereby contributing their quota to the knowledge-driven society. The burden of adding values to the knowledge-base of the society is much placed on librarians working in tertiary institutions' libraries.

As it has been argued earlier that research outputs are one of the means of determining the relevance of tertiary institutions. This makes it imperative for tertiary institutions' libraries to be rendering research support services, which are the library activities tailored towards assisting the users in conducting research and guiding them in scholarly communication. Research support services have become one the factors used to determine the need for tertiary institutions' libraries in recent times (Adeyeye & Oladokun, 2023).

In Nigeria, the role of tertiary institutions' libraries to research has been subjected to debates in different quarters. The reason for the debates is the noticeable disparity in the quality of services provided by libraries of the different levels of tertiary institutions in Nigeria. Studies have revealed that universities are enjoying an appreciable level of research support services compared to polytechnics, monotechnics and colleges of education. The imbalance experience of Nigerians on research support services in tertiary institutions' libraries justifies why this study explores librarians' readiness of positioning academic libraries for research services in the 5th industrial revolution (5IR).

Statement of the Problem

While academic libraries were attached to tertiary institutions to promote teaching, learning, community service and research, personal observations, experiences and field reports have confirmed the worrisome state of academic libraries in Nigerian higher institutions in their transitions to the 5IR. These problems are highly affecting the quality of services delivery, including research support services. One of the things that is important to clarify is that, it would be wrong to assume that research support services are unavailable in all Nigerian academic institutions' libraries; however, one may be right to assume that the quality of the research support services is low, making it not known among the users and less effective for their research outputs (Adeyeye & Oladokun, 2023).

It is important to stress that the evolution of advanced technologies has compounded the challenges Nigerian academic libraries faced in providing research services to users. Basically, management and leaders of Nigerian academic libraries are struggling to motivate their personnel to embrace technologies for services' provisions. Many librarians in developing and underdeveloped countries are sceptical of delivery library services with technologies, due to their fear becoming irrelevant and eventually losing their jobs to technologies. Moreso, the proficiencies required to operate and navigate emerging technologies further aggravate the librarians' perceptions and readiness to deploy those technologies for research services. Hence, the need to ascertain the readiness of librarians in specific locations to position their libraries for research services in the technology-driven world underscores why this study exploresthe readiness of librarians in academic libraries in Kwara State, Nigeria, to positiontheir libraries for research services in the 5th Industrial Revolution (5IR).

Objectives of the Study

The main objective of this study is to explore librarians' readiness of positioning academic libraries for research services in the 5IR.

The specific objectives are to:

1. determine the emerging technologies ready to be used for research services by librarians in selected academic libraries in Kwara State, Nigeria;
2. ascertain the research services ready to be provided with emerging technologies by librarians in selected academic libraries in Kwara State, Nigeria; and,
3. examine the factors hindering the readiness to provide research services with emerging technologies by librarians in selected academic libraries in Kwara State, Nigeria.

Research Questions

This study aims to answer the following questions:

1. What are the emerging technologies ready to be used for research services by librarians in selected academic libraries in Kwara State, Nigeria?
2. What are the research services ready to be provided with emerging technologies by librarians in selected academic libraries in Kwara State, Nigeria?
3. What are the factors hindering the readiness to provide research services with emerging technologies by librarians in selected academic libraries in Kwara State, Nigeria?

Literature Review

Research services have been prioritised in libraries in academic institutions across the globe, as this claim would be supported with literature. Librarians provide research support services such as literature guides, information and digital literacy, training on research skills, facilitating access to institutional repositories and academic databases to users. This is supported by Davlatov (2022) who reported that librarians play a crucial role in research and publication by providing access to printed materials, offering information about publications, and fostering reading culture. Their deep erudition and knowledge in library and information activities enhance users' engagement with resources.

Studies have also established that librarians have been key drivers of Open Science Initiative by encouraging researchers to make their studies available to other researchers through open access. For example, Shevchenko (2024) found that librarians played a crucial role in the research and publication process by facilitating open science practices, supporting researchers with tools throughout the research lifecycle, and ensuring that research results are publicly available, thereby promoting collaboration and transparency in scientific endeavours. This is also similar to the claim of The Scholarly Communication Landscape (2023) which posited that librarians play a crucial role in research and publication by supporting academic work, explaining key concepts like preprints and peer-reviewed publications and enhancing information and media literacy.

Another form of research support services librarians provide to researchers is research data management services. Kotur (2024) support this claim by reporting that librarians facilitate research and publication by curating information resources, managing literature reviews, and enhancing citation management. Librarians also connect researchers through networking initiatives, support technology integration, and create collaborative spaces, thereby optimizing the research collaboration environment within academic institutions.

Furthermore, librarians have been found to be advocates of ethical research by teaching and training researchers how to conduct research ethically. Schmidt et al. (2024) asserted that librarians play a crucial role in promoting responsible research practices by partnering with researchers, enhancing research infrastructure, and raising awareness about transparency and reproducibility, thereby supporting the overall effort to ensure research reproducibility within academic communities.

It has also been established in studies thatlibrarians guide researchers in publishing their works in reputable outlets. Mubofu and Mambo (2022) affirmed that librarians play a crucial role in supporting the publishing process in academic institutions by providing research support services, raising awareness among academicians about the services and addressing factors that hinder writing and publishing to ultimately improve researchers' publication rates. Moreover, librarians play a crucial role in advising researchers on Open Access (OA) publishing, addressing barriers, and advocating for regulated OA policies at national and institutional levels to enhance their influence as leaders in the OA movement (Kotur, 2024).

Contextually, literature have reported Nigerian academic institutions' libraries' provision of research support services to researchers using the traditional means. The noticeable overreliance of Nigerian librarians on traditional research support services made Adeyeye and Oladokun (2023) posited that the evolution of emerging technologies has brought drastic changes to research support services, forcing librarians in Nigerian academic libraries to adjust to the trending practices. This confirms the notion of Suleiman (2024) that Nigerian academic libraries can enhance research support by integrating AI technologies to improve information retrieval, provide personalized recommendations, and streamline administrative processes, ultimately transforming academic support and user satisfaction in the digital landscape.

Going forward, librarians in Nigerian academic institutions have been reported to provide research support services to users. The acknowledgement of this encouraging provision of research support services makes Rabasa and Abrizah (2024) argued that despite being perceived primarily as information providers,Nigerian academic librariansare increasingly empowered and engaged as research partners, enhancing their collaboration with faculty and improving research support through an embedded librarianship model.

In establishing the role of Nigerian academic institutions' roles to research and publications, Olanusi (2023) argued that Nigerian academic librarians actively engage in collaborative research, utilizing tools like Google+ and Whatsapp, which enhances publication output. Similarly, Nze et al. (2024) found that academic librarians in Delta State, Nigeria, play a crucial role in providing research resources and supporting research.

Moreso, studies have reported Nigerian academic librarians' partial adoption of emerging technologies such as AI, cloud computing, big data, IoT and drones for research support services. Adeyeye and Oladokun (2023) stressed that Nigerian academic libraries are increasingly adopting emerging technologies to enhance research support, addressing low research productivity among scholars. According to Ajayi et al. (2024), academic and research librarians in Lagos State are adapting to emerging technologies and trends, emphasizing the need for professional development to enhance their support for research and library services amidst challenges like funding scarcity.

Despite the growing attentions to the provision of research support services in Nigerian academic institutions' libraries, it has been reported that many problems mitigate its effectiveness. By compressing arrays of available literature, this paper found inadequate technological infrastructure, librarians limited technological skills, resistance to change hinder the effective implementation of these technologies, Internet connectivity issues and lack of funding as hinderances to research support services. Others include

challenges in accessing intervention programmes and low institutional support for AI-powered tools, etc (Adeyeye & Oladokun, 2023; Akwang & Ebiwolate, 2024; Akwang et al., 2024; Olanusi, 2023).

Methodology

This study adopted descriptive survey design to gather quantitative data on librarians' perceptions and opinions on their readiness of positioning academic libraries for research services in the 5IR. The population of this study is 53 professional librarians in libraries of universities in Ilorin metropolis, Kwara State, Nigeria, namely; University of Ilorin, Kwara State University and Al-Hikmah University. Total enumeration sampling technique was used since the population is small and manageable for the researchers to cover. A self-developed questionnaire, which was validated by two librarians in Ilorin was used to collect data from the respondents. Data collected was analysed and presented in simple percentage, frequencies, mean and standard deviation.

Data Analysis

Table 1: Demographic Information of Respondents

Options		F	%
Gender	Male	21	56.8
	Female	16	43.2
	Total	**37**	**100**
Respondent's library	University of Ilorin Library	19	51.4
	Kwara State University Library	11	29.7
	Al-Hikmah University Library	7	18.9
	Total	**37**	**100**
Age range	21-30 years	4	10.8
	31-40 years	20	54.1
	41-50 years	12	32.4
	51-60 years	2	5.4
	61 years and above	0	0
	Total	**37**	**100**
Academic qualification	ND	0	0.0
	HND	3	8.1
	BLIS	18	48.6
	MLIS	15	40.5
	PhD	1	2.7
	Total	**37**	**100**
Work experience	1-5 years	2	5.4
	6-10 years	18	48.6
	11-15 years	15	40.5
	16-20 years	2	5.4
	21 years and above	0	0.0
	Total	**37**	**100**

Source: Researcher's Field Survey, 2025

Table 1 shows that majority 21 (56.8%) of the respondents are male, while 16 (43.2%) are females. University of Ilorin has the highest representation with 19 (51.4%), followed by Kwara State University Malete, 11 (29.7%) and Al-Hikmah University 7 (18.9%). Also, 20 (54.1%) are within the age range 31 – 40 years, followed by 41 – 50 years (12 32.4%), 21 – 30 years (4 10.4%) and 51 – 60 years (2 1.4%). Moreso, most of the respondents are BLIS holders with 18 (48.6%), followed by MLIS (15 40.5%), HND (3 8.1%) and PhD (1 2.7%). Finally, 18 (48.6%) has 6 – 10 years' work experience, followed by 11 – 15 years (15 40.5%), have 1 – 5 years and 2 (5.4%) for 1 – 5 and 16 – 20 years respectively.

Table 2: Emerging technologies librarians are ready to use for research services in the 5IR

	SA		A		D		SD			
Options	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**M**	**SD**
AI tools	19	51.4	14	37.8	2	5.4	2	5.4	3.35	0.82
Internet-of-Things (IoT)	17	45.9	13	35.1	3	8.1	4	10.8	3.16	0.99
Cloud computing	11	29.7	17	45.9	4	10.8	5	13.5	2.92	0.98
Machine learning (ML)	6	16.2	23	62.2	4	10.8	4	10.8	2.84	0.83
Edge computing	10	27.0	10	27.0	8	21.6	9	24.3	2.57	1.14
Blockchain	7	18.9	11	29.7	12	32.4	7	18.9	2.49	1.02
Augmented reality (AR)	7	18.9	8	21.6	17	45.9	5	13.5	2.46	0.96
Virtual reality (VR)	3	8.1	6	16.2	15	40.5	13	35.1	1.97	0.93

Source: Researchers' Field Survey, 2025

Table 2 reveals that AI tools is ranked highest out of the emerging technologies librarians are ready to use for research services in the 5IR with (3.35 ± 0.82), followed by Internet-of-Things (3.16 ± 0.99) and cloud computing (2.92 ± 0.98). On the other hand, VR(1.97 ± 0.93) is ranked lowest. This implies that AI tools, Internet-of-Things and cloud computing are the major emerging technologies libraries are ready to use for research services in the 5IR.

Table 3: Research services librarians are ready to provide for positioning their libraries for the 5IR

Options	SA		A		D		SD		M	SD
	F	%	F	%	F	%	F	%		
Research support/consulta	15	40.5	14	37.8	4	10.8	4	10.8	3.08	0.98
Organising research sessions/workshops	12	32.4	17	45.9	6	16.2	2	5.4	3.05	0.85
Scholarly communication	11	29.7	19	51.4	3	8.1	4	10.8	3.00	0.91
Research data repositories	11	29.7	18	48.6	4	10.8	4	10.8	2.97	0.93
Acquisition of research oriented collections	10	27.0	16	43.2	8	21.6	3	8.1	2.89	0.91
Provision of access to e resources	10	27.0	14	37.8	11	29.7	2	5.4	2.86	0.89
Research data managemer	8	21.6	15	40.5	9	24.3	5	13.5	2.70	0.97
Open science initiatives	8	21.6	12	32.4	13	35.1	4	10.8	2.65	0.95
Digitalscholarship services	8	21.6	9	24.3	10	27.0	10	27.0	2.41	1.12
Interlibrary loan	7	18.9	11	29.7	8	21.6	11	29.7	2.38	1.11

Source: Researchers' Field Survey, 2025

Table 3 points out that research support is ranked highest out of the research services librarians are ready to provide for positioning their libraries for the 5IR with (3.08 ± 0.98), followed by organising research sessions/workshops (3.05 ± 0.85), scholarly communication (3.00 ± 0.91) and research data repositories (2.97 ± 0.93). However, interlibrary loan (2.38 ± 1.11) is ranked lowest. This means that research support, organising research sessions/workshops, scholarly communication and research data repositories are the major research services librarians are ready to provide for positioning their libraries for the 5IR.

Table 4: Factors hindering librarians' readiness to provide research services for positioning their libraries for the 5IR

Options	SA		A		D		SD		M	SD
	F	%	F	%	F	%	F	%		
Poor awareness of research services librarians can provide	23	62.2	7	18.9	4	10.8	3	8.1	3.35	0.98
Insufficient training on research services	18	48.6	15	40.5	2	5.4	2	5.4	3.32	0.82
Inadequate technological skills	17	45.9	11	29.7	5	13.5	4	10.8	3.11	1.02
Inadequate budget to support research services	14	37.8	14	37.8	5	13.5	4	10.8	3.03	0.99
Inadequate technological infrastructure	11	29.7	13	35.1	7	18.9	6	16.2	2.78	1.06
Workload	11	29.7	9	24.3	13	35.1	4	10.8	2.73	1.02
Researchers' undervaluing	10	27.0	10	27.0	13	35.1	4	10.8	2.70	1.00
Limited collaborations with researchers	6	16.2	11	29.7	11	29.7	9	24.3	2.38	1.04
Insufficient staff strength	8	21.6	7	18.9	12	32.4	10	27.0	2.35	1.11

Source: Researchers' Field Survey, 2025

Table 4shows that poor awareness of research services librarians can provide is ranked highest out of the factors hindering librarians' readiness to provide research services for positioning their libraries for the 5IR with (3.35 ± 0.98), followed by insufficient training on research services(3.32 ± 0.82), inadequate technological skills (3.11 ± 1.02) and inadequate budget to support research services (3.03 ± 0.99). On the other hand, insufficient staff strength(2.35 ± 1.11) is ranked lowest. This implies that poor awareness of research services, insufficient training on research services, inadequate technological skills and inadequate budget to support research services are the major factors hindering librarians' readiness to provide research services for positioning their libraries for the 5IR.

Discussion of Findings

It can be deduced from the findings of this study that the respondents are ready to adopt AI tools, IoT and cloud computing for research support services. This shows an encouraging trend in the respondents' awareness of the emerging technologies they can harness to provide research services, thereby complimenting their role as research partners that will be enhancing research collaborations within their respective institutions. The readiness to use the tools by the respondents affirmed the argument of Olanusi (2023) that Nigerian academic librarians have always actively being the frontrunners when it comes to deploying technologies for research-related services.

Interestingly, the respondents' readiness to use AI tools, IoT and cloud computing implies that the respondents are ready to adopt emerging technologies for different research processes, ranging from research conceptualisation, literature review, data collection and analysis and storage. For example, the respondents' readiness to adopt AI tools showed that the respondents are ready to be deploying ChatGPT, DeepSeek, Scite, PaperPal, SciSpace and others for research conceptualisation and reviewing of literature, while the cloud computing tools will be harnessed for research data management.

One of the purposes of deploying technologies for services delivery in libraries is to minimise geographical barriers, allowing librarians and users to interact on information provision, regardless of their locations. Consequently, it is disturbing to discover that VR has the lowest scores out of the emerging technologies the respondents are ready to adopt. This indicates a low level of understanding of VR among the respondents and how it can be adopted for research support services.

The emerging technological tools the respondents are ready to adopt can be used to have insights about the research support services they want to be providing. The respondents' readiness to adopt emerging technologies for research support, organising research sessions/workshops, scholarly communication and research data repositories affirm these researchers' deductions that the respondents' interest in the provision of research services. The respondents' readiness to render research support, organising research sessions/workshops and scholarly communication validates the claims of Adeyeye and Oladokun (2023); Kotur (2024) that academic librarians have started harnessing emerging technologies to drive collaborations among scholars and enhance their research productivity.

Moreso, the respondents' readiness to adopt emerging technologies for organising research sessions/workshops and scholarly communication corroborates the notions of Suleiman (2024) that Nigerian academic libraries are becoming fond of enhancing their research support services integrating AI technologies to improve information retrieval, provide personalized recommendations, ultimately transforming academic support and user satisfaction in the digital landscape. Moreover, the readiness to provide research data repositories' services by the respondents indicates their willingness to promote research data management by leveraging emerging technologies.

Nonetheless, discovering that the respondents' readiness to adopt emerging technologies for interlibrary loan being ranked lowest (2.38 ± 1.11) is worrisome. This reflects the respondents' level of awareness of some emerging technologies that can be adopted for interlibrary loan services. Technologies such as robotics, IoT and drones can be adopted for interlibrary loan services and they will help in rendering the services efficiently and effectively.

As ready as the respondents are to adopt emerging technologies for research support services, this study revealed that poor awareness of research services, insufficient training on research services, inadequate technological skills and inadequate budget to support research services constitute the banes of research support services they are ready to provide. This implies that the major factors limiting the respondents from providing research support services in the 5IR are associated with their institutions, as shown that only poor awareness of research services is a personal factor.

Among the problems revealed, inadequate budget to support research services is seen as the absolute problem that leads to other remote problems such as insufficient training on research services and inadequate technological skills. This is because the lack of funding would make it difficult for librarians to be trained; and when training is lacking, librarians will not be able to acquire the skills needed to perform research services prudently, particularly in this technology-driven era. This affirms the submission of Ajayi et al. (2024) that funding scarcity hampers librarians' participations in professional development to enhance their capacities for research support services.

Conclusion

The 5IR is an era that ushered in sophisticated technologies whose values can be exploited by librarians for research purposes. This study provides windows to peep into librarians' readiness to provide research services for positioning their libraries for the 5IR by revealing that librarians in university libraries in Ilorin metropolis are ready to use AI tools, Internet-of-Things and cloud computing for research support/consultation. Also, the librarians are ready to organise research sessions/workshops, support scholarly communication and research data repositories. Nonetheless, librarians' readiness can manifest in positioning libraries for research services in the 5IR by addressing the challenges such as poor awareness of research services, insufficient training on research services, inadequate technological skills and inadequate budget to support research services.

Recommendations

Based on the findings, this study recommends that:

1. Management of university libraries in Ilorin metropolis, Kwara State, Nigeria, should be providing training to orientate their personnel on emerging technologies like VR and AR that can be used for various research services that can position their libraries for the 5IR.
2. Librarians in university libraries in Ilorin metropolis, Kwara State, Nigeria, should, on their own, prioritise learning about emerging technologies and how they can be adopted for different library services. This will be serving as an impetus for exposing them to the different research support services emerging technologies can be adopted for the 5IR.

References

Adekoya, C. O. (2023). Research collaboration among library and information science professionals in Nigerian universities. *Library Management*. https://doi.org/10.1108/lm-07-2023-0062

Adeyeye, S.V. & Oladokun, T.A. (2023). Application of emerging technologies for research support in Nigerian academic libraries: Trends, problems and prospects, *IASSIST Quarterly*, 47(3-4), pp1-8. DOI: https://doi.org/10.29173/iq1069

Ajayi, T., Ojo, J., Oyeniyi, W. O., & Otuyalo, M. (2024). The survey of professional development practices for the emerging trends among academic and research librarians in Lagos State. https://doi.org/10.70118/ijkd.02040501.3

Akwang, N. E., & Ebiwolate, P. B. (2024). Library and Information Science professionals' awareness, competencies, institutional support, and application of ai-powered tools in research writing in South-South, Nigerian universities. *Asian Journal of Education and Social Studies,* 50(7), 451–466. https://doi.org/10.9734/ajess/2024/v50i71476

Akwang, N. E., Udoh, I. U., & Obot, I. N. (2024). Assessment of intervention programmes and technological innovations for library growth in public universities in Nigeria. *Asian Journal of Education and Social Studies*, 50(7), 627–639. https://doi.org/10.9734/ajess/2024/v50i71493

Davlatov, S. (2022). The leading role of the librarian in providing library and information services to users. *Infolib*, 29(1), 30–35. https://doi.org/10.47267/2181-8207/2022/1-100

Ikonne, C. N., Unegbu, V. E., & Sulaiman, M. (2024). Influence of institutional support on digitization practices of librarians in federal universities in Northeastern Nigeria. *Journal of Library Services and Technology*, 6(1), 107–119. https://doi.org/10.47524/jlst.v6i1.108

Kotur, M. (2024). Role of Librarian in Facilitating Research Collaboration: An Analysis. Social Science Research Network. https://doi.org/10.2139/ssrn.4830333

Mubofu, C., & Mambo, H. L. (2022). Academic writing and publication support services: The role of librarians in higher learning institutions. *Serials Librarian*, 83, 261–276. https://doi.org/10.1080/0361526x.2023.2227660

Nze, B. C., Achugbue, E. I., & Ogbomo, E. F. (2024). Librarians' attitudes, work environment and service delivery in academic libraries in Delta State, Nigeria. *Library and Information Perspectives and Research*, 6(2), 32–45. https://doi.org/10.47524/lipr.v6i2.33

Ojo, J.O., Mohammed, M., Buba, A.M. & Mairiga, H.M. (2019). Students' use of information resources of the Federal University Library, Dutse Library, Dutse, Jigawa State, Nigeria. *Library and Information Perspectives and Research,* 1(2), 71 – 79.

Olanusi, A. E. (2023). Collaborative research among academic librarians in public universities libraries in north–central, Nigeria. *Journal of Balkan Libraries Union*. https://doi.org/10.16918/jblu.1182876

Rabasa, T., & Abrizah, A. (2024). The academic librarians' empowerment and engagement as research partners: a qualitative study. *Malaysian Journal of Library & Information Science*, 29(1), 75–89. https://doi.org/10.22452/mjlis.vol29no1.4

Schmidt, B., Chiarelli, A., Loffreda, L., & Sondervan, J. (2024). Emerging roles and responsibilities of libraries in support of reproducible research. *The Liber Quarterly*. https://doi.org/10.53377/lq.14947

Shevchenko, L. B. (2024). A Librarian – a Member of Open Research Process. *Библиосфера*, 4, 89–97. https://doi.org/10.20913/1815-3186-2024-4-89-97

Sugihartati, R., Harisanty, D., Dewi, A., Suyanto, B., Wardhana, A. W. P., & Egalita, N. (2025). Perceptions of the role of research librarian: A phenomenological study. *IFLA Journal*. https://doi.org/10.1177/03400352241310551

Suleiman, Y. (2024). Adoption of ai-based library services: a necessity for Nigerian universities. 2(02), 288–303. https://doi.org/10.36349/lajocse.2024.v02i02.022

The Scholarly Communication Landscape. (2023). 1–10. https://doi.org/10.29085/9781783306268.002

Exploring Metadata Management in the Age of Artificial Intelligence, Challenges, Opportunities, and Future Trends for Libraries: A Content Analysis

Diseiye Oyighan[1], Ejiro Sandra Ukubeyinje[2] &Bolaji David Oladokun[3]
[1.] Delta State Maritime Polytechnic, Burutu, Delta State, Nigeria /Diseiyeoyighan@gmail.com / 07087166771
[2.] Library Department, College of Education Warri, Delta State/ukubeyinjesandra@gmail.com / 08160309072
[3.] Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom, Nigeria /Bolaji.oladokun@yahoo.com

Abstract

This study explores the integration of Artificial Intelligence (AI) into metadata management in libraries, focusing on the challenges, opportunities, and future trends. The objectives of the study are to identify challenges faced by libraries in AI-driven metadata management, to explore opportunities for improvement, and to examine future trends. Using a systematic literature review method, relevant articles were collected from academic databases and analyzed to extract key themes. The findings indicate that maintaining data quality, addressing ethical concerns, and overcoming technical limitations are critical challenges in AI-driven metadata management. However, AI presents promising opportunities, such as automating labor-intensive metadata creation and enhancing resource discoverability. The study also identifies trends, including the rise of linked data and predictive analytics, which will transform metadata management in the future. The paper concluded that while AI offers substantial advantages, human oversight remains crucial, and libraries must adapt by upskilling staff and developing new policies. The study recommends that library management should prioritize funding for AI-compatible systems and computing infrastructure, especially in underfunded institutions, to overcome technical barriers related to legacy systems and computational capacity, and librarians should actively monitor AI-generated metadata for accuracy, relevance, and cultural sensitivity.

Keywords: *Artificial Intelligence, Metadata Management, Libraries, Automation, Digital Preservation*

Introduction

Metadata often referred to as "data about data," plays a crucial role in library and information science discipline by providing structure, organization, and accessibility to information resources. It enables libraries to manage, categorize, and retrieve vast amounts of information effectively. Metadata includes descriptive details about a resource, such as author, title, publication date, and subject matter, making it essential for cataloging, discovery, and resource management. Traditionally, libraries have relied on standardized metadata systems like MARC (Machine-Readable Cataloging) and Dublin Core to ensure consistency and interoperability across institutions (Tella et al., 2023). These frameworks have long been the foundation of efficient library operations, supporting librarians and users in navigating complex collections of physical and digital resources.

In this digital age, the role of metadata management has expanded significantly. The sheer volume of digital content, ranging from e-books and online journals to multimedia resources, has required libraries to rethink how they manage and organize information (Cox, 2023). Digital collections necessitate more robust and flexible metadata frameworks, capable of handling various types of data formats and media. As libraries continue to shift from physical to digital repositories, metadata management becomes not only a tool for cataloging but also a critical component for ensuring access, visibility, and user engagement with digital resources. Furthermore, metadata is increasingly essential for enabling advanced search functions, cross-referencing across platforms, and ensuring compliance with emerging standards like linked data, which allows for greater interoperability between digital collections.

The introduction of artificial intelligence (AI) has brought about profound changes in how libraries manage metadata (Mahmud, 2024). AI technologies—such as machine learning, natural language processing, and image recognition—have the potential to automate many aspects of metadata creation and maintenance, reducing the need for manual input. This automation can increase the speed and accuracy of metadata generation, enabling libraries to keep pace with the rapid growth of digital collections. Moreover, AI-driven systems can analyze and generate rich, semantic metadata that enhances the discoverability of resources, allowing users to find information more efficiently. AI is also influencing how libraries interact with users, offering personalized recommendations and improving user experience by interpreting search queries and suggesting relevant resources.

Rationale for the Study

Metadata management is crucial in the AI era because it underpins the organization and accessibility of information in an increasingly digital and data-driven world. As AI becomes more integrated into library systems, metadata plays a pivotal role in ensuring that AI algorithms can effectively process, categorize, and retrieve information. Libraries are at the intersection of information management and technological innovation, making the integration of AI with metadata management an essential evolution for the field. Without high-quality metadata, AI technologies would struggle to perform key functions, such as content recommendation, automated cataloging, or advanced search capabilities. Therefore, efficient metadata management serves as the backbone for AI-enhanced library operations, ensuring that the technology can be fully leveraged to improve resource utilization, enhance user experiences, and support digital transformation.

Moreover, AI has the potential to solve some long-standing challenges in metadata management, such as improving the scalability of cataloging large collections and minimizing human errors. This implies that AI can help libraries operate more efficiently, freeing up resources for more strategic initiatives. However, these opportunities also come with challenges, including ensuring the accuracy and ethical use of AI in managing sensitive data, maintaining consistency with established metadata standards, and training staff to work alongside AI systems.

Statement of the Problem

Despite the growing body of research on AI's impact in various sectors, the literature addressing AI's specific influence on metadata management in libraries remains relatively sparse. While numerous studies explore AI in library operations more broadly—focusing on areas like user services, reference management, and digitization, there is limited focus on how AI transforms metadata processes specifically. Current research often addresses the technical aspects of AI and metadata separately, without considering how they intersect in practical library settings (Tella et al., 2023; Sukula, 2023).

Furthermore, many existing studies fail to account for the ethical and operational challenges that arise when integrating AI into metadata management (Chhetri, 2023; Mallikarjuna, 2024; Manoharan et al., 2024; Priya & Ramya, 2024). Issues such as bias in AI algorithms, the potential loss of human oversight, and the long-term sustainability of AI-driven metadata systems are often overlooked. As a result, there is a clear need for more focused research that examines both the practical and ethical implications of AI in metadata management within libraries. This study seeks to fill that gap by exploring the challenges and opportunities that AI presents for metadata management and identifying future trends that libraries must prepare for as they embrace AI technologies.

Research Questions

The following questions guided the study:

1. What challenges are libraries facing in metadata management with AI integration?
2. What opportunities does AI present for improving metadata processes?
3. How can libraries adapt to future trends in AI-driven metadata management?

Literature Review

Challenges in Metadata Management with AI in Libraries

The integration of Artificial Intelligence (AI) into metadata management in libraries presents numerous challenges that must be carefully addressed for effective implementation. AI has the potential to revolutionize how metadata is managed, but its adoption also introduces complexities related to data quality, ethical concerns, technical limitations, and human oversight (Kim, 2025; Joselin et al., 2024). Affum (2023) observes that one of the primary challenges in AI-driven metadata management is maintaining data quality and consistency. AI systems often rely on large datasets for training, and the accuracy of these systems is contingent upon the quality of the input data. In the context of libraries, this means that the quality of metadata must be high to ensure reliable outcomes. Poorly structured or inconsistent metadata can lead to erroneous outputs, such as incorrect cataloging or flawed recommendations. AI algorithms, particularly machine learning models, are highly sensitive to the quality of the data they process, and any inconsistencies in the metadata can result in suboptimal performance. For libraries, maintaining high standards of metadata consistency becomes a critical challenge, especially when dealing with vast and diverse collections (Bairagi & Lihitkar, 2024).

Another significant challenge is the ethical considerations involved in using AI for metadata management (Lalitha et al., 2024). AI algorithms, particularly those used in libraries, must be designed to be unbiased and transparent. However, biases can inadvertently be introduced into the algorithms due to the datasets used to train them. Furthermore, there are privacy concerns associated with the use of AI, particularly when dealing with sensitive information, such as user data for personalized services or metadata from archives containing confidential materials (Bisht et al., 2023).

The technical challenges associated with integrating AI into metadata management are also considerable. Rahman (2025) observes that many libraries operate on legacy systems that are not easily compatible with newer AI technologies. This poses a significant barrier to the seamless integration of AI-driven metadata management solutions. Moreover, AI systems require significant computational power and technical infrastructure, which may be lacking in many library environments, particularly in underfunded institutions (Balasubramanian & Tamilselvan, 2023). Even in well-resourced libraries, there may be challenges related to integrating AI with existing metadata standards, such as MARC, Dublin Core, or BIBFRAME(Abdulsalami et al., 2024). These traditional metadata frameworks may not fully accommodate the dynamic and nuanced metadata that AI systems can generate, leading to potential conflicts in data representation and retrieval.

Despite AI's capabilities, human oversight remains essential in the context of metadata management. Verman and Gupta (2022) state that librarians have long played a crucial role in curating and managing metadata, ensuring accuracy, and maintaining standards. With AI's introduction, there is a concern that the human expertise in metadata management could be overshadowed by the automation process. AI-driven systems, while efficient, may lack the contextual understanding that librarians bring to metadata management, leading to misinterpretations or inappropriate categorization (Sukula, 2023). Furthermore, the introduction of AI requires library staff to acquire new skills, such as understanding AI algorithms, troubleshooting technical issues, and managing the outputs of AI systems. This presents a skills gap that many libraries, particularly smaller ones, may struggle to bridge.

Implementing AI solutions for metadata management requires significant financial and technical resources. Many libraries, particularly in developing regions, face resource constraints that limit their ability to adopt and maintain AI systems (Mallikarjuna, 2024). The costs associated with acquiring AI tools, upgrading infrastructure, training staff, and maintaining these systems can be prohibitive. Additionally, there is a need for ongoing technical support to ensure the AI systems function optimally, which may require external expertise that is costly and difficult to procure.

Opportunities Presented by AI in Metadata Management in Libraries

Despite the challenges, AI presents numerous opportunities for improving metadata management in libraries. One of the most promising opportunities AI offers in metadata management is the automation of metadata generation (Affum & Dwomoh, 2023). Traditionally, metadata creation has been a labor-intensive process, requiring librarians to manually input details such as author, title, subject, and other descriptive information for each item. The authors argue that AI can automate much of this process, using machine learning and NLP techniques to extract metadata from digital objects automatically. For instance, AI can analyze text, images, and even audio and video files to generate metadata tags, reducing the need for human input. This automation can save time and resources, particularly in libraries with large or rapidly growing digital collections, enabling staff to focus on higher-level tasks.

AI has the potential to improve the discoverability of resources within a library's collection (Jayachristrayar & Hemapriyaa, 2023). Tait and Pierson (2022) state that AI can enhance metadata's ability to connect users with the information they need. AI-driven systems can analyze user search behavior, refine search results, and suggest relevant resources based on patterns in user queries. This makes metadata not only more dynamic but also more responsive to individual user needs. Mahmud (2024) states that AI also enhances faceted search capabilities, allowing users to filter results by specific attributes, such as date, format, or topic, and even predict the most relevant search terms based on previous queries.

AI can improve the richness and depth of metadata through semantic enrichment (Monyela & Tella, 2024). This involves adding more context and meaning to metadata records, allowing for a deeper understanding of the relationships between different pieces of information. AI-powered tools can analyze the content of documents, identify key concepts, and automatically link related items within a collection (Chhetri, 2023). For example, an AI system could recognize that two different terms refer to the same concept (e.g., "artificial intelligence" and "AI") and link them together in the metadata. This enhances the user's ability to find relevant resources, even when using varied search terms, and improves the overall accuracy of search results.

AI's ability to analyze and interpret metadata also enables libraries to offer personalized user experiences (Brzustowicz, 2023). AI suggests relevant materials based on individual preferences and past behaviors. This approach, often referred to as AI-driven recommender systems, can help users discover resources they might not have found through traditional search methods. Personalized recommendations can improve user satisfaction, increase engagement with library resources, and foster a more dynamic relationship between users and library systems (Balasubramanian & Tamilselvan, 2023).

As libraries expand their digital collections, managing metadata manually becomes increasingly challenging. AI offers a scalable solution, allowing libraries to process large volumes of data quickly and accurately (Tait & Peirson, 2022). AI's ability to handle vast amounts of information ensures that metadata

remains current and comprehensive, even as collections grow. More so, AI can improve the interoperability of metadata across different systems and platforms. Many libraries use a variety of metadata standards, such as MARC, Dublin Core, or BIBFRAME, which can make it difficult to integrate data from different sources (Mahmud, 2024). AI can bridge these gaps by analyzing metadata in various formats and translating it into a unified structure (Tella et al., 2023). This allows libraries to share metadata more easily with other institutions, facilitating collaboration and resource sharing. AI-driven systems can also help libraries adapt to evolving metadata standards, ensuring that their collections remain accessible and compatible with new technologies.

Future Trends in AI-driven Metadata Management for Libraries

The future of AI-driven metadata management for libraries is poised to be transformative as emerging technologies continue to evolve and integrate more deeply into library operations. As AI advances, libraries will need to stay ahead of trends that promise to reshape how metadata is created, managed, and utilized. These trends include the rise of linked data, predictive analytics, increased interoperability, and a shift in the role of librarians in metadata curation (Tella et al., 2023; Yoon et al., 2022; Brzustowicz, 2023). Monyela and Tella (2024) state that one of the most significant trends in AI-driven metadata management is the growing use of linked data and its integration with the semantic web. The authors submit that linked data enables metadata to be connected across different platforms, creating a web of interrelated data that can be easily searched and navigated. AI plays a crucial role in enhancing linked data by identifying relationships between different datasets, enriching metadata with contextual information, and improving the discoverability of resources.

Another emerging trend is the use of predictive analytics in metadata management (Yoon et al., 2022). Lalitha et al. (2024) discover that AI systems can analyze user behavior, patterns in resource usage, and metadata trends to predict future needs and optimize metadata for improved discoverability. Predictive metadata analytics could allow libraries to anticipate user queries, adjust metadata in real time, and offer proactive resource recommendations. According to Tella et al. (2023), AI plays an essential role in managing metadata for long-term archiving and accessibility. AI can automate the creation of preservation metadata, ensuring that digital objects remain accessible over time. This includes tracking the provenance of digital materials, documenting format changes, and maintaining records of access rights. AI's ability to analyze vast amounts of data quickly also makes it well-suited for identifying digital objects at risk of becoming obsolete and recommending appropriate preservation actions (Bisht et al., 2023).

AI-driven metadata management will continue to promote greater interoperability between different library systems and platforms (Joselin et al., 2024).In so doing, Affum and Dwomoh (2023) state that AI will facilitate the sharing and integration of metadata across institutions. This trend will lead to more collaborative cataloging efforts, where libraries contribute to and benefit from shared metadata repositories. AI can also streamline the process of converting metadata between different standards, enabling libraries to adopt new technologies without losing the value of their existing metadata (Rahman, 2025).

The increasing use of AI in metadata management will inevitably lead to a shift in the role of librarians (Abdulsalami et al., 2024). While AI will automate many of the manual tasks traditionally associated with metadata creation, librarians will take on more strategic roles, overseeing the implementation of AI systems, ensuring the quality of metadata, and addressing ethical concerns (Verma & Gupta, 2022). The human element will remain critical, particularly in managing complex or sensitive metadata that requires contextual understanding and cultural sensitivity (Lalitha et al., 2024). However, the future of metadata management will likely involve a greater focus on multimodal metadata, which includes text, images, audio, and video (Joselin et al., 2024). AI's ability to analyze different types of content—such as extracting keywords from images or identifying themes in videos—will enable libraries to create richer, more diverse metadata records (Affum & Dwomoh, 2023; Tella et al., 2023).

Methodology

This paper employed a qualitative research method through a systematic literature review. The primary objectives of the study were to determine the challenges libraries facing in metadata management with AI integration, the opportunities AI presents for improving metadata processes, and how libraries can adapt to future trends in AI-driven metadata management. To achieve these objectives, literature was sourced from multiple academic databases, including Google Scholar, Scopus, and Web of Science. The search focused on articles related to the study's title and objectives. Keywords such as "metadata," "library automation," "Artificial intelligence," "libraries," and "metadata management" were utilized to ensure a comprehensive and relevant collection of literature. More so, articles between 2020 and 2024 were duly considered for this search. The collected literature was subjected to thematic analysis. This involved identifying, analyzing, and reporting patterns (themes) within the data. Throughout the study, the researchers adhered to all ethical procedures. This included ensuring the proper attribution of all sources and maintaining academic integrity.

All references and citations were meticulously compiled and presented in the reference list following the APA 7th edition format.

Discussion of the Findings

This study aimed to examine the challenges, opportunities, and future trends in AI-driven metadata management in libraries.

Challenges in Metadata Management with AI in Libraries

The study revealed several significant challenges in implementing AI for metadata management. A primary concern is data quality and consistency. AI systems rely heavily on large, high-quality datasets for training, and any inconsistencies in metadata can result in suboptimal outcomes, such as incorrect cataloging or flawed recommendations. These findings are consistent with Affum's (2023) observation that maintaining high standards of metadata consistency is a critical challenge, particularly for libraries with diverse and expansive collections. Similar challenges are noted by Bairagi and Lihitkar (2024), who highlight the risks of poor-quality metadata leading to inaccurate outputs in AI systems.Ethical and privacy concerns also emerged as significant challenges. AI algorithms can perpetuate biases present in the training datasets, raising questions about fairness and transparency in AI-driven metadata systems. Lalitha et al. (2024) similarly emphasize the need for unbiased AI systems in libraries, while Bisht et al. (2023) highlight the privacy risks associated with handling sensitive metadata, particularly in personalized services. Furthermore, the technical barriers to integrating AI into legacy library systems present another challenge. Many libraries, especially in underfunded regions, lack the necessary computational infrastructure to support advanced AI solutions, a concern also raised by Balasubramanian and Tamilselvan (2023).Despite AI's potential, human oversight remains essential. Librarians' expertise in contextualizing metadata is difficult to replace with AI alone, as AI-driven systems may lack the nuanced understanding needed for accurate categorization. Sukula (2023) and Verma and Gupta (2022) support this finding, arguing that while AI enhances efficiency, it cannot fully substitute human judgment in metadata management. Additionally, the introduction of AI necessitates upskilling library staff, a challenge for many institutions due to resource constraints (Mallikarjuna, 2024).

Opportunities Presented by AI in Metadata Management in Libraries

Findings revealed that AI offers several promising opportunities for enhancing metadata management. Automation of metadata generation emerged as one of the most beneficial uses of AI. AI's ability to automate labor-intensive processes like cataloging can save libraries considerable time and resources. Affum and Dwomoh (2023) similarly note that AI can significantly reduce the manual workload involved in metadata creation by automating the extraction of metadata from various formats, including text, images, and videos.AI also has the potential to improve the discoverability of library resources. AI can analyze user queries to suggest relevant resources more effectively. This aligns with findings by Jayachristrayar and Hemapriyaa (2023) and Tait and Pierson (2022), who emphasize AI's ability to enhance search precision and user satisfaction through more dynamic, personalized results. AI's semantic enrichment capabilities also allow for deeper contextual understanding of metadata records, making it easier for users to find related materials, a point reinforced by Chhetri (2023) and Monyela and Tella (2024).Another key opportunity is AI's scalability. As libraries expand their digital collections, AI enables them to manage larger volumes of data quickly and efficiently. Tait and Pierson (2022) support this, noting that AI-driven systems can handle massive digital archives, ensuring that metadata remains up-to-date.

Future Trends in AI-driven Metadata Management for Libraries

The study identified several future trends that are likely to shape AI-driven metadata management. The growing use of linked data and its integration with the semantic web will allow libraries to connect metadata across platforms, creating a web of interrelated data that can be easily searched and navigated. Monyela and Tella (2024) emphasize linked data's potential for improving resource discoverability and facilitating cross-institutional collaboration, a trend also noted by Brzustowicz (2023).Another emerging trend is the use of predictive analytics in metadata management. AI systems can analyze user behavior and metadata trends to predict future needs and optimize metadata for improved discoverability. Yoon et al. (2022) and Lalitha et al. (2024) also highlight the potential of predictive analytics to anticipate user queries and proactively suggest relevant materials. AI's role in digital preservation is another important trend. As libraries focus more on preserving digital content, AI can automate the creation of preservation metadata, tracking the provenance of digital materials and ensuring long-term accessibility (Bisht et al., 2023).Finally, AI will likely lead to a shift in librarians' roles, from manual metadata creation to overseeing AI systems and addressing ethical concerns. While AI will automate many tasks, librarians' expertise will remain crucial in managing complex or sensitive metadata. This finding is supported by Abdulsalami et al. (2024) and Verma

and Gupta (2022), who argue that librarians will take on more strategic roles in the future, focusing on system oversight and maintaining metadata quality.

Conclusion

This study has highlighted the complex challenges, opportunities, and future trends associated with integrating Artificial Intelligence (AI) into metadata management in libraries. The key challenge identified was the difficulty in maintaining high data quality and consistency. AI systems depend on well-structured, accurate metadata, but inconsistencies can lead to erroneous outputs, such as misclassifications or irrelevant recommendations. Ethical and privacy concerns, particularly related to bias in AI algorithms, further complicate the use of AI. Additionally, the technical barriers posed by legacy systems and insufficient computational infrastructure present significant challenges, especially in underfunded libraries. Human expertise remains crucial, as AI systems often lack the contextual understanding that librarians bring to metadata management.

On the other hand, AI offers numerous opportunities for libraries, especially in automating labor-intensive processes like cataloging and classification. AI's ability to automate metadata generation can reduce the workload for librarians, allowing them to focus on higher-level tasks. The potential for AI to improve the discoverability of library resources is another key opportunity, as AI-driven systems can personalize searches and enhance user satisfaction. AI's scalability also allows libraries to manage large volumes of metadata efficiently, ensuring that collections remain well-organized as they expand.Future trends point toward the growing use of linked data and predictive analytics, which will likely transform how metadata is managed and accessed. AI's role in digital preservation will also become more prominent, helping libraries maintain the accessibility of digital resources over time. As AI-driven metadata systems become more advanced, the role of librarians will evolve, shifting from manual data entry to system oversight and ensuring ethical AI use.

Recommendations

1. Library management should prioritize funding for AI-compatible systems and computing infrastructure, especially in underfunded institutions, to overcome technical barriers related to legacy systems and computational capacity. They should also develop and enforce clear policies on ethical AI use, addressing concerns around data bias, privacy, and transparency in AI-driven metadata processes.
2. Librarians should actively monitor AI-generated metadata for accuracy, relevance, and cultural sensitivity. Human expertise is essential to ensure the contextual integrity of metadata.
3. Library and information science educators should integrate AI, data ethics, and metadata management into library and information science education to prepare future librarians for technology-enhanced roles.
4. Library users should also demand clarity on how AI systems handle metadata and search personalization to foster trust and informed usage of library services.

References

Abudulsalami, L., Queeneth, A. K., NKapia, S. S., Ligola, H. N., Ovigue, E. L., Obande, B. O., & Bilal, M. (2024). Artificial intelligence in academic libraries and its impact on library services and operations. Omanarp *International Journal of Library & Information Science,* 1(1), 53-61.

Affum, M. Q. (2023). The Role of Artificial Intelligence in Library Automation. *Library Philosophy & Practice.*

Affum, M. Q., & Dwomoh, O. K. (2023). Investigating the potential impact of artificial intelligence in librarianship. *Library Philosophy and Practice*, 1-12.

Balasubramanian, S., & Tamilselvan, N. (2023). Exploring the Potential of Artificial Intelligence in Library Services: A Systematic Review. *International Journal of Library & Information Science,* 12(1).

Bairagi, M., & Lihitkar, S. R. (2024). Optimizing Library Services Through the Integration of Artificial Intelligence Tools and Techniques. In Applications of Artificial Intelligence in Libraries (pp. 193-222). IGI Global.

Bisht, S., Nautiyal, A. P., Sharma, S., Sati, M., Bathla, N., & Singh, P. (2023, May). The role of Artificial Intelligence in shaping Library Management and its Utilization. In 2023 International Conference on Disruptive Technologies (ICDT) (pp. 467-472). IEEE.

Brzustowicz, R. (2023). From ChatGPT to CatGPT: the implications of artificial intelligence on library cataloging. Information Technology and Libraries, 42(3).

Chhetri, P. (2023). Analyzing the Strengths, Weaknesses, Opportunities, and Threats of AI in Libraries. Library Philosophy & Practice.

Cox, A. (2023). How artificial intelligence might change academic library work: Applying the

competencies literature and the theory of the professions. *Journal of the Association for Information Science and Technology*, 74(3), 367-380.
Jayachristrayar, S., & Hemapriyaa, S. (2023). Transforming libraries: Applications of artificial intelligence in library services. Gyankosh-*The Journal of Library and Information Management,* 14(1and2), 61-71.
Joselin, J., Beatrice, B. A., & Indhumathi, S. (2024). Enhanced Services of Next-Gen Libraries Through Artificial Intelligence. In Improving Library Systems with AI: Applications, Approaches, and Bibliometric Insights (pp. 107-114). IGI Global.
Kim, B. (2025). Artificial Intelligence Applications in Modern Library Services. Library Progress International, 45(1), 1-11.

Lalitha, B., Ramalakshmi, K., Gunasekaran, H., Murugesan, P., Saminasri, P., & Rajkumar, N. (2024). Anticipating AI Impact on Library Services: Future Opportunities and Evolutionary Prospects. In Improving Library Systems with AI: Applications, Approaches, and Bibliometric Insights (pp. 195-213). IGI Global.
Mahmud, M. R. (2024). AI in automating library cataloging and classification. *Library Hi Tech News*.
Mallikarjuna, C. (2024). An Analysis of Integrating Artificial Intelligence in Academic Libraries. DESIDOC *Journal of Library & Information Technology,* 44(2).
Monyela, M., & Tella, A. (2024). Leveraging artificial intelligence for sustainable knowledge organisation in academic libraries. *South African Journal of Libraries and Information Science*, 90(2), 1-11.
Priya, S., & Ramya, R. (2024). Future Trends and Emerging Technologies in AI and Libraries. Applications of Artificial Intelligence in Libraries, 245-271.
Rahman, T. (2025). A Comprehensive Review of Applications of Computer and Information Technology in Library Science: Challenges, Advantages and Future Directions. *Library Progress International*, 45(1), 34-41.
Sukula, S. K. (2023). Artificial intelligence and beyond library search strategies: Intuitions and comprehensions during recent past. *KIIT Journal of Library and Information Management*, 10(2), 72-76.
Tait, E., & Pierson, C. M. (2022). Artificial intelligence and robots in libraries: Opportunities in LIS curriculum for preparing the librarians of tomorrow. *Journal of the Australian Library and Information Association,* 71(3), 256-274.
Tella, A., Akanmu Odunola, O., & WO, L. (2023). Cataloguing and classification in the era of artificial intelligence: Benefits, and challenges from the perspective of cataloguing librarians in Oyo State, Nigeria. Vjesnik bibliotekara Hrvatske, 66(1), 159-176.
Verma, V. K., & Gupta, S. (2022). Artificial Intelligence and the Future Libraries. *World Digital Libraries-An international journal*, 15(2), 151-166.
Yoon, J., Andrews, J. E., & Ward, H. L. (2022). Perceptions on adopting artificial intelligence and related technologies in libraries: public and academic librarians in North America. Library *Hi Tech*, 40(6), 1893-1915.

Exploring the Artificial Intelligence (AI) in Library and Information Services in Africa: An Analytical Review

Muhammad Kabir ABUBAKAR
Dept. of Library and Information Science
Umaru Musa Yar'adua University, Katsina, Nigeria
+2348032979954
E-mail: muhammad.kabir@umyu.edu.ng

Abstract

The adoption and use of Artificial Intelligence (AI) is a growing worldwide phenomenon. Presently, many libraries in developed countries are adopting and using AI-driven technologies to support their library services. However, the same cannot be said for most libraries in the African continent. Consequently, there is a need for the libraries and the librarians around the continent to leverage on the potentials of AI-driven tools to improve their services. Exploring the artificial intelligence (AI) issue from an African perspective is the goal of this study. The study specifically looks into AI as a novel way to support library and information services. The study also identified other important new library and information service areas where AI could be helpful, such as data analytics, automation, and outreach for collaboration, preservation, and improved access.Based on a qualitative research approach, this study offers a thorough examination of the interaction between AI and library and information services through the use of content analysis tools. To offer insights and a more nuanced examination of the primary themes mentioned above, a comprehensive assessment of relevant and recent articles, treatises, etc. published in highly respected academic journals is carried out. According to this paper, there are many opportunities for AI to spread over the continent and enhance user services by being adopted and used to assist library and information services. Furthermore, the paper's findings are thought to have a number of consequences for many stakeholders, such as governments or policy makers, library administration, and technology companies.

Keywords: *Artificial Intelligence, Library and Information Services, Data Analytics, Automation, Outreach, Collaboration, Improved Access, Preservation, African Continent*

1. Introduction

The adoption and use of artificial intelligence (AI) is a developing phenomenon in the African continent. While the continent has seen a significant uptake of various technological innovations over the past four decades, such as computers, the Internet, and mobile phones, the same cannot be said for AI-driven technologies. In general, the African continent is lagging behind in terms of AI adoption and use compared to other continents, and in particular, this trend is slowly evolving in the continent's libraries.For example, according to the 2023 Global AI Vibrancy Ranking, the United States, China, and the United Kingdom are at the forefront of the AI adoption movement (Fattorini et al., 2024). However, only South Africa (sadly, at the bottom of the index) was included in a geographical visualisation of AI metrics that showed the distribution and intensity of AI-related activities across nations (Fattorini et al., 2024). Moreover, research have indicated thatthe adoption and implementation of AI in the continent's libraries and library and information services is happening slowly and isn't broadly dispersed (see for instance, studies by Bashorun, Tella, Ajani, & Adisa, 2024; Johnson, Frankline, Daniel, 2024; Owusu-Ansah et al., 2024). Nevertheless, the above stated scenario is not worrisome because AI in library and information service is generally evolving globally.

The resources and activities libraries offer to meet patrons' information needs are referred to as library services (Nwamu, 2021). Nwamu added that the growing technological improvement has altered the traditional library functions of information selection, acquisition, processing, preservation, and distribution to patrons. According to Nwamu, the form, function, and delivery of the library's collections—which include books, magazines, newspapers, manuscripts, films, maps, print documents, microforms, CDs, cassettes, video tapes, DVD, disc, e-books, and audio books—have also evolved. The development of artificial intelligence (AI) and its subsequent integration into libraries and library and information services has significantly changed the library and information environment and operations in recent years. Numerous academics have explained how new developments in AI technology have created new opportunities for enhancing and offering innovative library and information services (Widyardini, Partiwi, and Setyobudi, 2024).

Worldwide, many facet of human endeavours, including health, agriculture, security, commerce and trade, governance, education, and libraries,are being significantly impacted by the AI (Barsha & Munshi, 2024; Dubravova et al., 2024; Popoola, 2024; Ade-Ibijola & Okonkwo, 2022). The AI adoption and application in libraries could greatly enhance library and information services by improving information organisation

process, according to recent studies and scientific research projects (Barsha & Munshi, 2024; Rudiansyah, 2023). The adoption of the AI according to Hussain (2023) can facilitate user integration with libraries and access to a wealth of resources. Likewise,Nawaz & Saldeen (2020) have acknowledged that traditional reference services can be strengthened by utilising AI-driven tools like Chatbots. Moreover, AI is undoubtedly developing continuously to improve user experiences, expedite library services and manage library resources more effectively(Praveenraj et al., 2025).

However, as Barsha and Munshi (2024) clearly said, despite the potential of AI-driven tools to improve library and information services, utilisation and comprehension of AI library services remain challenging in undeveloped nations (of which African nations comprise a big portion).Prior research that examined the adoption and use of AI in African libraries' operations and information services has specifically focused on individual nations, such as Ghana (Owusu-Ansah et al., 2024), Egypt (Mahmoud, 2023), Zambia (Subaveerapandiyan, Sunanthini, & Amees, 2023), Nigeria (Ajani, Tella, Salawu, & Firdausi, 2022), and Kenya (Sang & Macharia, 2025; Masinde, Mugambi, & Wambiri, 2024) among many others.As Masinde, Mugambi, and Wambiri (2024) have noted, there appear to be little or no studies that look at the problem from the perspective of libraries on the African continent in general.Even though it has nothing to do with library and information science, the Gwagwa et al. (2020) study has made an effort to look at the problems and applications of AI in African contexts. Furthermore, just one article out of seven in the edited book "Responsible AI in Africa: Challenges and Prospects" by Eke, Wakunuma, and Akintoye (2023) mentions AI in libraries and other information sectors across the continent in an indirect manner.Furthermore, according to a bibliometric examination of 373 research articles on AI published in academic libraries between 2002 and 2022, only two countries—Nigeria and South Africa—were listed in the continent's very low level of international collaboration in AI-related research (Hussain & Ahmad, 2023). The aforementioned scenarios, demonstrate plainly the paucity of research in the field of the current study, highlighting the necessity of this kind of investigation. This study is also necessary because there aren't any well-established patterns or lines of research on AI that indicate a high level of understanding of the topic (Concha, Zenteno, & Alfaro, 2024).

In light of this, this study examines a number of areas in which AI may improve library and information services in Africa. The article specifically addresses data analytics, outreach and collaboration, improved access, automation, and preservation. Previous studies have confirmed the necessity for librarians and library professionals to do this kind of research (e.g., Praveenraj et al., 2025; Dutt, 2024; Gajbhije, 2024). This paper's concept is that African libraries may adopt and use AI to become more dynamic and provide cutting-edge library and information services. Therefore, adopting and using AI in African libraries is the best course of action in this day and age.

2. Objective of the study

The main objective of this paper is to explore the various areas where artificial intelligence (AI) can help provide novel support for library and information services in Africa. Specifically the paper focuses on adoption and use of AI in data analytics, adoption and use of AI in collaboration and outreach, adoption and use of AI in enhanced access, adoption and use of AI in automation, and adoption and use of AI in preservation.

3. Literature Review

The Concepts Artificial Intelligence (AI)

The genesis of Artificial Intelligence (AI) can be traced back to the mid-20th century, with the formal introduction of the term "Artificial Intelligence" by John McCarthy at the Dartmouth Conference in 1956. Ever since then, many significant developments and transformations have taken place in the AI world particularly in the 1990s and 2000s. These transformations and developments were engineered by significant growth in "computational power and the availability of large scale datasets" (Praveenraj et al., 2025).

AI is seen as a multi-disciplinary field of computer science aimed at creating systems that perform task requiring human-like intelligence (Praveenraj et al., 2025). These tasks include learning, reasoning, problem solving, perception, and language understanding. Furthermore, AI is defined from different perspectives by a number of scholars and agencies, including the European Commission, the Organisation for Economic Co-operation and Development (OECD) and the Institute of Electrical and Electronics Engineers (IEEE) (Gwagwa et al., 2020). In the environment of libraries, the AI refers to the use of machine learning and other techniques to expand library services (Zhang, 2024).However, after nearly six decades of the introduction of the term AI, its definition and understanding varies among scholars and individuals. These variations no doubt have helped draw connections across paradigms and create a more holistic understanding of the concept.

Brief Overview of AI Application in Library and Information Services

Artificial Intelligence (AI) has been applied to various library and information services and many scholars have identified it potential benefits (Praveenraj et al., 2025; Balasubramanian & Tamilselvan, 2023). Examples of AI-powered technologies adopted and used to enriched library and information services include, but are not limited to, Blockchain technology, Robotics, Expert Systems, Virtual and Augmented Reality (VA/AR), Semantic Web, Chatbots, the Internet of Things (IoT), Quantum Computing, and 5G Wireless Networks, to name a few. In an article "Applications of Artificial Intelligence in Academic Libraries," Vijayakumar and Sheshadri (2019) detailed the use of AI components in library services, including the use of natural language processing (NLP) for database searches, including the Online Public Access Catalogue (OPAC); machine learning (ML) for metadata generation, voice searching, text data mining, and other pattern recognition algorithms; robotics for document scanning; and expert systems for reference services, cataloguing, classification, indexing, and acquisition.

As AI is currently revolutionising the library world as seen above, however, most of the application of AI in library and information services are majorly taking place in the developed world. For example, information centers and libraries like the Online Computer Centre (OCLC), the Library of Congress, the British Library, the New York Public Library, the Harvard Library, the National Library of Medicine, the University of Oklahoma Libraries, the Toronto Public Library, the MIT Libraries, the Singapore National Library Board, the University of Rhode Island, and the University of California Libraries have all implemented AI based systems. However, in the Africa, available literature did not indicate any significant adoption and use of AI-driven technologies for library and information services in the continent.

4. Methodology and Analytical Framework

The purpose of this study is to explore the novel areas where the adoption and use of artificial intelligence can help support library and information services in Africa. An analytic review, which is based on the qualitative research approach, was used in this study to synthesis and critically analyse existing literature on the area. In carrying out this analytical review, asystematic search for existing literature in both developed and developing world was carried out using a variety of electronic academic databases, such as Google Scholar, Academic Search Complete (EBSCO), Emeralds Insight, and Elsevier's Scopus index, starting on December 10, 2024 to April 30, 2025. The main descriptors that were used in the search consist of the following six themes:

- AI and data analytics in library and information services
- AI and automation in library and information services
- AI and collaboration and outreach in library and information services
- AI and enhanced access in library and information services, and
- AI and preservation in library and information service

To offer insights and a more nuanced examination of the primary themes mentioned above, a comprehensive literature review of relevant and recent articles, book chapters, treatises, etc. published in highly respected academic journals was carried out.

To maximise the breadth and coverage of the review, no time restriction was placed on the search articles. Nevertheless, to maintain a modern-day perspective, emphasis was placed on the most recent and varied papers. Papers without identified keywords were not included, while those with the keywords were further scrutinised by reading there abstracts before the eventual inclusion and exclusion. Thus far, certain articles that had unsatisfactory information in the abstract for outright inclusion yet enough details to not to be rejected were further scrutinised by reading their full texts. The paper was able to find very few previous relevant studies on the above topic primarily because of the lack of research. To perform this study, given the above mentioned scenario, the paper looked at studies that look at the research problem from individual countries' perspective. These studies are crucial resources that this present study cannot overlook.

5. Findings and Discussions

Artificial intelligence (AI) has advanced; it has been adopted and implemented into many aspects of library services and operations in many parts of the world. The presentation of the results and discussions for "Artificial Intelligence (AA) as a Novel Element of Support in Library Services in Africa" delves into key themes of the study as follows:

- **Adoption and Use of AI in Data analytics Services**

Research interest on successful case studies and real-world application of AI-driven data analytics in diverse sectors, including healthcare, finance, marketing, manufacturing, and e-commerce has been conducted (Settibathini, Kothuru, Vadlamudi, Thammreddi, & Rangineni, 2023). The current state of artificial intelligence amalgamation with data analytics has made it easier to analyse vast amounts of data. This is accomplished by integrating a number of data analytics capabilities into different aspects of library

services (e.g., circulation statistics), such as comprehending user behaviour, including search queries, browsing patterns, preferences, usage patterns, and the popularity of resources, among other things (Gajbhije, 2024; Meesad & Mingkhwan, 2024). Additionally, libraries can get important insights and knowledge about how frequently their resources—such as databases, journals, and e-books—are accessed by utilising data analytics and data visualisation tools such as Google analytics.Similarly, libraries could evaluate their resources and services by learning which resources are most popular, when they are most used, when they are to be weeded, and what kinds of tools people use to access them by employing data analytics approaches. Furthermore, data analytics tools assist libraries in decision making and service enhancement.

For instance, Internet of Things (IoT) embedded technologies like Smart Shelves can be used to automatically detect when books are checked and returned, helping to streamline inventory management and improve the overall library experience. IoT also speeds up book reservations and collects data on user behaviour, resource usage, and environmental conditions.There are too many library services that can be offered and improved through the implementation of IoT to be covered in this brief treatise (for more information, see studies by Bensal, Arora, & Suri, 2018; Qin, 2018; Bayani & Vilchez, 2017).

Many libraries in the industrialised world have adopted data analytics and data visualisation techniques. The Harvard University Library and the University of California, Berkeley, for instance, are home to the majority of best practices and data initiative examples. The Harvard University library developed the analytical toolbox to assist patrons and librarians in spotting trends and changes in usage, collections, and other information. New York public library's AskNYPL, uses Chatbot-based research assistance and book recommendations. In some developing countries, for instance in Pakistan, Aslim, Arif and Rafiq (2022) reported that IoT enablers including intelligent hand sanitizers, automated fire alarms, smart air conditioners, and cutting-edge security had been installed in Pakistani university libraries.

It is evident from the aforementioned that the developed world is where a large portion of the adoption, use, and development of data analytics tools for library services occurs. However, research has shown that the African continent is still far behind. The potentialities of such technique are significant as before mentioned. As a result, this research anticipates that African libraries will use these and numerous other data analytics techniques to transform and offer their patrons efficient library services.

- **Adoption and Use of AI in Automation Services**

This paper did not intend to delve into the intellectual discourse of what the concept 'library automation' means, at both the pre and post AI age. However, what is incontestable is that library automation as a process has undergone significant transformation within the last one decade and this has helped improved library services. Within the primary responsibilities of' libraries is to process information resources for users to interact with. Automation of routing tasks such as cataloguing, classification and indexing is one area where AI-powered tools can help improve and provide innovative library services. Thereby ensuring more efficient and accurate organisation of resources and facilitating easier discovery for patterns. Examples of AI enabling tools that can aid library automation include Natural Language Processing (NLP) techniques, Natural Language Understanding (NLU) capabilities, and Chatbots equipped with Natural Language Processing (NLP) capabilities. As Praveenraj et al. (2025) pertinently mentioned, many libraries in the developed world, especially in the United States of America (e.g., Library of Congress and the Online Computer Library Centre (OCLC), are now relying on various AIs and machine learning algorithms to process large volumes of data as well as enhance accuracy and consistency of classification tasks. AI systems are also used for collection management, metadata generation, and automated tagging and indexing by analysing item content and creating relevant subject headings and keywords, which is helping to improve resource discoverability. For example, the British Library uses AI-powered tools to tag and categorizes its digital resources. University of California, Berkeley's OskiCat, uses AI-powered Chatbot for catalogue searching and library assistance.

Whereas there is extensive use of library automation AI's enablers in libraries in the developed world, in the case of libraries in Africa, the employment is gradual. According to this relational viewpoint, this paper expects African libraries will become more familiar with this new technology and use it to offer innovative library services. The more academic libraries on the continent have incorporated library management systems into their operations, the more they will be able to offer superior services through the adoption and use of automation techniques driven by artificial intelligence.

- **Adoption and Use of AI in Collaboration/Outreach Services**

Collaboration and outreach embodies a novel area in library services where application of AI can help improve considerably and their potential benefits are significant. Emerging AI-driven collaborative

technologies such as virtual meeting software such as Google meet zoom; collaborative document editing tools like Google form and docs; and shared repository platforms can help libraries to work more effectively with partners and stakeholders.

- **Adoption and Use of AI in Enhancing Access Services**

It can be difficult to find pertinent search results in traditional library catalogues. However, by comprehending context, semantics, and user purpose, AI-driven search engines enhanced with Machine Learning algorisms can improve search capabilities. The utilisation of Natural Language Processing (NLP) approaches facilitates more accurate and intuitive search functions, resulting in expedited information retrieval and access. AI is notably transforming access to library services and resources. According to Gajbhije (2024), "AI-driven accessibility features, such as text to speech conversion and language translation services, improve access to library resources for patrons with disabilities or language barriers"(p.8). As Kumari and Ingole (2024) pointed out, this scenario now helps ensures equitable and inclusive access to library services to one and all. AI-driven tool such as virtual assistant and Chatbots provide instant help and support to users to and improve the accessibility and functionality of library services (Dutt, 2024).

Similarly, Virtual Reality (VR) and Augmented Reality (VR) have greatly transformed how library users interact with materials and improve the entire learning environment. While AR superimposes digital content over physical world, VR on the other hand, submerges users in an entirely computer-generated reality. According to Nepali and Tamang (2022), with the adoption and use of VR and AR, libraries can develop immersive experiences, provide virtual tours of their spaces, create dynamic and interactive learning environment, enhance virtual access to rear or restricted collections and increase user engagement and inclusivity. The University of Michigan's Virtual Reality Lab for VR training for students and faculty and the San Francisco Public Library's VR programme for patrons are examples of successful AI-powered technology implementation in libraries to enhance access in library services.

Libraries in the industrialised world are mostly responsible for the adoption and usage of AI-driven technologies to improve access to library services. However, it is uncommon for libraries in the African continent to adopt and employ these AI-driven technologies for improved library service accessibility. Numerous empirical studies have demonstrated that AI adoption and application in Africa, including inside African libraries, is still in its infancy, thus this scenario is not surprising (Owusu-Ansah et al., 2024; Ajani et al., 2022).

- **Adoption and Use of AI in PreservationServices**

Preservation and conservation is a key area of library services. In today's world, one important area where AI is having a significant impact on library services is in the area of preservation. The digitisation, preservation, and archiving of library collections, including cultural heritage items, are greatly aided by AI enablers like optical character recognition (OCR), picture recognition, and machine learning algorithms (Gajbhije, 2024). The library collections' lifespan and accessibility for future use are maintained through preservation and archiving. The importance of managing and conserving these items is growing as libraries move more and more towards digital collections. Libraries may conserve their digital collections more effectively and efficiently with the use of AI capabilities such as web archiving tools, preservation software, and automated metadata generation. Similarly, AI algorithm can predict potential deterioration or damage to fragile materials by analysing environmental conditions. This enables proactive preservation measures such as controlled climatic adjustment and conservation interventions.

According to Widyardini et al. (2024), AI tools can be used to adjust environmental temperature in order to prolong the life of paper in libraries. In order to assess historical data and real-time input from Internet of Things (IoT) sensors implanted in the library, AI-driven environmental control systems, such as intelligent thermostats, will be able to learn and adapt to changes in the environment. According to Widyardini et al. (2024), these solutions aid in controlling temperature and humidity levels so that they stay within the optimal range for book preservation and visitor comfort.

Africa is a continent with rich cultural heritage and therefore leveraging on AI to preserve and archive its cultural and historical collections is necessary. As suggested by Widyardini et al., (2024), not only libraries, cultural institutions such as museums, archives, and galleries can leverage on AI capabilities to preserve their sensitive materials. In addition, considering the continents' climatic condition were humidity and temperature exceed the optimal range for book preservation of 40-60% and 20-24 °C, leveraging AI's tools can greatly enhance information materials preservation and sustainability. Likewise, users comfort will be improved.

In light of this, this paper anticipates that African libraries will adopt and use AI-driven environmental control and preservation systems at a higher rate than libraries on other continents. By utilising AI for preservation, African libraries will guarantee the long-term accessibility and conservation of Africa's rich cultural heritage and resources. Similarly, AI algorithm can predict potential deterioration or damage to fragile materials by analysing environmental conditions

6. Conclusion

In order to support library services in Africa, this paper investigates artificial intelligence as a new component. AI-driven technologies have the potential to revolutionise library and information services in every way, from evaluating vast amounts of data to optimizing automated procedures, boosting outreach and collaboration efforts, expanding access to library services, and conserving library collections and resources. These technologies have the potential to increase the effectiveness and caliber of library services when they are properly implemented and utilised. The adoption and successful usage of AI-powered solutions to enhance library services were demonstrated and highlighted in this study along with some best practices. Especially in the developed world, this is true. Given the aforementioned, it is reasonable to conclude that, in contrast to other regions of the world, the African continent does not have a big adoption and usage of AI-driven capability tools to support library and information services.

7. Implications of the Review

This systematic analytic review suggests several practical implications to overcome the slow adoption of AI to support library and information services in Africa. It might be claimed that the future of libraries and library services appears bright, despite the slow adoption and usage of AI in African libraries and library services, as this study sturdily demonstrated. This claim is supported by the enormous efforts being made by several nations on the continent to create their own national AI strategies. Since then, nations such as Mauritius, Egypt, Nigeria, Kenya, and Ghana have taken the initiative to develop their own National AI Strategies. Additionally, all parties involved—including librarians, library administration, library schools, governments, and AI designers and developers—should launch both individual and group projects to encourage the adoption and application of AI in library services.In order to promote equality and the widespread acceptance and usage of AI-powered products across many industries and countries, AI technology designers and developers must create practical procedures. Unequal access among countries, organisations, and individuals is one of the main issues preventing the adoption and usage of cutting-edge technologies like artificial intelligence. The disparity in acceptance and use between libraries in Africa and other parts of the world will persist until this is directly addressed. In a similar vein, librarians in Africa must upgrade and retrain themselves in order to use AI. This demands fresh knowledge and training on diverse elements of AI.Similarly, library schools must modify their curricula to take into account the emerging AI issue. In order to successfully traverse the AI-powered future of the library and information science industry, what additional knowledge and skills will the African workforce need? All of these must be investigated and incorporated into the curriculum. Likewise, governments across the continent must take advantage of AI potentialities through strong policy formulations and financial pledges. The continent's governments should be aware that integrating AI into various facets of life, including libraries, is essential for them to successfully compete in the modern information ecosystem.Even though the project calls for a significant financial outlay and budget cuts, it is the only sensible way to improve system quality and efficiency.

References

Ajani, A. Y., Tella, A., Salawu, K. Y., & Abdullah, F. (2022).Perspectives of librarians on the awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services. *Internet Reference Services Quarterly*, 1-18. DOI: 10.1080/10875301.2022.2086196

Balasubramanian, S., & Tamilselvan, N. (2023). Exploring the potential of artificial intelligence in library services: A systematic review. *International Journal of Library and Information Science*, 12 (1), 1 – 13.

Bashorun, M. T., Tella, A., Ajani, Y. A., & Adisa, R. M. (2024). Innovating academic library services through the adoption of artificial intelligence in tertiary institutions: The Nigerian experience. *UMYU Journal of Library and Information Science*, 1 (2), 58 -71.

Bayani, M., & Vilchez, E. (2017). Predictable influence of Internet of Things (IoT) in the higher education. *International Journal of Information and Education Technology*, 7 (12), 914 – 920.

Barsha, S., & Munshi, S. A. (2024). Implementing artificial intelligence in library services: a review of current prospects and challenges in developing countries. *Library Hi Tech News*, 41 (1), 7-10. https//doi.org/10.1108/LHTN-07-2023-0126

Bensal, A., Arora, D., & Suri, A. (2018). Internet of Things: Beginning of new era for libraries. *Library philosophy and Practice (e-journal)*, 2081.

Concha, K. M., Zenteno, F. P., & Alfaro, J. T. (2024). Use of artificial intelligence in libraries: a systematic review, 2019-2023. *SA Jnl Libs & Info Sci*, 90 (2), 1-13.
Dubravova, H., Cap, J., Holubova, K., & Hribnak, L. (2024). Artificial Intelligence as an innovative element of support in policing. *Procedia Computer Science*, 237, 237-244.
Dutt, M. (2024). The evolution of artificial intelligence and machine learning in library systems and services. In S. Hassan, S. Kumar, S. Panda, A. H. Mir, K. N. Khan & G. Samdani (Eds.), *Academic libraries: Sustaining excellence through innovation and technology* (pp. 73-85). New Delhi, India: Synergy Books.
Eke, D. O., Wakunuma, K., & Akintoye, S. (Ed.) (2023). *Responsible AI in Africa: challenges and prospects*. Switzerland, AG: Palgrave Macmillan.
Fattorini, L., Maslej, S., Perrault, R., Parli, V., Etchemendy, J., Shoham, Y., & Ligett, K. (2024). The global AI vibrancy tool. Institute for Human-Centered AI, Stanford University.
Gwagwa, A., Kraemer-Mbula, E., Rizk, N., Rutenberg, I., & De Beer, J. (2020). Artificial Intelligence (AI) deployments in Africa. Benefits, challenges, and policy dimensions. *The African Journal of Information Communication (AJIC)*, 26, 1-28. https://doi.org/10.23962/10539/30361
Gajbhije, C. K. (2024). Impact of artificial intelligence (AI) in library services. *International Journal of Multidisciplinary Research*, 6 (3), 1-13.
Hussain, A. (2023). Artificial intelligence in the library services: prospects and challenges. *Library Hi Tech News*, Emerald Publishing Limited, 0741-9058, DOI 10.1108/LHTN-11-2022-0125
Hussain, A., & Ahmad, S. (2023). Mapping the literature on artificial intelligence in academic libraries: A bibliometric approach. *Science & Technology Libraries*, 1-16. https://doi.org//10.1080/019426X.2023.2238198
Johnson, M. M., Frankline, M., & Daniel, M. W. (2024). Exploring the current landscape of artificial intelligence adoption in Kenyan academic libraries. In *17th International Conference on Theory and Practice of Electronic Governance (ICEGOV), October, 01-04-2024, Pretoria, South Africa.* ACM, New York, NY, USA, 6 pages. https://doi.org//10:1145/3680127.3680156
Mahmoud, A. S. (2023). Readiness of libraries in Egypt to support the national strategy for artificial intelligence: Misr public library as a model. *International Journal of Library and Information Sciences*, 10 (3), 168-195.
Masinde, J. M., Mugambi, F., & Wambiri, D. M. (2024). Exploring the current landscape of artificial intelligence adoption in Kenyan academic libraries. In *17th International Conference on Theory and Practice of Electronic Governance (ICEGOVE 2024), October 01-04, 2024, Pretoria, South Africa*. ACM New York, NY, USA, 6 pages. https//doi.org/10.1145/3680127.3680156
Nawaz, N., & Saldeen, M. A. (2020). Artificial intelligence Chatbots library reference services. *Journal of Management Information Decision Sciences*, 23 (S1), 442-449.
Nepali, S., & Tamang, R. (2022). A review on emerging trends and technologies in library. American Journal of Information Science and Technology, 6 (1), 8-15. https://doi.org/10.11.648/j.ajist.202206012.12
Nwamu, C. A. (2021, June). *Deployment of mobile applications for library services*. Paper presented at National Workshop of Librarian's Registration of Nigeria (LRCN). Kaduna State University, Kaduna State.
Owusu-Ansah, C. M. A., Amankwah, A., Yeboah, P., Amoako, K., Boateng, M., & Nutsukpui, E. (2024). Artificial intelligence (AI) in academic libraries in Ghana: a case study of three academic libraries. *International Journal Knowledge Content Development & Technology*, 1-27.
Popoola, O. P. (2024). Artificial intelligence for official statistics: Opportunities, practical uses and, challenges. Leibniz Information Centre for Economics, Kiel, Hamburg.
Praveenraj, D.D. W, Agarwal, K., Kim, B., & Singh, B. (2025). Artificial intelligence applications in modern library services. *Library Progress International*, 45 (1), 1-11.
Qin, J. (2018). The research of the library services based on Internet of Things. *Advances in Social Science Education and Humanities Research*, 89: 412- 420.
Rudiansyah, R. (2023). Artificial intelligence: prospects and challenges for library service. A Nugroho Widiadi et al. (eds.), *Proceedings of the 3rd International Conference on Social Knowledge Science and Education(ICSKSE) 2023 "Challenge and Continuity in Southeast Asia*", Advances in Social Science, Education and Humanities Research 800,
Sang, L. J., & Macharia, S. (2025). Artificial intelligence (AI) for smart library systems: a focus on awareness and level of adoption in the Kenyan university libraries. *The CUEA Journal of Science*, 2 (1), 1-19.
Settibathini, V.S.K., Kothuru, S.K., Vadlamudi, A.K., Thammreddi, L., & Rangineni, L. (2023).Strategic review of data analytics with the help of artificial intelligence. *International Journal of Advances in Engineering Research*, 26 (6), 1-10.
Widyardini, S. T., Partiwi, K. Y., & Setyobudi, D. E. (2024). Smart library: AI enhance visitors comfort books preservation via temperature and humidity control. *International Journal of Library Studies*, 2 (2), 42-62.

Exploring the Librarians Perception on Wikipedia as a Reference Tool in Kaduna State

By

Ramatu A. Haliru[1]
Arewa House Library, A.B.U, Kaduna – Nigeria
Email: ramatu4me@gmail.com
Rukkayya Mohammed Yunusa[2]
Bilya Sanda Library, Al-Qalam University, Katsina – Nigeria
Email: rrmylofty@gmail.com
Sakinat Ja'afar[3]
Medical Library, Ahmadu Bello University, Zaria
Sakinatjafar89@gmail.com

Abstract

Wikipedia is a free online encyclopedia created and edited by volunteers around the world. Wikipedia and library are not profit making with the aims of spreading free information. It is based on this, the study uncovered the use of Wikipedia as a reference tool among librarians in Nigeria, using Kaduna state librarians as a case study with two objective of the study which are to understand librarians' perceptions of Wikipedia as a reference tool and to identify the challenges librarians face when using Wikipedia as a reference tool in Kaduna state. The study adopted interpretive phenomenology approach while semi -structured interviews were conducted with ten librarians in Kaduna state as samples for the study. The interviews were analyzed using interpretive phenomenological analysis. The findings revealed that librarians perceived Wikipedia as online encyclopedia which is a ready reference for online users. The most librarians face challenges of using wikipedia are lack of digital skills and the Authenticity of wikipedia source is always questioned. *The study recommended more advocacies about Wikipedia in Nigeria libraries and curriculum.*

Keyword: Librarian, Reference Tool, Wikipedia

Introduction

Wikipedia is a free online encyclopaedia, created and edited by volunteers around the world. It started in 2001 and is hosted by the Wikimedia Foundation. Wikipedia operates under the open source management style. It is one of the most visited sites in the internet. Wikipedia and Libraries have many things in common. Tawnya, (2023), observed that like libraries Wikipedia are not for profit making and both are dedicated to free spread of information.

Moreover, Wikipedia can be used to create visibility to many library collections. Wikipedia received the highest number of articles editors (that is, those who edited more than one hundred articles in a month) in 2007 and by 2017, the number has declined to about one-third (Ford, 2016 in Tawnya, 2023). Wikipedia is an open-source knowledge repository with the incorporation of various resources and functions that enhance digital Study, Information access, and information Literacy in the same vein Wikipedia is a free, web-based encyclopedia running on wiki technology, a technology that allows anyone to quickly create or edit and modify web pages.

The free online encyclopedia has a huge lot of content, having to date approximately 7.9 million articles in different languages (Luyt et al, 2008) Unlike other open-access databases which have more stringent review processes involving subject experts and professional editors, Wikipedia relies on collaborative effort of volunteers, sourcing its content from more than 75,000 active contributors, practically anyone with an account and internet connection, The upside to this is that anyone who wants to contribute may do so, and articles are updated quickly, in fact, having the ability to unfold as events happen, according to Soules (2015) students flock to it, but faculty views including Librarians are mixed have the perspective that Wikipedia is not a good reference source for research. Osadebe et al (2022) observed that the use of Wikipedia and its sister projects by academics for research most especially in the African context is not encouraged, it is believed that the sources are not reliable, especially the fact that it is editable by anyone regardless of geographical location, Nevertheless, as the quality, scope, and usefulness of Wikipedia increases, it has become imperative to explore its usage as a reference source by librarians for learning and research, as an integral part of open access and open knowledge source and as a reliable alternative for information service delivery to the clientele of any libraries. It is against the background that, this study seeks to explore **the librarians perception of Wikipedia as A Reference Tool in Kaduna State.**

Statement of the problem

Librarians have always played a key role in information access and creation. Today, the information world turns around digital tools and media. However, library services can sometimes seem outdated and undervalued and most users have move to online sources of information. However, Librarians risk becoming irrelevant if they don't adapt to these trends. Therefore, sharing best practices helps librarian's

worldwide stay relevant and provides excellent information services. Librarians need to be quick to adopt new trends and guide users towards contributing their own cultural knowledge. This study explores the perception of Wikipedia as a reference tool by librarians in Kaduna State, Nigeria. It specifically looked at librarians participation on Wikipedia activities and how the view Wikipedia which **is as a result of some awareness campaign among librarians in Kaduna state from Wikimedia User Group Nigeria, Kaduna state.**

Objective of the Study

1. **To explore the librarians perceptions of Wikipedia as a reference tool in Kaduna State.**
2. **To identify the challenges librarians face when using Wikipedia as a reference tool in Kaduna state**

REVIEW OF RELATED LITERATURE

This section reviewed the literature re;ated to the study. Reviewing related literature gives an overview of the current knowledge on the study.

WIKIPEDIAAS A REFERENCE TOOL

Wikipedia is a global, open-source encyclopedia of information that engages users around the world in the creation, storage, and dissemination of knowledge. It has become an established starting point for preliminary research on the web. Over the last nineteen years, the encyclopedia has grown to 54 million articles in over 312 languages (Bordelon & Chang, 2020). Consistently ranking as one of the most popular sites on the web, Wikipedia has over 200,000 volunteer contributors around the world who help to improve free access to knowledge in their languages (Wikimedia Foundation, 2020).

However, Creating content on Wikipedia requires a lot of research across published sources to the ensure the information can be verified and shared with the public (Fenoll, Cummings, Tramullas & Hinojo, 2016). This is because Wikipedia is a tertiary source that drive it information from secondary sources of information such as the newspapers and books. Similarly, Wikipedia is making waves and has become one of the most consulted online references in the world by all professionals and groups. Now, the idea of Wikipedia strategy for 1lib1ref with the concept of having every librarian in the world adding one reference to Wikipedia moved and became blended (Osuchukwu, Agwu & Okonkwo, 2023). However, supporting users is a core priority for any library and disseminating information widely is a key motivation of the entire library professions. Therefore, the following indicates Wikipedia as a reference tool:

1. Wikipedia provides opportunity to reconcile physically disparate information resources in an online space and to collectively develop new knowledge and information. This can be seen in the Wikipedia article describing the National Library of Nigeria which highlights the activities about it. This article, created by a variety of editors, draws on digitised resources.
2. The digital editing platform Wikipedia allows editors to make contributions from any location, contributing a variety of perspectives that may be local and global. Contributions in more than 300 languages reflect both migration patterns and the ability of communities around the world to contribute regardless of location. Exposing collections and research into local language for example in Nigeria Wikipedia in Hausa, Tyap, Ibgo etc.
3. In many instances, Wikipedia has become a public face for science and other fields of endeavour, acting as a pathfinder to secondary and primary sources of information.
4. Further, there are over 280 languages with active Wikipedias, with some articles translated into other languages and others written from scratch in each language. Though representing a wide and global perspective, many of the smaller languages do not have vibrant or active language communities, and many minority cultures that use a shared language are underrepresented - thus offering opportunities for improved coverage and advocacy by stewards of these cultures and languages in libraries and archives. For African Librarians to be contributing to wikipedia, the African Library and Information Associations and Institutions (AfLIA) and Wikimedia Foundation collaboration and campaigns like #1Lib1Ref have attempted to bridge this gap, the actual uptake and integration of Wikipedia into library services have been inconsistent which was an online course that trained librarians (AFLIA,2019).

The review of the literature focuses on the several studies that offer a chronological summary of research studies on Wikipedia use and awareness as it related to the research.

Obuezie and Horsfall (2023) study titled African Academic libraries partnering with wikimedia projects: values and benefits. This study discusses the advantages and ideals of African university libraries joining up with Wikimedia initiatives, and provides a quick explanation of what Wikipedia and Wikimedia are. How academic libraries directly enhance Wikipedia's resources for trustworthy information; in particular, it emphasizes the need to correctly position librarians as knowledge keepers by describing the 1Lib1Ref campaigns and other related initiatives in which librarians in Africa worked with Wikipedia through the African Library and Information Associations and Institution (AfLIA) to add trustworthy sources, edit articles, and create narratives to enhance the authority, quality, and dependability of intellectual contents in Wikipedia. By connecting materials from institutional repositories to wiki articles in accordance with the UNESCO policy of guaranteeing public access to information, it illustrates the involvement of academic libraries in the creation of information resources to aid access to information for all citizens (UNESCO, 2017).

Osadepe et al. (2022) looked at the edit A thon initiative given by Wikimedia to raise awareness and usage in interviews conducted at the UNN University Library. Data was gathered using a questionnaire. The results demonstrate that academics use Wikipedia more often after learning about it through the Wikimedia edit A thon initiative.

Li & Thelwal (2021) This study investigated the perceptions of academic librarians regarding Wikipedia's use by students and researchers. The authors surveyed 161 librarians from various US institutions and found that while many librarians recognize the benefits of Wikipedia as a starting point for research, they also have concerns about its accuracy and reliability. The study also found that librarians who use Wikipedia themselves are more likely to encourage its use by students and researchers.

Bordelon and Chang (2020) looked studied how undergraduate students felt about Wikipedia and how using the site changed the way they developed their information literacy. After polling 297 students at a US institution, the authors discovered that although many of them utilized Wikipedia as a jumping off point for their study, they were also aware of its shortcomings and depended on other sources to confirm the accuracy of the information they found there.

The usage of Wikipedia in academic libraries is examined by Mills and Baur (2019), along with its applicability to information literacy training and the difficulties it poses for librarians. The authors contend that although Wikipedia can be a useful tool for students, librarians should notify their patrons of its limits and advise them to double-check information from Wikipedia with other sources.

Methodology

This study adopted the interpretive phenomenology approach and case study design.

Phenomenology is a form of qualitative research that focuses on the study of an individual's lived experiences within the world (Neubauer, Witkop & Varpio, 2019). This approach was adopted in that it allowed the exploration of the use of Wikipedia as a reference tools among academic librarians. Fifteen (15) Librarians were recruited at the onset of this study through purposive sampling technique but Ten (10) participants eventually constituted the sample of this study. This was achieved when the data saturation was reached. Data was collected through the use of semi structured interview guide. In-depth interview was used for data collection through the use of handheld device to capture the worldview of the participants on the use of Wikipedia as a reference tool among librarians in of Kaduna state. Data collected was analyzed using interpretive phenomenological analysis approach. This was to capture the lived experiences of the participants on the use of Wikipedia as a reference tools among academic librarians.

Results

LIBRARIANS PERCEPTION OF WIKIPEDIA AS A REFERENCE TOOL IN KADUNA STATE

This section consists of the narrative of Librarians perception of wikipedia as a reference tool in Kaduna State. One main category and two themes as sub – categories were emerged which are awareness of Wikipedia and knowledge of Wikipedia as Reference tool.

Theme one: Awareness ofWikipedia

All of the participants explained that they are aware of Wikipedia as encyclopedia that can give someone quick access to information. Narrative about this "yes I know it. Then, have you ever access information from Wikipedia? *Yes, I have access information from wikipedia*. Majority of the participants are aware of Wikipedia.

Theme two: Knowledge of Wikipedia as Reference tool.

Most the participants explained that, they have the knowledge of Wikpedia as reference tool for information access to librarians. Their narratives about this are captured as follows*; "Yes,* ok can you give your reasons '*Yes, because it is an open knowledge platform and it offers a quick overview of topic and references that can lead to authoritative recourse"* another respondent also said " *Yes, Wikipedia projects are freely available online which makes them a great starting point for research especially topics that are not well represented in the library collections.*"

The challenges librarians face when using Wikipedia as a reference tool

This section consists of the narrative of Librarians challenges of Wikipedia as a reference tool. One main category and two themes as sub – categories were emerged which are Authenticity of the source, limited coverage of topics and lack of Wikipedia editing Skill.

Theme one: Authenticity of the source

Majority of the participants reported that most academic institutions or lecturers does not accept wikipedia as good sources to cited in assignment. Their narrative about this are captured as follows: "*In the academic environment, almost all the academics don't accept sources gotten from wikipedia"* another respondent said "Authenticity *of the sources can be questionable a times"* similarly, another participent mentioned that "*Most academic are not accepting it as reliable sources of information"*

Theme Two: Limited coverage of topics

Most of the participants explain that some topics are missing in the wikipedia. Their

narrative about this are captured as follows: "*Some topics, especially those about underrepresented regions like Nigeria or cultures, have limited coverage or bias"* Another respondents reported that "*Sometimes when researching for information on Wikipedia you won't be able to access due to the fact that is not allowed and maybe the language in which the information is being presented is not covered"*

Theme Three: Digital Literacy skill

Most of the participants explained that, they lack digital literacy skills in respect to how to work o r access good information on Wikipedia. Their Narratives about this are captured as follows; "*Lack of online evaluation skills that identify good information on Wikipedia or how to work on the environment*".

Discussion of Findings

The lived experiences of participants in this study were described as their knowledge of the use of Wikipedia as a reference tools among librarians in Kaduna state

Knowledge of Wikipedia as reference tool

The findings of this study revealed that librarians in Kaduna state have the knowledge of Wikipedia as online encyclopedia. Majority of the participants view Wikipedia as a reference tool, since is open source information platform that link to other sources of information online. In support of this finding, Miller, 2014 reported that many students view Wikipedia as academic reference point. Similarly, wikipeida is the largest information database in the world today which has become ready reference for students and online users (Phetteplace, 2015: Dowell & Bridges, 2019). The implication of the study shows that librarians are aware of Wikipedia as online encycledia which is a reference tool in the library. Therefore, embracing Wikipedia is important for librarians in other to have the ability to evaluate, create, and edit content on the Wikipedia platform, which can serve as an essential tool for improving the visibility and accessibility of library resources. However, Wikipedia is a free, collaborative online encyclopedia that shares key values with libraries, including openness, neutrality, and a commitment to information equity. Studies have noted that over 99% of Google search results include Wikipedia on the first page (Tawnya, 2023). Therefore, it's recommended that Librarians should embrace wikipedia by learning the basic Wikipedia skills and polices regarding creating and editing Wikipedia and this will bring more visibility to library information resources.

The Challenges Librarians face when using Wikipedia as a Reference too

This finding revealed that participants have the challenges of authenticity of the sources is questionable, limited coverage of topics and lack of digital literacy skills in respect to how to work effectively on the Wikipedia platform. In support of this finding, the perception of distrust and lack of confidence in Wikipedia by the academic community have been reported (Jemielniak & Aibar 2016). The notion shows the warning of some academic staff on their students on not to use Wikipedia for scholarly writing. Similarly, Haren, Romero, Hottinger & DeJongher, 2020 shows that Wikipedia challenge is the digital literacy skill to contribute to Wikipedia by editing or creating article. Wikipedia is not only valuable object of study in higher institution but a platform in which students or users have access to information online. The implication of this finding is, there is knowledge of Wikipedia among librarians but these challenges discourage them from embracing or contributing to the global open knowledge site. Therefore, the study recommended that librarian should be for front in adding reliable sources to Wikipedia and also engage lecturers and students on how to use Wikipedia example how to Wikipedia link to other reliable source of information.

Conclusion

Wikipedia is a ready reference for our users this current digital age. This study concluded with librarian's skills and information resources in the library, they should embrace Wikipedia by adding value to the wikipedia platform which can enhance information services and build capacities of editors. This will help make library and information service easy. Conclusively, Librarian should be forefront of all online information platforms because they have the resources to contribute to the global knowledge.

Recommendation

1. It's recommended that Librarians should embrace wikipedia by learning the basic Wikipedia skills and polices regarding creating and editing Wikipedia and this will bring more visibility to library information resources.
2. The Libraries management and professional Ogranization should take up the battle to make entries created in Wikipedia part of promotion exercise to encourage participation of more staff.

Reference

AfLIA, (2019). African librarians invited to contribute knowledge to Wikipedia, Through a new Wikimedia/AfLIA19 partnership. https://web.aflia.net/african- librarians-invited to-contribute-knowledge-to-wikipediathrough-a- new

Bordelon, A. M., & Chang, C. (2020). Student perceptions of Wikipedia and their Information literacy

development. Journal of Academic Librarianship, 46(3).
Cooke, R. (2020). Wikipedia is the last best place on the internet. Wired. Retrieved January 24, 2025, from www.wired.com/story/ wikipedia-online-encyclopedia-best-place-internet/.
Dowell, M. L., & Bridges, L. M. (2019). A Perspective on Wikipedia: Your Students Are Here, Why Aren't You? *The Journal of Academic Librarianship*, *45*(2), 81–83. https://doi.org/10.1016/j.acalib.2019.01.003
Ezeani, C. N. (2022). Wikipedia edit-a-thon in a Nigerian academic library. Library Philosophy & Practice. (e Journal).
Fenoll, C., Cummings, J., Tramullas, J., & Hinojo, À. (2016). Opportunities for public libraries and Wikipedia. Retrieved on 12 February, 2023 from https://www.ifla.org/wpcontent/uploads/2019/05/assets/hq/topics/infosociety/iflawikipediaand
Ferzan, R; Savage, S. and Saviga C. (2016). Bringing on Board new enthusiasts! A Case of Impact of Wikipedia Art + Feminism edit-a-thon events on Newcomers.In: Spiro E., Ahn YY. (eds) Social Informatics. SocInfo 2016. Lecture Notes in Computer Science, vol 10046. Springer, Cham. http://saviaga.com/wp-content/uploads/2016/06/socinfo_ediathons.pdf
Ford, H. (2016). Wikipedia and the sum of all human Information. Nordisk TidssKritf for Informationsviden ska bog kulturformdling.5(1) 9-13 https://tidsskrift.dk/ntik/article/view/25878/22786
Haren, S. M., Romero, S., Hottinger, E.P., & DeJonghe,E.S. (2020). Using Wikipedia for project-based learning in information literacy instruction Journal of New Librarianship 9(13) 105-134 10.21173/newlibs/9/13
Li, J., & Thelwall, M. (2021). Wikipedia and academic librarians: perceived benefits and concerns. Journal of Librarianship and Information Science, 52(4), 1061- 1075
Luyt, B., Zainal, C. Z. B. C., Mayo, O. V. P., & Yun, T. S. (2008). Youth Perception and Usage of Wikipedia. Information Research, 13(4)
Miller, J. (2014). Building Academic Literacy and Research Skills by Contributing to Wikipedia: A case study at an Australian university, Journal of Academic Language & Learning 8(2), 73-93. Retrieved on 15 April, 2025 at davidr,+319-final (1).pdf
Mills, C., & Baur, K. (2019). Unpacking the use of Wikipedia in academic libraries. Journal of Academic Librarianship, 45(2), 97-103
Neubauer B.E, Witkop C.T. and Varpio L. (2019). How phenomenology can help us learn from experiences of other. Perspect Medical Education. 8(2):90-97
Obuezie, C.A. and Horsfall N.M. (2023) African Academic Libraries partnering with Wikimedia projects: Values and Benefits. Wikisource Journal.
Osadebe, N. E., Ukwoma, S. C. Dr; Njoku, E. O., Udochukwu, Madumere, C. P. & Ezeani, C. N. (2022). Wikipedia edit- a -thon in a Nigerian academic library. Library Philosophy and Practice (e-journal). 7231. Retrieved on 27th February, 2025 from https://digitalcommons.unl.edu/libphilprac/7231
Osuchukwu, N.P., Agwu, P.U. & Okonkwo, I.N. (2023). Empowering African Librarians: The AfLIA's Role in Enhancing Wikipedia through #1Lib1Ref in Nigeria. Niger Delta Journal of Library and Information Science, 4(2), 73-90. https://ndjlis.fuotuoke.edu.ng
Phetteplace, E. (2015). How can Libraries Improve Wikipedia? Reference and User Services Quarterly. 55(2), 109-112.
Wikimedia Foundation. (2020). About. Retrieved on 15 March, 2025 from https://wikimedia foundation.org/about

Exploring the Possibilities of Fifth Industrial Revolution Technologies for Sustainable Library Advocacy among Librarians in Nigeria

By
Vincent C. Opara
University Library
David Umahi Federal University of Health Sciences, Ebonyi State, Nigeria
oparachima77@gmail.com, oparavc@dufhus.edu.ng

Juliet C. Alex-Nmecha (PhD)
Rivers State University Central Library
Rivers State University, Port Harcourt, Nigeria
Juliet.anmecha@rsu.edu.ng
&
Innocent Iwezor Ordu (PhD)
Department of Library and Information Science, Rivers State University, Nigeria
Innocent.iwezor@gmail.com, innocent.ordu@ust.edu.ng

Abstract
This research explored the possibilities of leveraging the technologies of the 5th Industrial Revolution (5IR) to advance sustainable advocacy for libraries, particularly in the context of evolving digital literacy, library marketing and community engagement. The 5IR, driven by innovations such as artificial intelligence (AI), blockchain, and the Internet of Things (IoT) can offers unprecedented opportunities for transforming traditional library advocacy practices and fostering broader support for their role in society. The population of this study comprises the librarians in Nigeria. Their number ran into thousands. Data were gathered via Google Form Questionnaire that was distributed to respondents through Nigerian Library Association State Chapter WhatsApp Groups. 110 responses were received and used for the analysis. Mean scores was used to analyze the data. Results of the analysis show that artificial intelligent technology, augmented reality, blockchain technology, internet of things and big data analytics are 5IR technologies that can promote library advocacy. It also revealed that 5IR technologies have high possibilities of enhancing user experience, efficiency and streamline the delivery of library services, improve and promote sustainable library display and exhibition. While the challenges discovered are inadequate infrastructure, insufficient funding, Unequal access to technology, Limited technical expertise, Ethical considerations challenge, Library staff resistance to change and Data protection issues. This study therefore recommended that libraries should adopt and adapt to using 5IR technologies to build stronger advocacy strategies, ensuring they remain vital community resources in a rapidly changing world.
Key words: *library advocacy, librarians, sustainable development, 5IR Technologies*

Introduction

Library advocacy is an important aspect of library literacy and library marketing. It is the act and art of promoting awareness about what the library can offer actual and potential library users. It is actively a planned effort to promote general and specific understanding and awareness of libraries activities, influencing individuals, groups and the public to patronize libraries facilities, products and services. Library advocacy is a concept that carries a sense of persuasion, influence, display and exhibition, advertising and marketing of the program and services libraries can provide to users. Baranzan and Achie (2024) noted that library advocacy is not merely a promotional endeavor but a means to ensure that libraries remain at the forefront of academic excellence, innovation and knowledge. Libraries all over the world have in most cases preached their importance to the society especially in the bid to foster sustainable development. American Library Association (ALA) in 2001, partnered with international federation of Library Association (IFLA) to create campaign for the world's libraries. Libraries often times need to sustain the practices of library advocacy because of the need of users and potential users to be aware and assured of getting quality services and information resources provided by libraries for their all round development. Durney (2023) concluded that libraries need strong library advocates to raise awareness of the critical role libraries play in communities and to advocate for policies that advance the mission of libraries.

Pragmatically, library advocacy is a job for librarians, libraries, publishers, information professional and governments and other stakeholders to do, but often times left for librarians and libraries. Libraries are important in promoting the total wellbeing of humanity. This is as a result of it function in securing knowledge, and ensuring the production and reproduction of inventions and innovation that stimulates societal development. Meaning that library can be seen as center of human knowledge, learning, production, reproduction and promotion of knowledge through the use of it collection and the patronage of

its services. All this benefits and functions are packaged for potential library users to know through library advocacy. For advocacy to succeed as a concept, it has to employ marketing strategies. Kotler (2002) in Ezeala and Hundu, (2019) says that marketing deals with identifying and meeting human and social needs. Essentially libraries advocates for the use of facilities, collections and services.
For library advocacy in this age and time to be effective, sustainable and marketable it will deploy strategic approaches such as:

- Clear goals, mission and objective
- Active and collective participation of member and stakeholders
- Availability of funds
- Government and management understanding
- Technological involvement

The advancement and continuous development of technologies from 2.0, 3.0, 4.0 and now 5.0 revolutionized how and what way library advocacy should be practice. Therefore, the emergences of the 5th industrial revolution technologies can play a very strong role in promoting library advocacy. This can be attributed to the fact that library users or potential users are up-skilling and may not be able to be aware of the library resources and services using the tradition library advocacy platform or techniques. It becomes imperative for libraries and librarian to adopt and deploy emerging technologies in promoting effective library advocacy. Technologies such as: social media ads, artificial intelligence, block chain technologies; virtual reality technologies amongst others are becoming indispensible in this age. This new technologies can be a strong force in promoting the resources, services and the goodwill of libraries to the public.

Statement of the Problem

Organizations no matter their objectives promote marketing, advertising and advocate for the patronage of their products and services to potential users. This same strategy is very applicable to the library and often referred to as library advocacy. With the emergence of the 5th industrial revolution, new and reliable technologies which are very useful to promoting the libraries and its services are developing. On the order hand, library advocacy are gradually taking new forms mostly in the era of new and developing technologies. However, there is scarcity of literature on 'Exploring the possibilities of Fifth Industrial Revolution Technologies for sustainable library advocacy among Librarians in Nigeria.' Hence, the reason for this study.

Research Objective

The following are the research objectives used in this study:

1. To determine the 5th Industrial revolution technologies that can promote sustainable library advocacy.
2. To know the possibilities of 5th industrial revolution technologies for sustainable library advocacy.
3. To identify the challenges of exploring the possibilities of 5IR technologies for sustainable library advocacy

Research Question

The following are the research questions used in this study:

1. What are the 5th Industrial revolution technologies that can promote sustainable library advocacy?
2. What are the possibilities of 5th industrial revolution technologies for sustainable library advocacy?
3. What are the challenges of exploring the possibilities of 5IR technologies for sustainable library advocacy?

Literature Review

This section presents the review of related literature. The review is presented as follows:

Concept of Library Advocacy

Tedu (2014) defined advocacy as a bullet that goes straight to a stony heart. The word “advocacy” therefore takes its roots from the Latin word “advocare”, meaning to speak for someone, proposing or recommending something or someone for better options. It implies identifying a cause, believing in it, mobilizing and influencing others to support it so as to change the policy or programme that is negatively affecting that cause. Advocacy is a planned, deliberate sustained effort to raise awareness of an issue or issues. It is a continuous process during which support and understanding of the issue are gradually increased over an extended period of time. (Koukourakis, n.d). According to Bray-Casiano (n.d) Advocacy simply means to actively support or kick against a cause. Library supporters must remind their neighbors, community leaders, and elected officials of the fact that libraries provide great learning opportunities, excellent public service, and serve as invaluable contributors in their communities. Advocacy efforts ensure that libraries remain visible and relevant with the institution even as information landscapes evolve. Advocacy initiatives

are essential for securing the resources necessary to maintain and expand library collections, services and technologies (Durney, 2023). For advocacy to succeed as a concept, it has to employ marketing strategies. Kotler (2002) says that marketing deals with identifying and meeting human and social needs. Besant (2002) supports Kotler and argues that librarians and information professionals using the concept of advocacy are heading for effective library adverting which will in turn enhance the library's ability to contribute to student success and faculty research excellence.

Emezie, & Nwaohiri. (n.d.), opined that library advocacy should be a leading role for Librarians in repositioning the academic library for effective information service delivery in the 21st century. They further said, in the current dispensation, users no longer seek information in the library. The reverse has become the case where the library goes out to extend their information services to users using various innovative technologies. To achieve this, librarians need to look out for opportunities to connect and interact with users in a quick but sophisticated way. This therefore requires that libraries of a matter of necessity need to employ emerging technologies that are very user-friendly to promote and preach its services to potential patrons.

Evolving trends shows that Library advocacy is not merely a promotional endeavor but a means to ensure that libraries remain at the forefront of academic excellence, innovation, and knowledge dissemination (Baranzan & Achie, 2024). Advocacy is a weapon used by libraries to mobilize support for library services in general or for a particular situation, examples are supporting increased library services, increased financing of library services and new library legislation are also supported. The goal of advocacy is to influence results, in order to achieve objectives. Advocacy is the process of presenting a case, an argument, or a claim in support of a decision or a course of action. To be a library advocate, one needs to believe in the value of the library (Abegunde, Awujoola and Bamidele, 2023).

Library advocacy strategies

Librarians working in all types of libraries must be competent advocates and policy influencers. Librarians execute advocacy skills through a variety of actions, such as communicating regularly with the library's community, writing an informative letter to the editor to raise public awareness of library issues; researching policy issues and effectively communicating the policy impact on the library to stakeholders and decision-makers; testifying before a school board to oppose censorship and defend the freedom to read. In addition, librarians need a foundational understanding of how public policy impacts libraries. This understanding empowers librarians to advocate for policy that enables libraries to realize their mission in ensuring equal access to information for all. Library advocacy educate policymakers and community members about the important rolethat libraries play in their communities. Koukarakis cited Alire, (n.d) Advocacy uses many of the tools of marketing and public relations, but it is neither solely one nor the other. The public relations and marketing toolare: public meetings, news conferences, lobbying, surveys, focus groups, advertising in all media, strategic partnerships, a huge variety of print promotional material and much more.

Originally, library advocacy centered on the library itself, but current trends show libraries positioning themselves to demonstrate how useful they are to their communities. They are enabling forces for learning, providing environment in which creativity is fostered, and repository of culture; in fact, advocacy is planned to capture values and transformative impacts of libraries and librarianship through information service sequel to the changes brought by new technological developments in the libraries. In advocating the importance of libraries, librarians should take into consideration that technology has vastly changed the way information is access, and it has greatly enhanced library and information services and it has also raised some unsettling questions. In the information age, library advocates continue to have a crucial role to play in educating our communities about why libraries and librarians are essential in an information society. To be effective, they must speak loudly, clearly and with a unified voice. Society needs libraries, and libraries need advocates (Koukarakisn.d from Library Advocate's Handbook). To emphasis on the importance of advocacy in academic libraries, Obi (2023), citing Mlanga (2002) opined that the reason for advocacy and lobbying is that things are not going well in the library sector, to him, while libraries are integral units in country's welfare infrastructure, they are not immune to the technological possibilities that technologies can bring into promoting library services of modern clientele.

The viability of the 5th Industrial revolution technologies for library advocacy

The phases of technological development of the 21th Century from library 2.0 to 5.0 have continuously shows how important it is for libraries and librarians to up-skill, adopt and adapt to new development in technologies to provide user designed services and lure library users and potential library users to seek library support and services. the emergence of 5.0 technologies. Such as artificial intelligence, blockchain, the internet of things, virtual reality etc. is transforming the way libraries operate and can advocate for their

services (Tella et al., 2023). Studies have revealed that AI-powered chatbots can enhance user engagement in libraries by providing individualized support services (Dou, et al., 2023). For instance, the use of chatbots can help users find relevant resources, answer frequently asked questions, and provide recommendations for further learning. Through virtual and augmented reality technologies libraries can create immersive learning experiences that can engage library patrons and promote interactive learning atmosphere (Greene& Groenendyk, 2021).

The 5th Industrial revolution technologies have the capacity to improve resource discovery in libraries by providing more efficient and effective ways to find relevant information. One of the goals of library advocacy is to expose users to new ways of discovering how to locate relevant resources by this way library product and services are marketed (Ezeala, 2023). Also, the use of blockchain technology is capacitated to improve the security and transparency of digital resources, ensuring that users have access to reliable and trust worthy information (Chytis, 2019).

Talking about how effective library advocacy through the use of emerging technologies, Ihejirika, Goulding & Clvert (2021) shared that social media technologies are very viable, enabling libraries to network, share, train, engage, advertise and preach the good will of the libraries to potential users. The constant features added to social media have improved the capacity and diversification of social media in recent times. Social media is no longer less engaging, it have AI features that promote adds, intelligent replies and promptings thereby, making social media a hub for library advocacy in 5IR era. The issue of understanding community information seeking behaviour, track preferences and identify information trends for effective library advocacy can be done through the use of AI-powerd analytics. Fast and efficient way of tracking user's data, engagement, identify trends and make informed decision about resource allocation and information dissemination is equal to the adoption of emerging technologies in library routines.

Over the years, the promotion of libraries for user's patronage are not without challenges ranging from attitude, training, good communication skill, poor facilities, ineffective strategies prompted by inadequate knowledge and poor funding have long affected libraries and librarians to advocate for the use of library product and services. David-West and Bassey, (2017) stated that library professional seems not to apply the right advocacy tools to get government attention as a result the lack of librarian "know how" and "strong communication skills" which impedes the advocacy process. It even becomes more demanding in the wake of the 5IR age.

Methodology

Descriptive survey was adopted for this study. This was found appropriate because it is more ideal for studying a spread population of librarians across Nigeria. An online Google form questionnaire was used for this study and was distributed to respondents through Nigerian Library Association state chapters. One hundred and ten (110) respondents accurately filled the form and as such were considered valid for analysis. Mean score was adopted to analyze the data collected from the respondents. The bench mark for analysis is accepted when the mean 2.50 and above while a mean of less than 2.50 is rejected. The respondents scale and value assigned is SA=4, A=3, D=2 and SD=1

Analysis of data and results

Question 1: What are 5th Industrial revolution technologies that can promote sustainable library advocacy?

S/N	ITEMS	SA	A	D	SD	$\bar{x}$	Decision
1	Artificial intelligent technology	47	32	17	14	3.0	Accepted
2	Blockchain technology	33	37	22	18	2.8	Accepted
3	Big data analytics	24	29	30	27	2.5	Accepted
4	Augmented reality	43	34	19	14	3.0	Accepted
5	Mobile library applications	47	33	20	10	3.1	Accepted
6	Social media	45	36	18	11	3.0	Accepted
7	Internet of things	33	28	26	23	2.6	Accepted

Table 1 shows the mean response of the 5th Industrial revolution technologies that can promote sustainable library advocacy. From the table it shows that librarians recognise; Mobile library applications (3.1), Social media (3.0), Artificial technology (3.0), Augmented reality (3.0), Blockchain technology (2.8), Internet of things (2.6) and Big data analytics (2.5).

Question 2: What are the perceived possibilities of 5th industrial revolution technologies for sustainable library advocacy?

S/N	ITEMS	SA	A	D	SD	$\bar{x}$	Decision
1	5IR technologies has the possibility of enhancing user experience	43	38	17	12	3.0	Accepted
2	5IR technologies has the possibility of promoting personalized library marketing	39	37	16	18	2.9	Accepted
3	The 5th Industrial Revolution Technologies can reduce user library engagement.	22	20	36	32	2.3	Rejected
4	5IR technologies increase library resource accessibility	36	35	20	19	2.8	Accepted
5	5th IR technologies will improve and promote sustainable library display and exhibition	38	36	19	17	2.9	Accepted
6	5th IR technologies will enhance the efficiency and streamline the delivery of library services	47	30	18	15	3.0	Accepted
7	5IR technologies has the possibility of promoting equal access of library resources and services	34	30	27	19	2.7	Accepted
8	**5IR have the possibilities of increasing library's visibility**	40	36	21	13	2.9	Accepted

Table 2 shows the mean response of the perceived possibilities of 5th industrial revolution technologies for sustainable library advocacy. The table shows that librarians perceived that: 5IR technologies have the possibility of enhancing user experience (3.0), 5th IR technologies will enhance the efficiency and streamline the delivery of library services (3.0), 5th IR technologies will improve and promote sustainable library display and exhibition (2.9), 5IR technologies has the possibility of promoting personalized library marketing (2.9), 5IR have the possibilities of increasing library's visibility (2.9), 5IR technologies increase library resource accessibility (2.8), 5IR technologies has the possibility of promoting equal access of library resources and services (2.7) and The 5th Industrial Revolution Technologies can reduce user library engagement (2.3)

Question 3: What are the challenges of exploring the possibilities of 5IR technologies for sustainable library advocacy?

S/N	ITEMS	SA	A	D	SD	$\bar{x}$	Decision
1	Inadequate infrastructure that support 5IR technologies	52	47	11	-	3.4	Accepted
2	Insufficient funding	54	40	16	-	3.3	Accepted
3	Limited technical expertise	34	32	24	20	2.7	Accepted
4	Unequal access to technology	37	29	25	19	2.8	Accepted
5	Library staff resistance to change	32	30	25	23	2.6	Accepted
6	Ethical considerations challenge	36	30	23	21	2.7	Accepted
7	Data protection issues	33	28	26	23	2.6	Accepted

Table 3 shows the mean response of the challenges of the possibilities of the 5th industrial revolution technologies for sustainable library advocacy. From the table it shows identified challenges such as; Inadequate infrastructure that support 5IR technologies (3.4), Insufficient funding (3.3), Unequal access to technology (2.8), Limited technical expertise (2.7), Ethical considerations challenge (2.7), Library staff resistance to change (2.6) and Data protection issues (2.6).

Discussion of findings

The research question on the 5IR technologies that can promote sustainable library advocacy reveal that Mobile library applications, Social media, Artificial intelligent technology, Augmented reality, Blockchain technology, Internet of things and Big data analytics are very viable to promote the good will of the library to actual and potential library users. This can be justified by the result of the data collected and analysed. This result was hitherto supported by Ajani et al., (2022), Tella et al., (2022), and Moll, (2023), they agreed that the 5IR is propelling libraries into a period marked by innovative technological advancements and societal transformations that is profitable in promoting library service in this digital era. According to Noble et al., (2022) the 5thindustrial revolution signifies the harmonious integration of diverse technologies such as cloud computing, AI, internet of things and sophisticated big data analytics. Oladokun and Gaitanou, (2024), noted that digital era is advancing to new technologies that forces unprecedented advancement and opportunities. The proliferation and spread of these technologies have high tendencies of continuous development to include features that propagate the services and products that libraries offer. Burkhardt, (2017) in former research shared that social media technologies are very viable, enabling libraries to network, share, train, engage, advertise and preach the good will of the libraries to potential users. At the centre of sustainable library advocacy, is the adoption of new technologies.

The research question on the possibilities of 5th industrial revolution technologies for sustainable library advocacy shows that 5IR technologies have high possibilities of enhancing user experience, efficiency and streamline the delivery of library services, improve and promote sustainable library display and exhibition, promote personalized library marketing. It has the possibilities of increasing library's visibility, and increase library resource access. Discussing on the proficiency that the 5IR technologies can offer, Chaturvedi & Verma (2023), stated that AI systems have assumed a significant role libraries as it have become instrumental in revolutionizing library's operations through AI-driven Virtual assistants, chatbots and recommendation algorithms providing personalized and efficient library services. Kraft –Terry and Brown (2023) asserted that libraries are harnessing the power of data analytics and big data to gain deeper insight into user behaviour, resource accessibility, utilization, collection development, information dissemination and resources visibility. Of course, data-driven insights are pivotal to shaping libraries strategies to meet the dynamic demand of users. Another researcher supported that LoT technologies are transforming libraries into smart and responsive spaces to enhance user experiences and to promote sustainability (Azizi et al, 2020). This research therefore indicates that libraries are exploring a wide range of sophisticated technologies to navigate the 5IR, redefining their roles and expanding their impacts by enhancing user experience, streamlining the delivery of library services, improving sustainability and most importantly visibility in the era of digital transformation.

The research question on the challenges of exploring the possibilities of 5IR technologies for sustainable library advocacy revealed that challenges such as; inadequate infrastructure that support 5IR technologies, Insufficient funding, Unequal access to technology, Limited technical expertise, Ethical considerations challenge, Library staff resistance to change and Data protection issues. The observed findings are supported by Bareh, (2020), Lee (2021) and Budhwar et al (2023) pointed out that ethical challenge, data security and privacy issues constitute persistent challenges in this digital era. Bermanet et al., (2021), expresses that libraries frequently operate on tight budget constraints as a result of insufficient fund from parent institutions and other stakeholders. Mackey and Jackson (2018), argued that limited financial, technological, and human resources can impede the unprecedented possibilities of emerging technologies for sustainable library services. Gallagher (2020), notes that librarians face steep learning curves while adapting to change in the use of digital technologies. Horsfall and Opara (2022), emphasized the need to ensure equal access to technologies. Agosto (2021), noted that many librarians express low formal training on the use of emerging technologies and therefore call for increase in training programs so that librarian can be more effective and confident to carrying out their duties.

Conclusion

The transition to the 5IRhas necessitated new exploration to uncover its possibilities for sustainable library advocacy. As libraries and librarians face the technological transformation in this 21st century, there is need to explore the opportunities that each phase of innovation bring to library services. From the study, it becomes evident that 5IR technologies hold wonderful opportunities in promoting library advocacy from the integration of AI, internet of things, blockchain, chatbots, virtual assistant etc. these technologies have the potential to enhance library services, increase visibility, customize user experience and engage user, making information more accessible. However, these prospects also bring a set of consideration that necessitates careful contemplation.

Recommendations

Based on the findings, the researchers recommend that;

1. Libraries should invest on 5IR technologies to promote library patronage, create awareness and library advocacy.
2. Libraries should develop a strategic library advocacy plan for implementing 5.0 technologies, including a clear vision, goals, and objectives.
3. Libraries should training and support for staff and users to ensure that they are equipped to effectively use 5IR Technologies.
4. Libraries should foster collaboration with other libraries, institution, and organizations to share knowledge, resources and best practices in implementing 5.0 technologies.

Future directions

Libraries and librarians should focus on exploring the potential of 5.0 technologies in different library settings, including academic, public, and school libraries, additionally, studies should investigate the impact of 5.0 technologies on library services and user engagement.

References

Abegunde, T., Awujoola, O. A. & Bamidele, O. A. (2023). Influence of advocacy and awareness programmes on use of digital library resources and services by postgraduate students in three federal universities in south-west, Nigeria. *Library Philosophy and Practice (e-journal).* 7756. https://digitalcommons.unl.edu/libphilprac/7756

Alex-Nmecha, J.C. &Bassey, M. M. (2021). Library Advocacy: a strategy to sustaining library in the 21st century. *Anthology in Library and Information Science: A festschrift in honour of Prefessor Blessing EsuruAhiauzu*

Agosto, D. E. (2021). Libraries and the metaverse: Opportunities and challenges for information professionals. *Journal of Library Administration,* 61(2), 239–249. https://doi.org/10.1080/01930826.2021.1894537

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullahi, F. (2022). Perspectives of librarians on awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services in Nigeria. *Internet Reference Service Quarterly*, 26(4), 213-230.

American Library Association (ALA). Retrieved from http://egreengage./com/ala/home

Azizi, S., Nair, G., Rabiee, R., & Olofsson, T. (2020). Application of internet of things in academic buildings for space use efficiency using occupancy and booking data. *Building and environment*, 186, 107355

Baranzan, A. & Achie, J (2024). Exploiting library advocacy as a funding strategy among academic libraries for information service delivery in kaduna State, Nigeria. *Journal of Science Technology and Education,* 12(3).

Bareh, C.K. (2022). Privacy policy Analysis for compliance and readability of library vendors in india. *The Serials Librarian*. 83(2), 148-165.

Berman, E. M. Bowman, J.S., West, J. P., & Van Wart, M. R. (2021). Human resource management in public service: paradoxes, processes, and problems. CQ Press

Besant, L.X. (2000). *Libraries need relationship marketing in information Outlook,* http://www.findarticles.com.cf-4/61533802/

Budwar, P., Chowdhury, S., Wood, G., Aquinis, H., Bamber, G. J., Beltran, J. R. & Varma, A. (2023). Human resource management in the age of generated artificial intelligence. Perspectives and research directions on chat GPT. *Human Resource Management Journal, 3*3(3), 606-659.

Brey-Casiano, C.A. (n.d). *Library Advocacy in a World Community.*

http://www.library.illinois.edu/mortenson/book/14_brey-cassiano2.pdf
David-West, B. T. & Bassey M. M. (2017). Advocacy for School Libraries in Nigeria. *International Journal of Scientific Research in Education.* 10(4), 373-378
Durney, S. M. (2023). The library advocacygap: Increasing librarians' political self-efficacy: A mixed methodsresearch study. *The Political Librarian*, 6(1).
Chytis, E. (2019). A review of blockchain technology and itsapplications in the business environment. *In Res Gate Conf* (pp. 1-16).
Chaturvedi, R., & Verma, S. (2023). Opportunities and challenges of AI-Driven customerservice. Artificial Intelligence in Customer Service: *The Next Frontier for Personalized Engagement*, 33-71
Dou, F., Ye, J., Yuan, G., Lu, Q., Niu, W., Sun, H., &Song, W. (2023). Towards artificialgeneral intelligence (AGI) in the internet of Things (IoT): Opportunities and challenges. https;//ar5iv.labs.arxiv.org/html/2309.07438
Emezie, &Nwaohiri. (n.d.). 21st century librarians and effective information service delivery. Retrieved from https://google.com
Ezeala, L. O. (2023). Role of the library in creating an inclusive society for indigenous knowledge in theattainment of sustainable development goals. *Tin-City Journal of Library, Archival & Information Science,* 12(1).
Gallagher C.S., Lutz A., & Cline J.A. (2020) Virtual reference services in virtual reality: using engage to provide personalized assistance to users. *Journal of Electronic Resources Librarianship* 32(3): 150–158. DOI: 10.1080/1941126X.2020. 1790158
Gorman, M. (2005). Library advocacy. Paper presented at the 52nd National Conference retrieved from http://www. cl3ver.com/blog/bim-project-stakeholders-outsidethe- bim-ecosystem/
Greene, D., & Groenendyk, M. (2021). An environment scan of virtual and augmented reality services in academic libraries. *Library Hi Tech,* 39(1), 37-47.
Horsfall, M. & Opara, V. C. (2022). Availability of Information Resources for Visually Impaired Students in University Libraries in Nigeria: A Tool for Inclusive University Education. *International Journal of knowledge content and development*.
Ihejirika, K. T., Goulding, A., & Calvert, P. (2021). Rethinking academic library use of social media for marketing: management strategies for sustainable user engagement. *Journal of Library Administration,* 61(1), 58-85
Kotler, P. (2002). *Marketing Management. Millenium Edition. Custom Edition for University of Phoenix.* Boston. Pearson Custom Publishing.
Koukourakis, M. (n.d.). Library advocacy modernization of academic library services in Moldova W2. *Advocacy marketing workshop*: University of Crete.
Krafy-Terry, S. D., & Brown, J. (2023). Data-Informed planning and Decision-making. *In Academic Advising Administration* (pp. 181-194). Routledge.
Mackey, T.P., & Jacobson, T.E. (2018) Metaliteracy: Reinventing Information Literacy to Empower Learners. Chicago, IL: American Library Association.
Marcum,D.B. (2003). Research Questions for the Digital Era Library," *Library Trends,* 51, 36-651.
Mlanga, M. 2014. Advocacy and lobbying for people centered libraries. Retrieved from www.goethe.de/ins/za…/Kenyamlanga.
Moll, I. (2023). Why there is no technological revolution, let alone a “Fourth Industrial Revolution”. *South African of Science*, 119(1-2), 1-6.
Noble, S.M., Mende, M., Grewal, D., & Parasuraman, A (2022). The fifth industrial revolution: how harmonious human-machine collaboration is triggering a retail and service revolution. *Journal of Retailing*, 98(2), 199-208.
Obi, H. E. (2023). Advocacy, conducive environment and students' patronage of library information services in tertiary institutions in University of Port Harcourt, Rivers State. *British Journal of Education*, 11(3), 55-63.
Oladokun, B. D., &Gaitanou, P (2024). Avatars and their players-art in the libraries. Library Hi Tech News.
Tebu, S. (2014). Library advocacy. A paper presented at Zimbabwe Library Association week.
Tella, A., Amuda, H. O., & Ajani, Y. A. (2022). Relevance of Blockchain technology and the management of libraries and archives in the 4IR. *Digital Library Perspectives*, 38(4), 460-475.

Exploring the Role of Polytechnic Library as Strategic Collaborator for the Next-Generation Research Initiatives

By
Dr Olatoye, Adebola Aderemi CLN, MNLA
J. C. Pool Library,
Nigerian Baptist Theological Seminary,
Ogbomoso, Oyo State, Nigeria

Professor Olaojo, Pius Olatunji JP; FNLA
Department of Library and Information Science,
Wesley University, Ondo,
Nigeria

and
ADEOLA, Folake Folasade
M. T. Kontagora Library
Federal School of Surveying, Oyo Town, Oyo State, Nigeria
Adeolafolake2013@gmail.com

Abstract

This study explores the role of polytechnic libraries as strategic collaborators in next-generation research initiatives. Using a mixed-methods approach, this research investigates the current state of polytechnic libraries in supporting research initiatives and identifies areas for improvement. The findings suggest that polytechnic libraries can play a critical role in supporting research initiatives by providing access to relevant information resources, offering research support services, and collaborating with researchers. Recommendations made include: Polytechnic libraries should develop more effective research support services including training programmes for researchers and library staff; the polytechnic library should collaborate more closely with researchers to support research initiatives; and they should provide access to relevant information resources including online databases and e-journals for users' consultation.

\

Introduction

Polytechnic libraries are academic libraries that serve polytechnic institutions, which offer higher education programmes in various fields such as technology, engineering and applied sciences. The primary role of polytechnic libraries is to support the teaching learning and research activities of the institution by providing access to relevant information resources, facilities and services. They are equally established to provide high-quality information services in support of teaching and research for academic staff members and students. With the increasing emphasis on research and innovation, polytechnic libraries are expected to play a more active and crucial role in supporting research initiatives in their institutions. They provide various resources and services to support researchers in the area of access to databases and e-journals. Polytechnic libraries subscribe to various databases and e-journals that provide access to relevant research articles, conference papers and other scholarly materials.

Not only that, polytechnic libraries serve as research assistance. The librarians provide research assistance to students and faculty, helping them to locate relevant information resources; develop research strategies and evaluate sources. The information literacy role played by polytechnic libraries also suffices in that libraries support students learning through makerspaces, which foster creativity, innovation and collaboration. These spaces enable students to build self-efficacy, explore entrepreneurial spirit and develop skills that last beyond their academic careers (Quigley, Caswell, Burroughs, Costello, Ness, Van Diest, Wang and Yang, 2024). Polytechnic libraries offer information literacy instruction to students, teaching them how to effectively locate, evaluate and use information resources. Another unique function of polytechnic libraries is research data management. Some polytechnic libraries provide support for research data management, helping researchers to organize, store, and share their research data.

Strategically speaking, polytechnic libraries can serve as collaborators for research initiatives in a number of ways including: partnership with faculty; collaboration with research centres; support for research grants and dissemination of research output. Librarians can partner with faculty members to develop research projects, provide research assistance and support the integration of information literacy into the curriculum. In the same vein, polytechnic libraries can collaborate with research centres and institutes within the institution to provide research support, develop research databases and promote research output.

In furtherance of their strategic collaboration for research initiatives, polytechnic libraries through the librarians can assist researchers in identifying potential funding sources, developing grant proposals and

managing research grants. Finally, polytechnic libraries can support the dissemination of research output by providing platforms for publishing research papers, creating research repositories and promoting open access publishing. Despite the potential for polytechnic libraries to serve as strategic collaborators for research initiatives, there could be several challenges that may require attention. This is however not in the immediate focus of this paper.

Statement of the problem

Polytechnic libraries are facing challenges in supporting research initiatives due to limited resources and infrastructure.There is a lack of collaboration between polytechnic libraries and researchers, resulting in inadequate support for research initiatives (Smith, 2020).Polytechnic libraries are not fully utilizing their potential as strategic collaborators in research initiatives, leading to missed opportunities for innovation and growth (Johnson, 2019).

Objectives of the study

The research objectives for the study are to:

1. investigate the current state of polytechnic libraries in supporting research initiatives;
2. identify the challenges faced by polytechnic libraries in supporting research initiatives;
3. examine the role of polytechnic libraries as strategic collaborators in research initiatives; and
4. develop a framework for polytechnic libraries to support research initiatives effectively.

Literature Review

Previous studies have highlighted the importance of libraries in supporting research initiatives. For example, a study by Luu (2010) found that libraries can play a critical role in supporting research by providing access to relevant information resources and offering research support services. Polytechnic libraries play active roles in facilitating the research process for its users. They achieve this role by providing rich collections which gives access to a wide range of information resources including books, journals, databases and digital collections (Library Journal, 2024). Libraries also assist through database subscriptions. Libraries subscribe to various databases such as JSTOR, ScienceDirect and ProQuest to provide access to relevant research articles, conference papers and other scholarly materials. Libraries also provide access to electronic journals and books which can be accessed remotely or on-campus. They equally offer interlibrary loan services which allow users to borrow materials from other libraries to satisfy users' needs.

Another study by Needle (2015) emphasized the importance of libraries in collaborating with researchers to support research initiatives. Libraries essentially engage in information resource provision by creating access to relevant literature such as found in) journals, books and databases facilitating literature reviews and informing research design. The library often subscribes to specialized databases and tools such as citation management software that support research workflows. Librarians offer expert guidance on research design, methodology and information seeking, helping researchers to refine their research questions and approaches. Additionally, libraries provide instruction on information literacy, teaching researchers how to effectively locate, evaluate and use information resources. They may offer support for research data management including data storage, sharing and preservation.

Kesselman and Watstein (2017) discussed the role of libraries in supporting research initiatives in the digital age. They opined that libraries provide access to digital versions of books and journals; offer subscriptions to databases and datasets relevant to various research fields; establish institutional repositories to store and provide access to research outputs. They further submit that libraries offer support for digital scholarship, including data analysis, visualization and digital pedagogy. They often provide guidance on research data management including data storage, sharing and preservation as well as teach researchers how to effectively use digital tools and resources.

While examining the role of libraries in supporting interdisciplinary research initiatives, Saunders and Owen (2018) state that libraries provide access to databases that cover multiple subjects and disciplines; offer subscriptions to journals and publications that focus on interdisciplinary research and establish digital collections and repositories that store and provide access to interdisciplinary research outputs. Commenting further, the authors were of the views that libraries offer research consultations that cater to the needs of interdisciplinary research such as mixed-methods research; offer data management and analysis services that cater to the needs of interdisciplinary researchers. In a related submission, they added that libraries provide access to research platforms that support interdisciplinary research such as

collaborative workspaces and data sharing platforms; offer access to software and tools that support interdisciplinary research such as data analysis and visualization tools and provide access to high-performance computing resources that support interdisciplinary research.
In their own case, Chow and Goh (2019) discussed the importance of libraries in supporting innovation and entrepreneurship initiatives. They concluded that libraries are useful in providing physical and virtual spaces; resources and tools; provide programme opportunities and services; engage in partnerships and collaborations; offer training on digital literacy including coding, data analysis and digital marketing. Provision of training and resources on entrepreneurship skills such as business planning, pitching and fundraising is in the purview of the library. They also provide innovation and design thinking offering training and resources on innovation and design thinking methodologies. Umar (2019) highlighted challenges faced by the federal polytechnic libraries in North Eastern States of Nigeria. The identified problems are inadequate funding, lack of trained personnel, poor infrastructure, limited access to digital resources, power supply and internet connectivity issues, lack of research culture, inadequate library automation and security issues.

Methodology
This study used a mixed-methods approach, combining both quantitative and qualitative data collection and analysis methods. The study population consisted of five polytechnic librarians and five researchers in Oyo State, Nigeria. Data were collected using a questionnaire and interview schedule. A survey was conducted to collect data on the current state of polytechnic libraries in supporting research initiatives. Interviews were conducted with librarians and researchers to gather more in-depth information on the challenges and limitations faced by polytechnic libraries in supporting research initiatives.

Data analysis, interpretation and discussion of findings
The findings of this study suggest that polytechnic libraries can play a critical role in supporting research initiatives by providing access to relevant information resources, offering research support services, and collaborating with researchers. The study also identified areas for improvement, including the need for polytechnic libraries to develop more effective research support services and to collaborate more closely with researchers.More specifically, the Table 1 to 3 present the data obtained for this study and the interpretation showing the responses of the respondents as captured in frequency of occurrence and percentages. The fourth table presents the consensus of opinions of the respondents who were polytechnic librarians on what a standard framework of libraries to support research initiatives should look like.

Table 1: Current State of Polytechnic Libraries in Support for Research Initiatives

S/N	Names of Polytechnics	Well Supported	Fairly Supported	Poorly Supported	Not Supported
1	Adeseun Ogundoyin Polytechnic, Eruwa	-	Yes	Yes	-
2	Federal Polytechnic, Ayede	-	-	-	-
3	Oyo State College of Agriculture & Technology, Igboora	-	Yes	-	-
4	The Ibadan Polytechnic, Ibadan	-	Yes	-	-
5	The Oke-Ogun Polytechnic, Saki	-	Yes	-	-

Table 1 presents the results of the current state of polytechnic libraries support for research initiatives. None of the five polytechnics sampled has supported research initiatives well enough. Only 80% respondents fairly supported research initiatives of their users. A polytechnic librarian claimed that he cannot say he has supported research initiatives of his users excellently but he made bold to state that no user encounters the library without being satisfied. In fact, he claimed to have also supported his users in other countless ways but he was only being modest to say he has provided needed services satisfactorily when it comes to supporting researchers. One respondent, representing 20% also claimed to have poorly supported research initiatives of its users. This finding is contrary to Needle (2015) opinion that the importance of libraries can be seen in collaborating with researchers to support research initiatives.

Table 2: Challenges Faced by Polytechnic Libraries in Supporting Research Initiatives

S/N	Challenges faced by Polytechnic Libraries	Yes	%	No	%
1	Funding related problems	05	100	-	-
2	Digital transformation issues	03	60	02	40
3	Information overload	01	20	04	80
4	Limited resources	03	60	02	40
5	Changing user needs	02	40	03	60
6	Scholarly communication	03	60	02	40
7	Inadequate staffing	04	80	01	20

Table 2 presents the various challenges polytechnics are grabbling with at the time of research. A perfect percentage (100%) of the polytechnics under study has funding problems. Inadequate staffing has affected four representing 80% respondents. In fact a library has only two staff members which is not a good occurrence in a government owned polytechnic library. Only one (20%) library claimed to have experienced information overload as a challenge. This implies that other eighty percent cannot be said to possess sufficient information needed by their users. This uphold Umar (2019) that highlighted challenges faced by federal polytechnic libraries in North Eastern states of Nigeria to include the ones here-in identified as shown in the Table 2.

Table 3: Role of Polytechnic Libraries as Strategic Collaborators in Research Initiatives

S/N	Roles of Polytechnic Libraries in Research Initiatives	Yes	%	No	%
1	Literature search	05	100	-	-
2	Database access	02	40	03	60
3	Developing research methodologies	-	-	05	100
4	Information literacy training	03	60	02	40
5	Providing support on digital scholarship	01	20	04	80
6	Facilitating collaboration between researchers	02	40	03	60
7	Building partnerships with industry partners	-	-	05	100
8	Collaborating with research institutions onshore and offshore	02	40	03	60
9	Providing training and development opportunities for staff	02	40	03	60
10	Offering training and support for researchers	03	60	02	40
11	Providing access to digital infrastructure	02	40	03	60
12	Creating dedicated research spaces	04	80	01	20
13	Promoting research initiatives and achievements	02	40	03	60
14	Advocating for the role of libraries in supporting research	03	60	02	40

Table 3 indicates that five (100%) libraries under the study engaged in literature search and offered the service to their reading populace. Also, none of the libraries build partnerships with industry partners. A total of four (80%) libraries have created dedicated research spaces for their clienteles. Only one, 20% libraries do provide support on digital scholarship. While three libraries representing 60% of the participants engage in information literacy training, only two (40%) each offer database access; facilitating collaboration between researchers; collaborating with research institutions locally and internationally; providing training and development opportunities for staff; providing access to digital infrastructure and promoting research initiatives and achievements. These findings support Saunders and Owen (2018) submission on roles of libraries as collaborators in research. It also supported Luu (2010) who found that libraries can play a critical role in supporting research by providing access to relevant information resources and offering research support services. The finding uphold Chow and Goh (2019) views on importance of libraries.

Table 4: Framework for Polytechnic Libraries to Support Research Initiatives

S/N	ITEMS OF THE FRAMEWORK	KEY INDICATORS / ATTRIBUTES		
1	RESEARCH SUPPORT INFRASTRUCTURE	Dedicated research space	Research technology and equipment	High-speed internet and networking
2	RESEARCH RESOURCES AND COLLECTIONS	Curated research collections	Open access resources	Specialized databases and datasets
3	RESEARCH SUPPORT SERVICES	Research consultations	Literature review and search support	Data management and analysis
4	COLLABORATION AND PARTNERSHIPS	Research partnerships	Interdisciplinary collaboration	Community engagement
5	TRAINING AND EDUCATION	Research skills training	Digital scholarship training	Information literacy instruction
6	ASSESSMENT AND EVALUATION	Research output metrics	User feedback and surveys	Continuous improvement

Source: Interview sessions with the Polytechnic Librarians

Table 4 shows the areas well detailed as what should constitute the framework that could guide the polytechnic libraries that may want to support research initiatives of their patrons most efficiently and effectively too. Six main areas have been suggested with three highlighted indices for measuring the presence of the six in these libraries. The very first column states that there is need for research support infrastructure measurable with dedicated research space, presence of research technology and equipment and availability of high-speed internet and networking. In the same vein, the table recommends the inclusion of assessment and evaluation as a major construct needed in the framework if any polytechnic library will support the research initiatives of its clients. The three indicators to determine this are: research output metrics, user feedback and surveys as well as continuous improvement.

Conclusion

This study highlights the importance of polytechnic libraries as strategic collaborators in next-generation research initiatives. The findings of this study suggest that polytechnic libraries can play a critical role in supporting research initiatives by providing access to relevant information resources, offering research support services, and collaborating with researchers. The study's recommendations include the need for polytechnic libraries to develop more effective research support services and to collaborate more closely with researchers.

Recommendations

The following recommendations were suggested based on the research findings:

1 Polytechnic libraries should develop more effective research support services, including training programmes for researchers and library staff.

2 Polytechnic libraries should collaborate more closely with researchers to support research initiatives.
3 Polytechnic libraries should provide access to relevant information resources, including online databases and e-journals.

Theoretical Framework

This study will use the Collaborative Innovation Framework (CIF) as its theoretical framework. The CIF emphasizes the importance of collaboration between different stakeholders, including libraries, researchers, and industry partners, to support innovation and research initiatives.

References

1. Chow, A. S., &Goh, D. H. (2019). "The Role of Libraries in Supporting Innovation and Entrepreneurship." Journal of Business & Finance Librarianship, 24(1), 34-48. doi: 10.1080/08963568.2019.1559492.

2. Johnson, K. (2019). Library management in the digital age. ABC Publishers.

3. Kesselman, M., & Watstein, S. B. (2017). "The Role of Libraries in Supporting Research in the Digital Age." Journal of Library Administration, 57(5), 531-543. doi: 10.1080/01930826.2017.1309714.

4. Library Journal (2024). Index of Public Library Service.

5. Luu, J. (2010). "The Role of Libraries in Supporting Research: A Case Study of a University Library." Journal of Academic Librarianship, 36(4), 278-286. doi: 10.1016/j.acalib.2010.04.003.

6. Needle, J. (2015). "Collaboration between Librarians and Researchers: A Review of the Literature." Library & Information Science Research, 37(2), 149-157. doi: 10.1016/j.lisr.2015.02.002.

7. Quigley, B. D., Caswell, T. R., Burroughs, J. M., Costello, L., Ness, C., Van Diest, K., Wang, M., & Yang, A. (2024) 2024 Top Trends in Academic Libraries. Association of College and Research Libraries.

8. Saunders, L., & Buckley Owen, T. (2018). "Interdisciplinary Research and the Role of the Library." College & Research Libraries, 79(3), 311-324. doi: 10.5860/crl.79.3.31.

9. Smith, J. (2020). The impact of library services on student success. Journal of Library Science, Vol. 50 No. 2, Pp. 12 – 20.

10. Umar, H. (2019). “Challenges faced by Federal Polytechnic Libraries in North Eastern States of Nigeria. Journal of Education and Human Development, 8(2), 1-8.

Exploring Undergraduates' Perceptions and Anxieties Towards Artificial Intelligence Integration into Blended Learning in Kwara State University, Malete, Nigeria

Prof. Kamal Tunde OMOPUPA
Department of Library and Information Science
University of Ilorin, Nigeria.
Omopupa_kt@yahoo.com

Shuaib Agboola OLARONGBE, Ph.D.
The Polytechnic Librarian
Kwara State Polytechnic
Ilorin, Nigeria.
Olarongbe.sa@unilorin.edu.ng

Kennedy Arebamen EIRIEMIOKHALE, Ph.D.
Department of Library and Information Science,
Faculty of Information and Communication Technology,
Kwara State University, Malete, Nigeria.
kennedy.eiriemiokhale@kwasu.edu.ng

Florence Olabisi AJANI, Ph.D.
Deputy University Librarian
Kwara State University, Malate
florence.ajani@kwasu.edu.ng

Abdulakeem Sodeeq SULYMAN
Department of Library and Information Science
Kwara State Polytechnic
Ilorin, Nigeria.
Sulyman.abdulakeem@obc.ac.uk

&

Iskil Arisekola Bolaji
Social Research Department, University of Hull, England
bolaji-2022@hull.com

Abstract

The invention of Artificial Intelligence (AI) has transformed learning, causing the emergence of different learning patterns which blended learning is part of. This underscores why this study explores undergraduates' perceptions and anxieties on AI integration into blended learning. The population of this study is 1,523 undergraduates of Kwara State University, Malete, Nigeria. Krejcie and Morgan Table was used to select 371 respondents who are chosen randomly. A self-developed questionnaire was used for data collection. Data collected was downloaded in csv format and analysed with SPSS, using frequencies, percentages and mean ($\bar{X}$). Findings revealed that the respondents are apprehensive because the use of AI for learning will cause changes in teaching($\bar{X}$= 2.94), lack of control on the use of AI for learning ($\bar{X}$= 2.85) and use of AI for learning will cause overdependence on it ($\bar{X}$= 2.80). Furthermore, the respondents perceived that AI is powerful for solving complex learning problems ($\bar{X}$= 334), will enable learning solutions ($\bar{X}$= 3.34), can enhance learning outcomes ($\bar{X}$= 3.32), personalising learning experience ($\bar{X}$= 3.32), strengthen digital literacy skills ($\bar{X}$= 3.27) and making learning efficient ($\bar{X}$= 3.25). Moreso, AI makes the respondents learn remotely ($\bar{X}$= 3.37), creates flexible pathways for learning ($\bar{X}$= 3.30) and allows access to information about their courses ($\bar{X}$= 3.26). However, poor Internet network ($\bar{X}$= 3.40), inadequate funding of the university to acquire AI infrastructure needed for blended learning ($\bar{X}$= 3.06), lecturers resisted using AI for my learning enhancement ($\bar{X}$= 2.85) and doubt the quality and accuracy of AI-generated contents ($\bar{X}$= 2.82) affect the integration of AI into blended learning. This study concludes that undergraduates of LIS in Kwara State University, Malete, Nigeria, have different perceptions and anxieties about AI. One of the recommendations of this study is that management of Kwara State University, Malete, should collaborate with the faculties and departments to organise AI literacy training for their undergraduates.

Keywords: AI, Anxieties, Blended learning, Library and Information Science, Kwara State University, Perceptions, Undergraduates

Introduction

Learning is one of the indispensable exercises that avail people the opportunities of acquiring and mastering new skills. The world of learning has evolved overtime from the traditional form to the contemporary ones, with blended learning a notable one. Blended learning uses a variety of instructional modalities, which results in superior learning outcomes for students. Since each student prefers a certain technique of learning, educators who employ a variety of ways throughout teaching help students comprehend concepts better(Ghafar, 2023). Muxtorjonovna (2020) stressed that blended learning is becoming pervasive in the education system in recent years because it allows the integration of traditional face-to-face learning with technology, the Internetand distance learning. Blended learning provides the opportunity for flexibility to both instructors and students. It allows students to easily absorb the material while enabling educators to employ a range of teaching techniques.

Notably, technology is a steer for exponential change in all societies.Globally, one of the evolving technologies that have attracted much attentions among humans is artificial intelligence (AI). This underscores why AI has become a major aspect of innovative change in all dimensions of humans, causing the needs to give it special attentions (Obiano et al., 2022) by exploring its practical applicability in the various dimensions of human life. With regards to education, it is no doubt that AI is one of the technological innovations shaping and transforming educational activities in every society because of the ease and simplification it brings to learning activities and exercises (Andreu-Perez et al., 2017).

Dhara et al. (2022); Obiano et al. (2022) noted that among the distinguishing features of AI are their cognitive capabilities to learn, reason and make autonomous decisions. These features positioned AI for meeting the demands of the contemporary learnings, which blended is part of. With the advancement of AI in the last couple of decades, it has become very much possible to be adopted for learning purposes (Dhara et al, 2022).Despite its relatively recent history, AI is increasingly being introduced into the classroom through different modalities, with the aim of improving student achievement (Garcia-Martinez et al., 2023). In recognising the growing relevance of AI in education, Eiriemiokhale et al. (2024a); Eiriemiokhale et al. (2024b) pointed that AI has aroused a growing interest in education as it promises to transform education and learning from the traditional form to smart process.Ghafar (2023) posited that the integration of AI into blended learning would make educators have more time to connect with students in the classroom and monitor their progress.

However, despite the appreciable potentials of AI in blended learning, studies have reported that its integration into blended learning is not balanced across societies due to some factors including technological infrastructure, level of digital skills, users' perceptions, awareness and readiness to adopt AI (Cai, 2024; Eiriemiokhale et al., 2024; Mustakul, 2024; Park & Doo, 2024). Out of the factors reported in studies, the one that majorly concerns this study is perceptions, which deal with the impressions or views AI users have about it. This can influence the users' confidence with AI, resulting in the level or types of anxieties they have for it.

Wu et al. (2024) found that students view AI as a valuable tool for enhancing their learning experience and outcomes. Park and Doo (2024) noted that users' mixed perceptions of AI integration into blended learning influenced their anxieties for it. Similarly, Aydemir and Seferoğlu (2024) reported that students hold favorable opinions towards AI, particularly chatbots and adaptive learning technique integration into blended learning. These positive perceptions of respondents motivated them to be using AI for blended learning. The need to ascertain how AI perceptions among the students influenced their anxiety for its usage in blended learning environment underscores why this study explores the perceptions and anxieties of integrating AI into blended learning among undergraduates of Kwara State University, Malete, Nigeria.

Statement of the Problem

Artificial Intelligence has become a revolutionary tool, transforming how people learn. Its potential in learning transformation has been appraised by scholars and researchers, commending the opportunities it offers in redefining learning patterns. It has been established that one of the factors influencing and shaping users' adoption of AI is perception. Suraj (2023) submitted that perceptions of AI tools in blended learning are influenced among educators and students positively impacts adoption.

However, Suraj's (2023) position needs to be validated in the Nigerian context because observations by these researchers and analysis by educators have revealed contrary trends. One of the details revealed that AI integration into blended learning in Nigeria is being hampered by erratic power supply, inadequate technological infrastructure, low Internet bandwidth, ethical issues and lecturers are discouraging students from using AI. All these could result to negative perceptions, which may be making students be apprehensive in integrating AI in blended learning.

It is noticeable that the data forming the basis for the formulation of this problem needs to be expanded in order to generate empirical data about the issue. This would allow the researchers draw boundaries on the concept and location to investigate as well as having robust data future studies can depend on. This, therefore, underscores why this study exploredundergraduates' perceptions and anxieties towards AI integration into blended learning in Kwara State University, Malete, Nigeria.

Objectives of the Study

The main objective of this study is to explore undergraduates' perceptions and anxieties towards AI integration into blended learning in Kwara State University, Malete, Nigeria.The specific objectives are to:

i. identify the perceived causes of anxiety on the integration of AI for blended learning among undergraduates of Kwara State University, Malete, Nigeria;
ii. examine the perceived influence of AI on blended learning among undergraduates of Kwara State University, Malete, Nigeria;
iii. ascertain the perceived benefits of integrating AI into blended learning by undergraduates of Kwara State University, Malete, Nigeria; and,
iv. examine the perceived barriers of integrating AI into blended learning among undergraduates of Kwara State University, Malete, Nigeria.

Research Questions

The study seeks to answer the questions below:

1. What are the perceived causes of anxiety on the integration of AI for blended learning among undergraduates of Kwara State University, Malete, Nigeria?
2. What are the perceived influence of AI on blended learning among undergraduates of Kwara State University, Malete, Nigeria?
3. What are the perceived benefits of integrating AI into blended learning by undergraduates of Kwara State University, Malete, Nigeria?
4. What are the perceived barriers of integrating AI into blended learning among undergraduates of Kwara State University, Malete, Nigeria?

Review of Related Literature

The evolution of AI has taken blended learning into another level, influencing people's perceptions of it and shaping their apprehensions about it. Satria and Saputra (2025) found that students generally perceive AI positively in blended learning based on their believe that AI enhances focus, simplifies material comprehensionand accelerates task completion. Interestingly, Idroes et al. (2023); Wu et al. (2024) found positive perceptions of AI in blended learning, noting that AI-driven personalized learning paths significantly boosted student engagement by 20%.Mustakul (2024) found that students' perceptions of AI in blended learning are generally positive. This is similar to the findings of Robby et al. (2024), which reported that both students and faculty members generally hold positive attitudes towards AI integration in education.

What is obtainable in literature regarding students' and faculties' perceptions of integration of AI into blended learning contrasts the available studies on AI anxieties among the students. AI anxiety among students in blended learning includes concerns about learning difficulties, AI configuration challenges, job replacement fears, and sociotechnical blindness. These anxieties can positively or negativelyimpact learning, especially when moderated by students' self-efficacy in AI (Idroes et al., 2023; Wen et al., 2024). According to Smith (2024), scholastic integrity and the failure of some education systems to foster critical thinking have exacerbate anxieties in blended learning environments.

Lund et al. (2024) found general AI anxiety among Information Science students. Wen et al. (2024) identifies AI learning anxiety and job replacement anxiety as significant concerns for secondary school students. These anxieties negatively impact their behavioral intention to use AI tools for English as a Foreign Language learning. Similarly, Wang et al. (2022) found that AI learning anxiety negatively impact learning motivations, while AI job replacement anxiety positively influences extrinsic motivation. These anxieties significantly affect students' intentions to learn AIimportance in blended learning environments.

Lin and Qiu (2024) found that AI applications in education heightened performance anxiety among students due to constant assessments and technical frustrations, which disrupted the learning process and led to emotional disengagement, despite some benefits in creativity and engagement.Fawns et al. (2024) found that students expressed anxieties about AI in blended learning due to ambiguous policies on acceptable use, fears of academic integrity violations, and concerns over dependency on AI tools, which could undermine learning and skill development.In Brazil, Pinto et al. (2023) found a low incidence of technology anxiety among students regarding AI, with minimal fears of job loss to AI.

Studies have shown that AI can be beneficial for blended learning. Wu et al. (2024) found that students using AI-driven methods showed a 25% increase in vocabulary learning and a 30% boost in reading comprehension compared to traditional methods. Also, Rahman et al. (2023) found that AI-based blended learning significantly enhances students' science literacy, with an effect size of 0.93, effectively supports students in improving their understanding and skills in scientific concepts. This underscores why Toribio (2023) posited that AI can mitigate academic anxiety by empowering self-regulated learning, boosting self-efficacyand providing comprehensive guidance. Similarly, Park and Doo (2024) contended that AI enhances student autonomy and flexibility, while also serving as a supplementary assistant through advanced learning analytics, promoting effective interactions and facilitating the learning process.

Aydemir and Seferoğlu (2024); Cai (2024) and Idroes et al. (2023)also stressed that AI significantly enhances traditional education by facilitating interaction, enhancing learning experiences, motivation, engagement,promoting independent learning, thus improving overall learning outcomes. Moreso, AI applications in blended learning primarily support online asynchronous individual learning, enhancing student flexibility and autonomy. They serve as supplementary assistants through advanced learning analytics, promoting effective interactions and facilitating the learning process, though less focus exists on AI as pedagogical agents (Park& Doo, 2024).

Furthermore, Cai (2024) claimed that AI significantly enhances blended learning by integrating traditional classroom methods with online resources, facilitating improved student-teacher interaction and personalized learning experiences. This innovative approach leverages technology to optimize educational outcomes and foster independent learning among students.Integrating AI chatbots in blended learning enhances students' satisfaction, perceived usefulness, and attitude, which significantly boosts their intention to learn and academic performance, demonstrating the positive impact of AI on educational outcomes (Kobicheva, 2024; Xiang & Ma, 2023).

It is important to state that the underlying potential of AI on blended learning also comes with its barriers. According to Mustakul (2024); Namaziandost and Rezai (2024), barriers to deploying AI for blended learning include ethical, legal, social, pedagogical, and technical issues, such as ensuring quality, validity, fairness of AI applications, protecting privacy and security, and addressing the digital divide among learners and instructors.Park and Doo (2024) mentioned limited integration of AI in connecting online and offline activities as the main barrier to AI integration to blended learning.

Moreso, Ciolacu and Svasta (2021) noted that integrating diverse technologies, ensuring data privacyand addressing the varying emotional states and stress perceptions of learners during the learning process constitute AI anxiety among the students. Similarly, Mustakul (2024); Satria and Saputra (2025) noted that over-reliance on AI can result to potential laziness, technology dependenceand misuse, which can ultimately contribute to students' anxieties regarding AI in blended learning.

Methodology

This study adopted descriptive survey design to collect quantitative data on students' opinions on their perceptions and anxieties on integration of AI into blended learning. The population of this study is 1,523 undergraduates of Kwara State University, Malete, Nigeria. Krejcie and Morgan Table was used to select 371 respondents who are chosen randomly. A self-developed questionnaire, validated by two experts (one from education technology and LIS educator). The questionnaire was further designed with Google Forms and administered to the undergraduates through their WhatsApp groups. Data collected was downloaded in csv format and analysed with SPSS, using frequencies, percentages and mean ($\bar{X}$).

Data Analysis

Table 1: Demographic Information of Respondents

Options		F	%
Gender	Male	192	51.8
	Female	179	48.2
	Total	**371**	**100**
Level	100	43	11.6
	200	49	13.2
	300	256	69.0
	400	23	6.2
	Total	**371**	**100**
Age range	16-20 years	182	49.1
	21-25 years	188	50.7
	26-30 years	1	0.3
	31 years and above	0	0.0
	Total	**371**	**100**

Source: Researchers' Field Survey, 2025

Table 1 shows that majority 192 (51.8%) of the respondents were male, followed by females (179 48.2%). Respondents in 300 level are highly represented with 256 (69.0%), followed by 200 level with 49 (13.2%) and 100 level (43 11.6%). Finally, respondents within the age range 21 – 25 years are 188 (50.7%), followed by 16 – 20 years with 182 (49.1%) respectively, while 26 – 30 years is 1 (0.3%).

Table 2: Perceived causes of students' anxiety on the integration of AI for blended learning

Options	M	DR
I feel the use of AI for learning is confronted with technical issues	3.05	A
I feel the use of AI for learning will cause changes in teaching	2.94	A
I am worried with the lack of control on the use of AI for learning	2.85	A
I feel the use of AI for learning will make me depend on it too much	2.80	A
I feel using AI for learning will make me lazy	2.78	A
I feel I could lose much information on AI if i use the wrong prompts	2.71	A
I feel AI results are always bias and inaccurate	2.65	A
I feel using AI for learning will displace teachers	2.64	A
I feel using AI for learning will cause data privacy issues	2.57	A
I am not ready to use AI for learning because of my fear of making mistakes	2.56	A
Using AI for learning intimidates me	2.54	A
I am scared of using AI for learning	2.50	A
$\bar{X}G = (2.72)$		

Decision Rule: If mean is 1.0 to 1.74 = Strongly Disagree (SD); 1.75 to 2.49 = Disagree (D); 2.50 to 3.24 = Agree (A); 3.25 to 4.0 = Strongly Agree (SA).

Table 2 reveals that the respondents generally agreed to their perceived causes of AI anxiety with ($\bar{X}G$ = 2.72). Specifically, the respondents feel the use of AI for learning is confronted with technical issues ($\bar{X}$ = 3.05), followed by feel the use of AI for learning will cause changes in teaching($\bar{X}$ = 2.94), worried with the lack of control on the use of AI for learning ($\bar{X}$ = 2.85) and feel the use of AI for learning will make me depend on it too much ($\bar{X}$ = 2.80). This implies that the respondents' feeling about the use of AI for learning is confronted with technical issues, use of AI for learning will cause changes in teaching, worried with the lack of control on the use of AI for learning and the use of AI for learning will make me depend on it too much are the major perceived causes of AI anxiety.

Table 3: Students' perceived influence of AI on blended learning

Options	M	DR
I believe AI is powerful for solving complex learning problems	3.44	SA
I believe AI is an enabler to learning solutions	3.34	SA
I believe AI can enhance learning outcomes	3.32	SA
I believe AI helps in personalizing learning experience	3.32	SA
I believe using AI for learning strengthen my digital literacy skills	3.27	SA
I believe AI makes learning efficient	3.25	SA
I believe using AI for learning will complement teachers' lapses	3.07	A
$\bar{X}G = (3.29)$		

Decision Rule: If mean is 1.0 to 1.74 = Strongly Disagree (SD); 1.75 to 2.49 = Disagree (D); 2.50 to 3.24 = Agree (A); 3.25 to 4.0 = Strongly Agree (SA).

Table 3 points out that the respondents generally strongly agreed to the perceived influence of AI on blended learning with ($\bar{X}G$ = 3.29). Specifically, the respondents strongly believed that AI is powerful for solving complex learning problems ($\bar{X}$= 334), followed by AI is an enabler to learning solutions ($\bar{X}$= 3.34), AI can enhance learning outcomes and AI helps in personalizing learning experience ($\bar{X}$= 3.32) respectively, using AI for learning strengthen my digital literacy skills ($\bar{X}$= 3.27) and AI makes learning efficient ($\bar{X}$= 3.25). This means that the respondents' major perceived influence of AI on blended learning are AI is powerful for solving complex learning problems, AI is an enabler to learning solutions, AI can enhance learning outcomes, AI helps in personalizing learning experience, using AI for learning strengthen digital literacy skills and AI makes learning efficient.

Table 4: Students' perceived benefits of integrating AI into blended learning

Options	M	DR
I believe AI provides me new information to make the best choice about my learning	3.42	SA
I believe AI is helping me to learn remotely	3.37	SA
I believe AI has created flexible pathways for my learning	3.30	SA
I believe AI allows me to access more information about my courses	3.26	SA
I believe AI has transformed my learning experience	3.21	A
I believe AI hashelped me overcome the psychological breakdown associated with traditional learning	3.19	A
I believe AI has helped me take control of my learning	3.18	A
I believe AI has improved the quality of my learning	3.06	A
I believe AI helped me predict my academic performance	2.95	A
$\bar{X}G = (3.22)$		

Decision Rule: If mean is 1.0 to 1.74 = Strongly Disagree (SD); 1.75 to 2.49 = Disagree (D); 2.50 to 3.24 = Agree (A); 3.25 to 4.0 = Strongly Agree (SA).

Table 4 reveals that the respondents generally agreed to the perceived benefits of integrating AI into blended learning with ($\bar{X}G$ = 3.22). Specifically, the respondents strongly believed that AI provides new information to make the best choice about my learning ($\bar{X}$ = 3.30), followed by AI helps to learn remotely ($\bar{X}$ = 3.37), AI has created flexible pathways for learning ($\bar{X}$ = 3.30) and AI allows more access to information about my courses ($\bar{X}$ = 3.26). This shows that the respondents' major perceived benefits of integrating AI into blended learning are AI provides new information to make the best choice about my learning, AI helps to learn remotely, AI has created flexible pathways for learning and AI allows more access to information about my courses.

Table 5: Students' perceived challenges of integrating AI into blended learning

Options	M	DR
Poor internet network affects my use of AI for learning	3.40	SA
Inadequate funding of the university to acquire AI infrastructure needed for blended learning	3.06	A
My lecturers resisted using AI for my learning enhancement	2.85	A
Ethical concerns, such as bias and discrimination affect my usage of AI for learning	2.83	A
I always doubt the quality and accuracy of AI-generated contents	2.82	A
I do not use AI for learning because of cost of subscription for advanced features	2.64	A
I do not use AI for learning because it leads to cheating and plagiarism	2.63	A
I do not use AI for learning because it minimizes learning experience	2.63	A
I resist using AI for learning	2.63	A
I do not have the expertise to use AI for learning	2.62	A
AI tools are inaccessible and uninclusive	2.60	A
I do not use AI for learning because of risk of losing my privacy	2.60	A
I do not use AI for learning because it reduces human-to-human interactions associated with learning	2.54	A
I do not use AI for learning because of risk of abusing my data	2.47	D
I do not use AI for learning because it generates false or inaccurate references	2.44	D
I do not use AI for learning because it provides unreliable information	2.42	D
$\bar{X}G = (2.70)$		

Decision Rule: If mean is 1.0 to 1.74 = Strongly Disagree (SD); 1.75 to 2.49 = Disagree (D); 2.50 to 3.24 = Agree (A); 3.25 to 4.0 = Strongly Agree (SA).

Table 5 shows that the respondents generally agreed to perceived challenges of integrating AI into blended learning with ($\bar{X}G = 2.70$). Specifically, the respondents strongly perceived that poor Internet network affects the use of AI for learning ($\bar{X} = 3.40$), followed by those who normally perceived inadequate funding of the university to acquire AI infrastructure needed for blended learning ($\bar{X} = 3.06$), lecturers resisted using AI for my learning enhancement ($\bar{X} = 2.85$), ethical concerns, such as bias and discrimination affect my usage of AI for learning ($\bar{X} = 2.83$) and doubt the quality and accuracy of AI-generated contents ($\bar{X} = 2.82$). This implies that the respondents' major perceived challenges of integrating AI into blended learning are poor Internet network affects the use of AI for learning, inadequate funding of the university to acquire AI infrastructure needed for blended learning, lecturers resisted using AI for learning enhancement, ethical concerns, such as bias and discrimination affect my usage of AI for learning and doubt the quality and accuracy of AI-generated contents.

Discussion of Findings

Findings revealed that there are many causes to the respondents' anxieties of integrating AI into blended learning. These causes include the respondents' feeling about the use of AI for learning is confronted with technical issues, use of AI for learning will cause changes in teaching, worried with the lack of control on the use of AI for learning and the use of AI for learning will make students depend on it too much. These findings align with the opinions of Eiriemiokhale (2024a); Eiriemiokhale (2024b) that technical issues and fear of embracing technologies can make people be apprehensive about it.

Moreso, findings showed that the respondents perceived that AI can be influential on blended learning because it is powerful for solving complex learning problems, enhancing learning outcomes, personalizing learning experience, strengthening the learning of digital literacy skills and making learning efficient. The opinions of the respondents affirm the point of Obiano et al. (2024) that AI is a steer for exponential change in education.The import of these findings is that the respondents perceived that AI holds enormous influence to blended learning.

Interestingly, the respondents' opinions on the perceived influence of AI on blended learning also influenced their perceived benefits of it by opining that AI provides new information to make the best choice about learning, helps to learn remotely, creates flexible pathways for learning andallows more access to information aboutcourses of interest. The respondents' opinions are related to the points of Aydemir and Seferoğlu (2024); Cai (2024); Idroes et al. (2023); Park and Doo (2024); Rahman et al. (2023); Toribio (2023) that AI has opened a new vista for learning, allowing both teachers and learners interact with the information resources of their choice at their comfort.

In spite of the perceived benefits of integrating AI into blended learning, it is interesting to find that poor Internet network, inadequate funding of the university to acquire AI infrastructure needed for blended learning, lecturers resisted using AI for learning enhancement and ethical concerns affect the integration of AI into blended learning. The finding about ethical concerns corroborates the positions of Mustakul (2024); Namaziandost and Rezai (2024), who noted that ethical concerns mitigate the adoption of AI for blended learning.

Conclusion

Artificial Intelligence, since its invention, has revolutionised all dimensions of human affairs, including education and learning. This study brings into fore that undergraduates of LIS in Kwara State University, Malete, Nigeria, have different perceptions about AI. This caused them to exhibit some anxieties in using AI for blended learning. On perceptions about integrating AI into blended learning, undergraduates of LIS feel that the use of AI for learning is causing significant changes to the learning processes, though expressed worries about technical issues and lack of control on the use of AI for learningbecause most of them depend too much on it.

However, undergraduates of LIS' anxieties were relived because of their perceptions that AI is powerful for solving complex learning problems, enabling learning solutions, enhancing learning outcomes, personalising learning experience and strengthening digital literacy skills, thus making learning efficient. Moreso, undergraduates of LIS perceived that AI is beneficial for blended learning by providing new information to make the best choice about their learning, helping to learn remotely, creating flexible pathways for learning and allowingmore access to information about their courses.

Despite these, this study acknowledges that the undergraduates of LIS in Kwara State University, Malete, perceived the challenges to their AI integration to blended learning to poor Internet network affects the use of AI for learning, inadequate funding of the university to acquire AI infrastructure needed for blended learning, lecturers resisted using AI for learning enhancement, ethical concerns, such as bias and discrimination and doubt the quality and accuracy of AI-generated contents. These challenges must be addressed if the undergraduates of LIS in Kwara State

University, Malete, are expected to form positive impressions and overcome their anxieties of integrating AI into blended learning.

Recommendations

Based on the findings, this study recommends that:

1. Management of Kwara State University, Malete, Nigeria, should collaborate with the faculties and departments to organise AI literacy training for their undergraduates. This will equip the undergraduates with the abilities to use AI ethically, legally and knowing how to verify the facts and claims in AI-generated contents.
2. Management of Kwara State University, Malete, Nigeria, should adequately be funding the university in order to be financially buoyant to acquire the necessary technological infrastructure needed for the adoption of AI for blended learning.
3. Lecturers in Kwara State University, Malete, Nigeria, should consider encouraging students to use AI to support their learning. They can achieve this by endeavouring to train their students on overcoming ethical concerns associated with using AI for learning.

References

Andreu-Perez, J., Deligianni, F., Ravi, D. & Yang, G. Z. (2017). Artificial intelligence and robotics. London: UK-RAS Network.

Aydemir, H., & Seferoğlu, S. S. (2024). Investigation of users' opinions, perceptions and attitudes towards the use of artificial intelligence in online learning environments. The *European Journal of Open, Distance and E-Learning*, 26(s1), 70–92. https://doi.org/10.2478/eurodl-2024-0007

Cai, W. (2024). Construction and Effect Analysis of AI-enabled Hybrid Learning Model.*International Journal of Education and Humanities*, 17(2), 31–34. https://doi.org/10.54097/f6xa6t51

Chen, C., Hu, W., & Wei, X. (2024). From anxiety to action: exploring the impact of artificial intelligence anxiety and artificial intelligence self-efficacy on motivated learning of undergraduate students. *Interactive Learning Environments*, 1–16. https://doi.org/10.1080/10494820.2024.2440877

Ciolacu, M., & Svasta, P. (2021). Education 4.0: AI Empowers Smart Blended Learning Process with Biofeedback. *Global Engineering Education Conference*, 1443–1448. https://doi.org/10.1109/EDUCON46332.2021.9453959

Dhara, S., Chatterjee, S., Chaudhuri, R., Goswami, A. & Ghosh, S.K. (2022). Artificial intelligence in assessment of students' performance. https://www.researchgate.net/publication/361861919

Eiriemiokhale, K.A., Olarongbe, S.A., Jacob, P.A., Ishola, S.O. & Sulyman, A.S. (2024b). Prospects and challenges of smart teaching and learning in Nigeria's tertiary institutions. *Niger Delta Journal of Library and Information Science*, 5(2), 39 – 47.

Eiriemiokhale, K.A., Oyedepo, F.S. & Sulyman, A.S. (2024a). Adopting artificial intelligence in a blended learning environment: Issues and prospects in Nigeria. *In proceedings of the 3rd International Conference on ICT for National Development its Sustainability*, held from May 21st – 24th, 2024, 1 – 19.

Fawns, T., Henderson, M., Matthews, K., Oberg, G., Liang, Y., Walton, J. K., Corbin, T. A., Bearman, M., Shum, S. B., McCluskey, T., McLean, J., Shibani, A., Bakharia, A., Lim, L.-A. Y. L., Pepperell, N., Slade, C., Chung, J., & Seligmann, A. (2024). Gen AI and student perspectives of use and ambiguity. https://doi.org/10.14742/apubs.2024.1218

Garcia-Martinez, I., Fernández-Batanero, J.M., Fernandez-Cerero, J. & Leon, S.P. (2023). Analysing the impact of artificial intelligence and computational sciences on student performance: Systematic review and meta-analysis. *Journal of New Approaches in Educational Research*, 12(1), https://doi.org/10.7821/naer.2023.1.1240.

Ghafar, Z.N. (2023). Blended learning, an educational tool for students in the academic places: A descriptive study. *Journal of Language, Literature, Social, and Cultural Studies*, 1(3), 184-190.

Idroes, G. M., Noviandy, T. R., Maulana, A., Irvanizam, I., Jalil, Z., Lensoni, L., Lala, A., Abas, A. H., Tallei, T. E., & Idroes, R. (2023). Student perspectives on the role of artificial intelligence in education: A survey-based analysis. https://doi.org/10.60084/jeml.v1i1.58

Kobicheva, A. (2024). Students' intention to learn and academic performance in the blended learning environment: The role of artificial intelligence chatbots. *International Journal of Information and Education Technology*, 14(6), 807–813. https://doi.org/10.18178/ijiet.2024.14.6.2105

Lin, H., & Qiu, C. (2024). Artificial intelligence (AI) -integrated educational applications and college students' creativity and academic emotions: Students and teachers' perceptions and attitudes. *BMC Psychology*, 12(1). https://doi.org/10.1186/s40359-024-01979-0

Lund, B., Mannuru, N. R., & Agbaji, D. (2024). AI anxiety and fear: A look at perspectives of information

science students and professionals towards artificial intelligence. *Journal of Information Science*, 53(2), 19 – 41. https://doi.org/10.1177/01655515241282001
Mustakul, S. (2024). Redesigning blended learning models in the era of artificial intelligence. https://doi.org/10.70764/gdpu-jbte.2024.1(1)-04
Muxtorjonovna, M.A. (2020). Significance of blended learning in education system. *The American Journal of Social Science and Education Innovations*, 2(8), 507-511. Doi: https://doi.org/10.37547/tajssei/Volume02Issue08-82.
Namaziandost, E., & Rezai, A. (2024). Special issue: Artificial intelligence in open and distributed learning: Does it facilitate or hinder teaching and learning? *The International Review of Research in Open and Distributed Learning*, 25(3), i–vii. https://doi.org/10.19173/irrodl.v25i3.8070
Obiano, D.C., Onuoha, C.O., Adeoye, A.A., Nwosu, J.C. & Folarin, M. (2022). Aiding the exploration of artificial intelligence in Nigerian academic libraries in the 21st century. *Information Technology and Librarianship*, Vol. 2(1&2), 1-13.
Park, Y.-J., & Doo, M. Y. (2024). Role of AI in blended learning: A systematic literature review. *The International Review of Research in Open and Distributed Learning*. https://doi.org/10.19173/irrodl.v25i1.7566
Pinto, P. S. de A., Ugulino de Araujo, V. M., Ferreira, C., Goulart, L. L., Aguiar, G. S., Beltrão, J., de Lira, P. D., Mendes, S., Vaz Monteiro, F. de L., & Avelino, E. L. (2023). Assessing the psychological impact of generative AI on computer and data science education: An exploratory study. https://doi.org/10.20944/preprints202312.0379.v2
Rahman, A., Santosa, T. A., Ilwandri, I., Suharyat, Y., Aprilisia, S., & Suhaimi, S. (2023). The Effectiveness of AI Based Blended Learning on Student Scientific Literacy: Meta-analysis. *Literacy: International Scientific Journals of Social, Education and Humanities,* 2(1), 141–150. https://doi.org/10.56910/literacy.v2i1.542
Robby, O., Robiños, J., Binhamza, M. H., Casyao, I. M., Combis, H., Melgar, S. M., Sora, L., & Austria, Ma. G. (2024). Examining attitudes and perceived usefulness of ai integration in teaching and learning processes. *Journal of Interdisciplinary Perspectives*, 2(12). https://doi.org/10.69569/jip.2024.0591
Satria, F., & Saputra, R. H. (2025). Analysis of student perceptions of the use of artificial intelligence in learning in the digital age. *Literacy: International Scientific Journals of Social, Education and Humanities,*4(1), 299–308. https://doi.org/10.47352/3032-503x.80
Smith, D. A. (2024). How fears of ai in the classroom reflect anxieties about choosing sophistry over true knowledge in the American education system. https://doi.org/10.33470/2836-3140.1032
Suraj, N. (2023). The relationship between ai tools and their aspects in higher education. Social *Science Research Network*. https://doi.org/10.2139/ssrn.4689952
Toribio, N. F. (2023). Analysis of chatGPT and other AI's ability to reduce anxiety of science-oriented learners in academic engagements. *Journal of Namibian Studies: History Politics Culture*. https://doi.org/10.59670/jns.v33i.3132
Wang, Y., Wei, C.-L., Lin, H.-H., Wang, S.-C., & Wang, Y.-S. (2022). What drives students' AI learning behavior: A perspective of AI anxiety. *Interactive Learning Environments*, 1–17. https://doi.org/10.1080/10494820.2022.2153147
Wen, F., Li, Y., Zhou, Y., An, X., & Zhou, Q. (2024). A study on the relationship between ai anxiety and ai behavioral intention of secondary school students learning English as a foreign language. *Journal of Educational Technology Development and Exchange*, 17(1), 130–154. https://doi.org/10.18785/jetde.1701.07
Wu, Z., Abdul Halim, H., & Bin Mohd Saad, M. R. (2024). Artificial intelligence (AI) and gamification in blended learning: enhancing language and literacy in Shanxi, China. *Malaysian Journal of Social Sciences and Humanities*, 9(12), e003159. https://doi.org/10.47405/mjssh.v9i12.3159
Xiang, J., & Ma, C. (2023). Modeling the effectiveness of blended learning promotion with artificial intelligence adaptive learning system. *Journal of Logistics, Informatics and Service Science*. https://doi.org/10.33168/jliss.2023.0307.

Factors Influencing the Adoption of Robotic Technologies in Libraries of Industry 5.0

Columbus O. Udofot[1] & Bolaji David Oladokun[2]

[1]Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom State, Nigeria /Columbusudofot@yahoo.com / 08035637958
[2]Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom State, Nigeria / Bolaji.oladokun@yahoo.com

Abstract

This study explores the factors influencing the adoption of robotic technologies in libraries within the framework of Industry 5.0. The objectives of the study were to examine the level of awareness and understanding of robotic technologies among library professionals, assess librarians' perceptions toward robotic integration in service delivery, and identify key factors affecting adoption. Employing a systematic review methodology guided by the PRISMA framework, the study synthesized evidence from 27 peer-reviewed journal articles published between 2020 and 2025. The inclusion criteria focused on studies that addressed the use or potential of robotic technologies in library contexts, while excluding non-library settings and non-peer-reviewed works. Findings reveal that the adoption of robotic technologies is shaped by a complex interplay of factors including institutional readiness, infrastructural availability, financial resources, policy support, staff training, and user receptiveness. Awareness and perceptions among librarians significantly influence implementation outcomes, with positive attitudes linked to higher levels of adoption. Moreover, libraries in technologically advanced regions are leading in robotic integration, while those in developing contexts face challenges such as limited infrastructure, digital literacy gaps, and financial constraints. The study concludes that successful adoption requires strategic investment in technology, capacity building for library staff, supportive policy frameworks, and user-centered design approaches.

Keywords: *Robotic technologies, Library services, Industry 5.0, Technology adoption, Human-robot collaboration*

Introduction

The emergence of Industry 5.0 is characterized by the collaborative interaction between humans and intelligent technologies, which has sparked a revolutionary wave across diverse sectors, including libraries. Unlike its predecessor, Industry 4.0, which emphasized automation and digitization, Industry 5.0 prioritizes a human-centric, sustainable, and resilient integration of advanced technologies such as artificial intelligence (AI), robotics, the metaverse, and the Internet of Things (IoT) (Oyedokun, 2024). Within this context, the library and information science profession is experiencing a disruptive yet promising transformation, wherein robotic technologies are being integrated to support service delivery, user engagement, and administrative efficiency (Ajani et al., 2024; Tella, 2020).

Robotic technologies in libraries encompass a wide range of applications, including humanoid robots, robotic assistants, autonomous shelf-scanners, chatbots, and robotic animal companions. These tools are designed not only to support routine tasks such as shelving and inventory but also to enhance the user experience through personalized interaction, emotional support, and intelligent information retrieval (Edwards et al., 2022; Nguyen, 2020). As libraries evolve into intelligent and responsive spaces, the adoption of robotics represents a strategic move toward smart service environments and participatory learning hubs (Asemi, Ko & Nowkarizi, 2021; Indraji, Naikar & Dominic, 2024).

Despite the promise, the adoption of robotic technologies in libraries is influenced by multiple factors, including technological readiness, perceived usefulness, cost, staff attitudes, user acceptance, infrastructure, and institutional policy frameworks (Shahzad, Khan & Iqbal, 2024). These factors, serving as core variables in this study, determine how and to what extent libraries embrace robotics within their operations. In Nigeria and other African contexts, additional layers such as infrastructural limitations, digital literacy gaps, and economic challenges further complicate adoption (Abba, 2024; Oladokun et al., 2023).

One critical factor is technological infrastructure and institutional readiness. Owate and Ogonu (2023) observed that many public universities in Bayelsa State lacked the necessary frameworks for robotic integration, including stable internet, supportive policy structures, and adequately trained personnel.

Similarly, Owolabi et al. (2022) emphasized the low readiness of academic librarians in Nigeria, citing insufficient technical skills and lack of professional development opportunities. These infrastructural and human capital constraints create a significant barrier to meaningful adoption.Studies show that librarians' understanding and attitude toward robotics and AI strongly influence the extent of technology implementation (Eiriemiokhale & Sulyman, 2023; Hervieux & Wheatley, 2021). Where awareness is high and the perceived usefulness of robotic technologies is acknowledged, adoption rates tend to increase (Yoon, Andrews & Ward, 2022). Conversely, skepticism, fear of redundancy, and ethical concerns about privacy and surveillance have led to resistance in some quarters (Cox, 2022; Luca, Narayan & Cox, 2022).
Cost and funding availability are also central to the adoption process. Robotics technologies often require substantial financial investment for acquisition, customization, and maintenance. This challenge is particularly pronounced in developing nations, where library budgets are frequently constrained (Ajani et al., 2024). In this regard, De Sarkar (2023) advocated for collaborative funding models and partnerships with technology vendors to mitigate financial barriers.Moreover, the user dimension plays a vital role. The success of robotic integration depends heavily on user receptiveness and interaction patterns. For instance, studies on robot animal companions have demonstrated that students are more likely to engage with library services when robotic elements are integrated in stress-reducing or entertaining ways (Edwards et al., 2022). Yueh et al. (2020) also found that children demonstrated greater enthusiasm for library literacy programs when robot companions were present, suggesting that user demographics and behavioral patterns significantly shape adoption trajectories.

Policy and leadership commitment further influence how robotic technologies are adopted. Institutions with visionary leadership and forward-looking policies are better positioned to explore and invest in robotics for service innovation (Oyetola et al., 2023; Oyelude, 2021). This includes the establishment of ethical guidelines, staff training modules, and evaluation metrics to measure the impact of robotics on library performance.Importantly, the collaborative potential of robots and human librarians should not be overlooked. Adetayo, Abwage, and Oduola (2023) asserted that robots are not intended to replace librarians but rather to augment their capacities by handling repetitive tasks and enabling staff to focus on more complex, human-centered services. This synergy aligns perfectly with the human-centric ideology of Industry 5.0 and reinforces the idea that the library of the future is not devoid of humans but is redefined by advanced human-robot collaboration (Tella & Ajani, 2022).

The literature also reveals regional disparities in robotic adoption, with Western and Asian libraries leading in implementation compared to those in Africa and Latin America. While countries like Australia have made significant progress in deploying humanoid robots in public libraries (Nguyen, 2020), African libraries remain largely in the exploratory or pilot phases (Abba, 2024; Oladokun et al., 2023). This indicates the need for tailored strategies that consider local contexts, capacities, and user needs.This study, therefore, sought to investigate the factors influencing the adoption of robotic technologies in libraries within the framework of Industry 5.0, focusing on key variables such as technological infrastructure, awareness and perceptions, institutional readiness, funding, policy environment, and user engagement. As a result, the research aims to provide actionable insights for policymakers, librarians, and technologists seeking to foster sustainable and human-centered technological innovation in libraries.

Objectives

1. To examine the level of awareness of robotic technologies among library professionals in the context of Industry 5.0.
2. To determine perceptions of librarians toward the integration of robotic technologies in service delivery.
3. To identify the factors influencing the adoption of robotic technologies in libraries.

Literature Review

The evolution of libraries into digitally enhanced, intelligent spaces is a defining feature of the Fifth Industrial Revolution (Industry 5.0), which emphasizes the synergistic integration of human creativity and machine intelligence. Within this framework, robotic technologies have emerged as transformative tools capable of enhancing efficiency, improving user experience, and redefining service delivery in libraries. The adoption of robotic technologies in libraries is influenced by a complex interplay of institutional, technological, human, and ethical factors. A significant driver of robotic adoption in libraries is the institutional readiness and technological infrastructure available to support such innovations. Owolabi et al. (2022) assessed the readiness of academic librarians in Nigerian universities and highlighted the pivotal role of training, funding, and administrative support in fostering adoption. Similarly, Owate and Ogonu

(2023) emphasized that infrastructural preparedness—such as internet connectivity, digital literacy, and integration of automation tools—is essential for the effective deployment of robots in public universities. These infrastructural enablers often determine the feasibility of introducing service robots, cataloging assistants, or robotic shelves in library settings.

Studies by Hervieux and Wheatley (2021) and Eiriemiokhale and Sulyman (2023) revealed that librarians' understanding and attitudes toward artificial intelligence (AI) and robotics significantly influence the pace of adoption. In regions where librarians are more technologically literate and open to innovation, robotic integration is more feasible. Conversely, skepticism and fear of job displacement may hinder implementation. Abba (2024) further posited that the perception of AI as an aid rather than a replacement is crucial to achieving harmonious human-machine collaboration in university libraries. Also, user acceptance and perceived usefulness of robotics also play a pivotal role in shaping adoption decisions. Ajani et al. (2024) explored public libraries' current use of robots and found that user receptiveness, especially among children and the elderly, is often contingent on intuitive interaction and emotional engagement. The study by Edwards et al. (2022) on the use of robotic animal companions to mitigate student stress demonstrates how emotional design and user-centered functionality can enhance acceptance and utilization. Yueh et al. (2020) also found that users, particularly younger patrons, responded positively to literacy activities facilitated by robot and human companions, indicating a growing readiness for robotic inclusion in educational settings.

Economic and financial considerations are recurrent themes in the literature. Implementing robotics in libraries requires substantial investment, not only in acquisition but also in maintenance, staff training, and software updates. According to Wójcik (2024), the financial viability of adopting robotics is often evaluated against operational gains and user satisfaction. De Sarkar (2023) indicated the importance of cost-benefit analysis in determining whether robots add tangible value to library operations or remain experimental novelties. Limited budgets, especially in developing nations, often pose barriers, necessitating external funding, partnerships, or phased implementations.

The availability and adaptability of robotic technologies to library-specific tasks are also determinants of adoption. Asemi, Ko, and Nowkarizi (2021) categorized library robots into various types, including mobile shelving robots, service robots, and chatbots, noting that their adaptability to local contexts significantly affects integration. The study by Indraji, Naikar, and Dominic (2024) highlighted how the ability to customize robotic functionalities to accommodate cataloguing, information retrieval, and user guidance is instrumental in successful adoption. Similarly, the emergence of chatbots tailored for academic and public library environments, as discussed by Panda and Chakravarty (2022) and Kaushal and Yadav (2022), demonstrated how technological relevance influences integration outcomes.
From a sociotechnical perspective, the role of leadership, policy, and vision cannot be overstated. According to Oladokun et al. (2023), the lack of clear policies and guidelines on robotics in libraries may lead to fragmented or inconsistent adoption efforts. Shahzad, Khan, and Iqbal (2024), in their systematic literature review, identified strategic planning, change management, and stakeholder engagement as foundational pillars for successful robotic integration. Furthermore, Oyedokun (2024) emphasized that libraries in the 5IR era must embrace emerging technologies, including AI, blockchain, and robotics, through coherent policy frameworks that align innovation with service mandates. Ethical considerations constitute another key factor influencing robotic adoption in libraries. Cox (2022) present eight ethical scenarios that explore the implications of AI and robotics in libraries, ranging from privacy concerns to biases in machine decision-making. Libraries are traditionally viewed as safe, inclusive, and neutral spaces. The introduction of robotics must therefore be navigated carefully to uphold these values. Luca, Narayan, and Cox (2022) echoed this by arguing that the design and deployment of robotic systems should reflect ethical and cultural sensitivities, especially in diverse user environments.

Human-robot interaction dynamics also play a role in adoption. Tella and Ajani (2022) discussed how the integration of robots in public libraries can enhance engagement, but must be designed to complement rather than dominate human services. Adetayo, Abwage, and Oduola (2023) comparedhuman librarians and robots in service delivery, advocating for hybrid models where robots perform repetitive or physically demanding tasks while librarians focus on complex cognitive and relational activities. This blend, they argue, aligns with the industry 5.0 principle of human-machine collaboration, where empathy, judgment, and creativity are not supplanted but enhanced by intelligent technologies.

The cultural context in which libraries operate can either facilitate or hinder robotic adoption. Yoon, Andrews, and Ward (2022) report regional differences in the adoption of AI and robotics in libraries across

North America, influenced by institutional missions, user expectations, and regulatory environments. In Africa, according to Abba (2024) and Oyelude (2021), cultural perceptions, digital divides, and resource constraints shape the local adoption landscape. Therefore, efforts to adopt robotic technologies must be context-sensitive, balancing innovation with local needs and realities.

Finally, the broader trajectory of technological innovation and the diffusion of digital transformation across sectors provide momentum for robotic adoption in libraries. Oyetola et al. (2023) highlight the growing potential of AI in library services, calling for proactive investments in research and innovation. Similarly, Tella (2020) contended that libraries must not lag behind other sectors in embracing robotics, lest they risk becoming obsolete. The impact of humanoid robots in Australian libraries, as examined by Nguyen (2020), serves as a case study in how proactive adaptation to technological change can yield significant benefits in user satisfaction and operational efficiency.

Methodology

This study adopts a systematic review research design to critically explore scholarly evidence on the factors influencing the adoption of robotic technologies in libraries within the framework of Industry 5.0. The systematic review method is appropriate for synthesizing existing knowledge, identifying patterns, and uncovering research gaps, especially in emerging and multidisciplinary areas such as robotics, AI-human collaboration, and smart libraries.

The review is guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, ensuring transparency, replicability, and methodological rigor. The review process followed four main PRISMA phases: identification, screening, eligibility, and inclusion (Figure 1).

During the identification stage, a comprehensive literature search was conducted across major academic databases including Google Scholar, Scopus, and Web of Science. Boolean logic and a set of defined keywords were used to maximize the retrieval of relevant literature. The search terms included: *"robotic technologies," "robot librarians," "library automation," "service robots," "human-robot interaction," "smart libraries," "robotics in LIS," "Industry 5.0,"* and *"technology adoption in libraries."*

Inclusion criteria for selected studies were as follows:

- Peer-reviewed journal articles published between 2020 and 2025
- Written in English
- Focused on the use or potential adoption of robotic technologies in library contexts

Exclusion criteria included:

- Non-library contexts (e.g., hospitals, manufacturing)
- Studies not focused on robotics
- Grey literature, opinion pieces, or non-peer-reviewed sources
- Articles with inadequate methodological rigor

After duplicates were removed, all records were subjected to title and abstract screening, followed by full-text review based on the inclusion criteria. The number of articles retrieved, screened, excluded, and included will be illustrated in a PRISMA flow diagram.Eligible articles were organized using a structured data extraction spreadsheet capturing key variables such as:
(a) Author(s) and year, (b) Geographic context, (c) Library type (d) Robotic technologies studied (e.g., humanoid robots, robotic arms, AI-enabled robots), (f) Study population and methodology, and (g) Key findings related to awareness, perceptions, and adoption factors

To ensure quality, all included studies were critically appraised using the Critical Appraisal Skills Programme (CASP) checklist corresponding to their design (qualitative, quantitative, or mixed-methods). Only methodologically sound studies were included in the final synthesis.The extracted data were analyzed using thematic synthesis, with themes directly mapped to the study's research objectives. Each theme aggregates evidence across studies, offering both convergence and divergence of scholarly insights. The results of this synthesis are presented in the findings section.

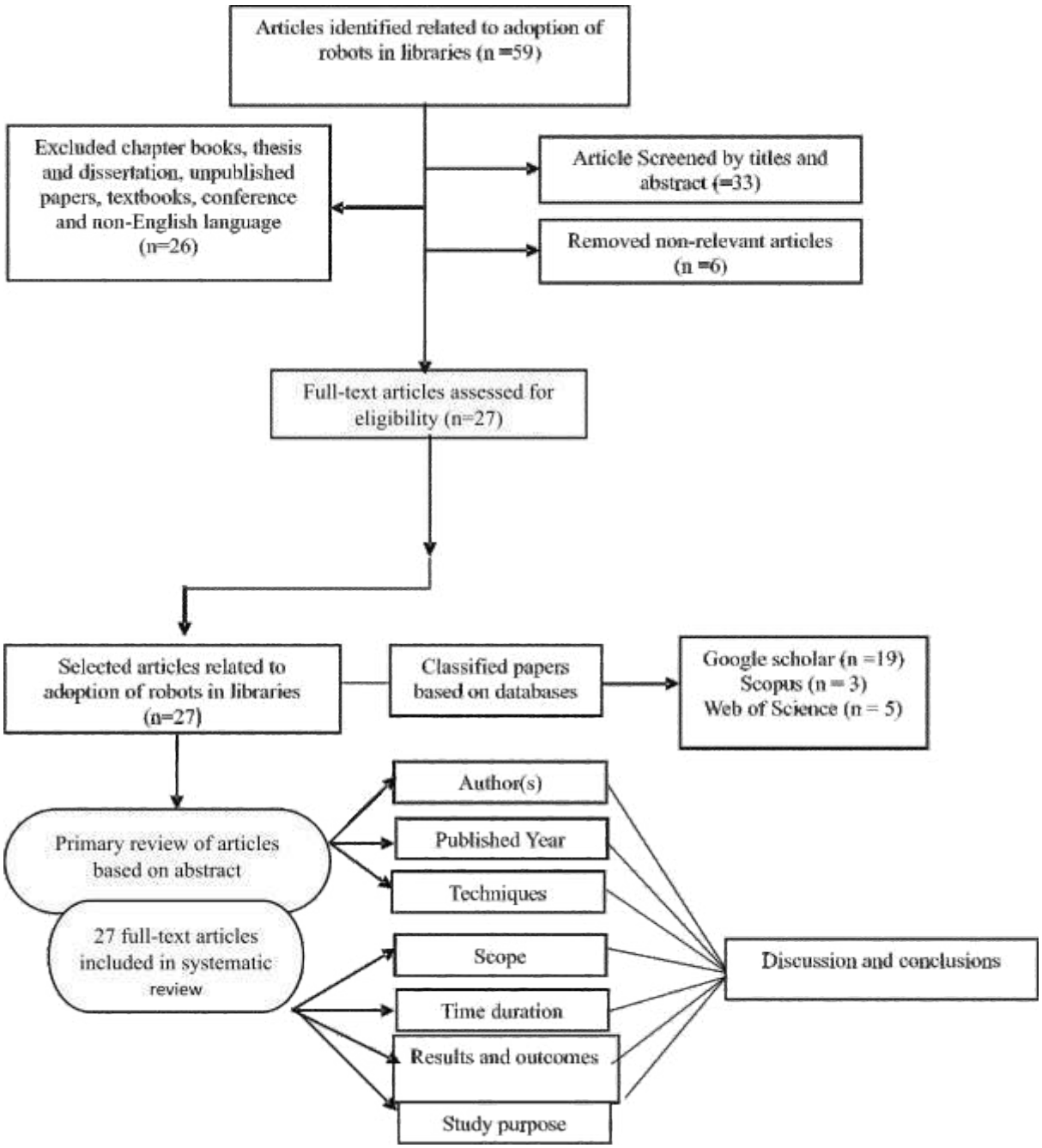


Figure 1: Literature search process using PRISMA

Results

Awareness and Understanding of Robotic Technologies

Awareness and understanding of robotic technologies among librarians significantly influence the trajectory of adoption and integration. Several studies indicate varying levels of awareness and technological literacy among library professionals. Eiriemiokhale and Sulyman (2023) found that while librarians in Kwara State, Nigeria, had heard of artificial intelligence (AI) and robotics, their practical understanding remained limited, creating a barrier to strategic implementation. Similarly, Hervieux and Wheatley (2021) conducted a cross-national survey in Canada and the United States, revealing that academic librarians' perceptions were shaped by both exposure to and comprehension of AI, with those better informed more open to experimenting with robotic applications. Awareness levels were also found to be regionally skewed; for example, Abba (2024) highlighted that university libraries in Africa, while increasingly aware of AI tools, often misinterpreted their capabilities, thus stalling practical integration. The literature indicates that improving awareness through targeted professional development is essential for preparing library personnel for Industry 5.0. Additionally, Tella (2020) questioned whether librarians are adequately prepared for the coming wave of robotic intervention, pointing to the urgency of upskilling and reskilling in the face of rapid technological transformation.

Librarian Perceptions toward Robotic Integration

Librarian perceptions toward robotic integration vary considerably and are deeply influenced by their understanding, experience, and institutional culture. Positive perceptions often correlate with readiness to adopt, whereas negative attitudes can become obstacles. Eiriemiokhale and Sulyman (2023) reported that many librarians expressed cautious optimism, viewing robots as supportive tools rather than threats. However, skepticism rooted in fears of job displacement, ethical concerns, and the loss of human touch was also prevalent. Hervieux and Wheatley (2021) found that academic librarians in North America viewed AI technologies more favorably when they believed these tools would augment, rather than replace, traditional services. Likewise, Adetayo, Abwage, and Oduola (2023) stressed the need for balanced perceptions, advocating for a hybrid service model where human and robotic collaboration enhances user experience without undermining the role of librarians. Cox (2022) explored eight ethical scenarios that challenged librarian comfort with AI, such as privacy breaches and algorithmic bias, indicating that without clear ethical guidelines, perceptions may remain skeptical. In contrast, studies like those by Tella and Ajani (2022) documented more optimistic views, especially among librarians exposed to the practical benefits of robotics in public libraries. Yoon, Andrews, and Ward (2022) also found that perceptions in North America were shaped not just by individual attitudes but by institutional mission statements and regulatory environments. Thus, librarian perceptions are multifaceted, shaped by a blend of professional ideology, practical experience, and broader institutional narratives.

Factors Influencing Robotic Adoption in Libraries

Multiple interrelated factors influence the adoption of robotic technologies in libraries. A key determinant is institutional readiness, including infrastructure, funding, and administrative vision. Owolabi et al. (2022) and Owate and Ogonu (2023) identified significant gaps in technological infrastructure and policy support in Nigerian universities, citing these as major adoption barriers. Financial constraints also emerged as a consistent challenge. Wójcik (2024) emphasized the need for a sound financial model that justifies investment through measurable operational benefits, while De Sarkar (2023) advocated for strategic funding mechanisms and vendor partnerships. The adaptability of robotic systems to specific library contexts is another critical factor. Asemi, Ko, and Nowkarizi (2021) categorized robots based on function and adaptability, stressing that successful adoption depends on how well robotic tools align with library-specific workflows. Indraji, Naikar, and Dominic (2024) further supported this, highlighting the role of customization in enhancing relevance. Policy frameworks and leadership commitment are equally vital. Shahzad, Khan, and Iqbal (2024) identified strategic planning, stakeholder engagement, and change management as essential precursors to successful robotic integration. Oladokun et al. (2023) and Oyedokun (2024) echoed these sentiments, stressing the importance of visionary leadership and coherent policy structures. Human factors, such as staff training and digital literacy, remain central, as noted by Abba (2024) and Ajani et al. (2024). User receptiveness also plays a pivotal role. Studies like those by Edwards et al. (2022) and Yueh et al. (2020) demonstrated that robotic features designed for emotional engagement and entertainment positively influenced user interaction, particularly among students and children. Finally, cultural context influences adoption: Luca, Narayan, and Cox (2022) emphasized the need for ethical sensitivity, while Oyelude (2021) called for localized strategies to bridge digital divides in Africa. These interconnected factors form a complex ecosystem that either accelerates or impedes robotic adoption in libraries.

Conclusion

This study concludes that the adoption of robotic technologies in libraries within the framework of Industry 5.0 is influenced by a constellation of interrelated factors spanning institutional readiness, financial capacity, technological infrastructure, librarian awareness, and user engagement. A key finding is that while the theoretical potential of robotics in enhancing library efficiency and user experience is widely acknowledged, practical implementation remains uneven due to gaps in infrastructure and technical expertise. Libraries in developing contexts, particularly in Africa, are constrained by limited funding, inadequate digital infrastructure, and insufficient training opportunities for library staff. These deficiencies impede the transition from conceptual interest to tangible adoption.

Furthermore, librarian awareness and understanding of robotic technologies were found to be critical enablers or barriers depending on context. Where librarians are better informed and perceive robots as tools for augmentation rather than replacement, attitudes tend to be more accepting, leading to greater openness to adoption. Conversely, skepticism, often rooted in fears of job redundancy and ethical concerns, continues to hinder progress in some settings. Librarian perceptions are further shaped by institutional culture, exposure to technological innovation, and the presence or absence of strategic leadership and supportive policy frameworks.

User receptiveness, especially among children, students, and tech-savvy patrons, emerged as a reinforcing factor in favor of robotic adoption, particularly when robots are designed for emotional engagement and entertainment. This aligns with the human-centric ethos of Industry 5.0, which envisions collaborative synergy between human intelligence and machine capabilities. In this light, robotic technologies should not be viewed as replacements but as strategic assets capable of augmenting library services through automation of routine tasks, facilitating personalized interactions, and fostering participatory learning environments. Generally, findings suggest that a successful transition toward robotics-enhanced library services requires not only technological investments but also a broader commitment to librarian education, policy coherence, and user-centered innovation. Addressing these dimensions holistically can enable libraries to embrace the opportunities presented by the Fifth Industrial Revolution while remaining grounded in their core mission of equitable, ethical, and inclusive information access.

Implications of the Study

The findings of this study have significant implications for both policy and practice in library reference services. First, the study indicates the urgent need for library institutions to develop comprehensive policies that facilitate the integration of robotic technologies into service delivery. Without strategic planning, libraries risk lagging behind in the global technological shift that is redefining user expectations and service standards. The adoption of robotics offers a pathway to enhance reference services by automating repetitive tasks, improving information retrieval processes, and providing interactive support for users. Policymakers must therefore prioritize the creation of regulatory frameworks that support innovation while maintaining ethical standards, user privacy, and data protection.

In practice, the study's findings suggest that library management must invest in ongoing staff training and capacity development to bridge the knowledge gap related to robotics and artificial intelligence. As reference librarians play a central role in user engagement, their ability to collaborate effectively with robotic systems will be crucial in ensuring smooth service delivery. Furthermore, the integration of robots can extend the operational hours and responsiveness of reference services through the use of AI-powered chatbots and digital assistants. For this to be successful, libraries must reimagine their service models to accommodate hybrid workflows where human and robotic interactions are optimized for efficiency, consistency, and user satisfaction. The findings also point to the need for a user-centered approach in the design and implementation of robotic tools, ensuring that the technologies align with the expectations and comfort levels of library patrons.

Limitations of the Study

This study has some noticeable limitations. First, the study is based on a systematic review of existing literature, which means it relies entirely on secondary data. As a result, the conclusions drawn are contingent upon the scope, depth, and methodological rigor of the original studies reviewed. The absence of primary data collection, such as surveys or interviews with librarians and users, limits the ability to capture real-time experiences and context-specific nuances related to robotic integration.

Further, much of the existing research originates from technologically advanced regions, while studies from underrepresented areas, particularly in Africa and parts of Latin America, remain limited. This uneven distribution may have skewed the findings toward contexts where robotic adoption is more advanced or already underway, potentially overlooking localized challenges in less-resourced environments.

Additionally, the review focused specifically on peer-reviewed journal articles published in English between 2020 and 2025. This exclusion of grey literature, non-English publications, and earlier studies may have resulted in the omission of relevant insights that could have enriched the analysis. Finally, the study's reliance on published academic work means it may not fully capture emerging developments or pilot projects currently underway but not yet documented in scholarly journals. As a result, the findings should be interpreted as indicative rather than exhaustive, offering a foundation for further empirical research and localized assessments.

References

Abba, T. (2024). Use of artificial intelligence technologies in rendering library services: Empirical evidence from university libraries in Africa. *African Journal of Library, Archives & Information Science*, *34*(1), 23-35.

Adetayo, A., Abwage, K., & Oduola, T. (2023). Robots and human librarians for delivering library services to patrons. *The Reference Librarian*, *64*(2-4), 69-84.

Ajani, Y. A., Oladokun, B. D., Enakrire, R. T., Ogunjimi, B. E., Ilori, O. O., & Akin-Fakorede, O. O. (2024). Robots in Public Libraries: An Empirical Analysis of Current Applications and Future Opportunities. *Public Library Quarterly*, 1-20.

Asemi, A., Ko, A., & Nowkarizi, M. (2021). Intelligent libraries: a review on expert systems, artificial intelligence, and robot. *Library Hi Tech*, *39*(2), 412-434.
Cox, A. (2022). The ethics of AI for information professionals: Eight scenarios. *Journal of the Australian Library and Information Association*, *71*(3), 201-214.
De Sarkar, T. (2023). Implementing robotics in library services. *Library Hi Tech News*, *40*(1), 8-12.
Edwards, A., Edwards, C., Abendschein, B., Espinosa, J., Scherger, J., & Vander Meer, P. (2022). Using robot animal companions in the academic library to mitigate student stress. *Library Hi Tech*, *40*(4), 878-893.
Eiriemiokhale, K. A., & Sulyman, A. S. (2023). Awareness and perceptions of artificial intelligence among librarians in university libraries in Kwara State, Nigeria. *Indonesian Journal of Librarianship*, 107-118.
Hervieux, S., & Wheatley, A. (2021). Perceptions of artificial intelligence: A survey of academic librarians in Canada and the United States. *The Journal of Academic Librarianship*, *47*(1), 102270.
Indraji, C., Naikar, S., & Dominic, J. (2024). Use of Robotics and Artificial Intelligence for Enhancing Library Services. *Library Progress International*, *44*(3), 3002-3010.
Kaushal, V., & Yadav, R. (2022). The role of chatbots in academic libraries: An experience-based perspective. *Journal of the Australian Library and Information Association*, *71*(3), 215-232.
Luca, E., Narayan, B., & Cox, A. (2022). Artificial intelligence and robots for the library and information professions. *Journal of the Australian Library and Information Association*, *71*(3), 185-188.
Nguyen, L. C. (2020). The impact of humanoid robots on Australian public libraries. *Journal of the Australian Library and Information Association*, *69*(2), 130-148.
Oladokun, B. D., Owolabi, A. K., Aboyade, M. A., Wiche, H. I., & Aboyade, W. A. (2023). Emergence of robotic technologies: implications for Nigerian academic libraries. *Library Hi Tech News*, *40*(6), 15-18.
Owate, C. N., & Ogonu, J. G. (2023). Assessment of Preparedness of Academic Libraries towards the Use and Adoption of Robotic Technologies in Public Universities in Bayelsa State. *Library of Progress-Library Science, Information Technology & Computer*, *43*(2).
Owolabi, K. A., Okorie, N. C., Yemi-Peters, O. E., Oyetola, S. O., Bello, T. O., & Oladokun, B. D. (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. *Library Management*, *43*(3/4), 296-305.
Oyedokun, T. T. (2024). Reimagining libraries in the fifth industrial revolution (5IR): The impact of robotics, artificial intelligence (AI), metaverse, blockchain, and emerging technologies. *Business Information Review*, 02663821251328839.
Oyelude, A. A. (2021). AI and libraries: trends and projections. *Library Hi Tech News*, *38*(10), 1-4.
Oyetola, S. O., Oladokun, B. D., Maxwell, C. E., & Akor, S. O. (2023). Artificial intelligence in the library: Gauging the potential application and implications for contemporary library services in Nigeria. *Data and Metadata*, *2*(1), 5.
Panda, S., & Chakravarty, R. (2022). Adapting intelligent information services in libraries: A case of smart AI chatbots. *Library Hi Tech News*, *39*(1), 12-15.
Shahzad, K., Khan, S. A., & Iqbal, A. (2024). Factors influencing the adoption of robotic technologies in academic libraries: A systematic literature review (SLR). *Journal of Librarianship and Information Science*, 09610006241231012.
Tella, A., & Ajani, Y. A. (2022). Robots and public libraries. *Library Hi Tech News*, *39*(7), 15-18.
Tella, A. (2020). Robots are coming to the libraries: are librarians ready to accommodate them?. Library Hi Tech News, 37(8), 13-17.
Wójcik, M. (2024). Areas and contexts of the use of robotics in libraries: an overview of the applied solutions and a discussion of prospects. *Library Hi Tech*, *42*(5), 1443-1456.
Yan, R., Zhao, X., & Mazumdar, S. (2023). Chatbots in libraries: A systematic literature review. *Education for Information*, *39*(4), 431-449.
Yueh, H. P., Lin, W., Wang, S. C., & Fu, L. C. (2020). Reading with robot and human companions in library literacy activities: A comparison study. *British Journal of Educational Technology*, *51*(5), 1884-1900.
Yoon, J., Andrews, J. E., & Ward, H. L. (2022). Perceptions on adopting artificial intelligence and related technologies in libraries: public and academic librarians in North America. *Library Hi Tech*, *40*(6), 1893-1915.

Impact of Artificial Intelligence on Libraries in the 5th Industrial Revolution: Empowering Librarians for the Future

Gift Ihunanya Nwosu (CLN)
The College Library
Rivers State College of Health Science and Management Technology,
Oro-Owo, Rumueme, Port-Harcourt, Rivers State
giftnwosu.ozjn@gmail.com;nwosugift@rschst.edu.ng;

Ikenna Cyril Ihejirika (CLN)
Department of Library and Information Science
Captain Elechi Amadi Polytechnic, Rumuola, Port-Harcourt, Rivers State
cyril.ihejirika@portharcourtpoly.edu.ng

Helen Omolara Aribatise
Deputy Director, Library
Nigerian Army School of Finance and Administration, Apapa Lagos State
lara_3009@yahoo.com

Abstract

This study explores the transformative potential of artificial intelligence (AI) in shaping the future of libraries and empowering librarians in the 5th Industrial Revolution. Driven by the rapid convergence of advanced technologies, this era presents both challenges and opportunities for the library profession. This research investigates how AI is redefining the roles and responsibilities of librarians, the essential skills they require to effectively utilize AI, and the impact of AI-driven empowerment on library services and professional development. The study employed a descriptive research design to capture the current state and future needs of librarians in the context of AI integration. The target population consisted of librarians across Nigeria. A sample of 40 librarians was selected from two state chapters of the Nigerian Library Association: Lagos and Rivers State. A structured questionnaire served as the primary data collection instrument. The instrument underwent face and content validity assessment by experts and achieved a Cronbach's Apha reliability coefficient of 0.79, indicating strong internal consistency. Data were analyzed using mean scores to determine the level of agreement with the questionnaire items. The findings revealed that AI is significantly altering librarians' roles, requiring them to become not just curators but also navigators of digital information, data analysts, and trainers in AI literacy. Essential skills identified include proficiency in AI tools, data interpretation, and ethical considerations surrounding AI implementation. The study concluded that AI empowers librarians by enhancing their efficiency, expanding their service offerings, and elevating their professional standing. The study recommends that library schools incorporate AI-related training into their curricula, and that libraries invest in professional development programs to equip librarians with the necessary skills to thrive in the AI-driven library landscape.

***Keywords**: Artificial intelligence, libraries, librarians, 5th Industrial Revolution, empowerment, skills, competencies, professional development.*

Introduction

The Fifth Industrial Revolution (5IR) represents the next phase of industrial evolution, emphasizing a harmonious collaboration between humans and advanced technologies such as artificial intelligence, robotics, and biotechnology. Unlike the Fourth Industrial Revolution, which focused primarily on automation, digitization, and efficiency, 5IR centers on enhancing human creativity, emotional intelligence, and ethical considerations, aiming to create a sustainable, human-centric future? It prioritizes personalization, environmental stewardship, and social well-being, seeking to balance technological progress with human values and global challenges like climate change. This revolution envisions technology as a partner that amplifies human potential rather than replacing it, fostering inclusive growth and resilience across industries and societies (5th Industrial Revolution, 2024)

The 5th Industrial Revolution (5IR) represents a transformative era marked by the convergence of artificial intelligence (AI), automation, and human creativity. In this context, libraries, once traditionally perceived as physical spaces for storing books and resources, are evolving into digital ecosystems that harness AI to enhance user experience, streamline library management, and deliver more personalized services (Mamabolo & Durodolu, 2025). AI technologies have begun to significantly influence library operations by enabling tasks such as automated cataloging, user behavior analysis, and personalized recommendations.

These advancements are poised to shift the roles and responsibilities of librarians from traditional gatekeepers of information to active facilitators of knowledge discovery in a technologically-driven environment.

As libraries integrate more AI tools, there is an increasing demand for librarians to acquire new skills and competencies to adapt to these technologies. The integration of AI into library systems not only enhances operational efficiency but also empowers librarians to offer more dynamic, responsive services to users. For instance, AI-driven chatbots, voice search technologies, and machine learning algorithms are now being used in libraries to automate routine tasks and provide users with real-time information retrieval (Agim, Abah & Ezejiofor, 2025). This technological shift has brought new expectations for librarians, who must now understand how AI can be used to improve library services and meet the evolving needs of users in a digital-first world. The future of librarianship, therefore, requires an understanding of both technological innovations and the implications of these changes for the profession.

However, despite the growing integration of AI in libraries, there is a lack of comprehensive studies focusing on how these technologies are specifically empowering librarians for future challenges. According to Azmar (2018), much of the existing research on AI in libraries centers on technology adoption, but there is limited exploration of the skills librarians need to effectively utilize AI or the broader impacts of AI on their professional development. Moreover, while libraries globally are adopting AI-based tools, the strategies for equipping librarians with the necessary skills remain underexplored. This study seeks to address these gaps by focusing on how AI is impacting libraries in the 5IR and how it empowers librarians for future roles.

Research Questions

The study will examine the following research questions:

1. How is AI redefining the roles and responsibilities of librarians in the 5th Industrial Revolution?
2. What essential skills do librarians require to effectively utilize AI?
3. What is the impact of AI-driven empowerment on library services and professional development in the 5th Industrial Revolution?
4. What challenges exist in empowering librarians to adapt to AI in the 5IR?

Literature Review

Artificial Intelligence in Libraries: An Overview

Artificial Intelligence (AI) has rapidly transformed library operations, offering innovative solutions that extend beyond traditional cataloging and circulation tasks. Recent studies highlight that AI technologies, such as machine learning, natural language processing, and predictive analytics, are now instrumental in personalizing user services, automating metadata generation, and enhancing information retrieval systems (Ajakaye, 2022). AI-powered systems, such as chatbots and virtual reference assistants, have significantly improved user engagement by providing 24/7 information support and reducing librarians' workload (Agim, et al, 2025). Furthermore, AI algorithms are facilitating advanced resource discovery by recommending materials based on user behavior and preferences, which has redefined user-library interactions in digital spaces (Donkor&Afrane, 2023). These technological advancements demonstrate that AI is not merely an add-on but an integral part of contemporary library infrastructure, supporting more efficient, user-centered service delivery.

However, while AI integration in libraries presents significant opportunities, it also raises critical considerations regarding ethics, data privacy, and the changing professional roles of librarians. Scholars like Anumula, et al (2024) argue that the adoption of AI compels librarians to acquire new competencies in data science, algorithm literacy, and ethical information management. Libraries must navigate the challenge of integrating AI responsibly to ensure transparency, fairness, and inclusivity in service delivery. Moreover, the shift towards AI-assisted environments demands a rethinking of traditional librarianship skills, blending technical expertise with human-centered service values (Basak, et al, 2024). Overall, the literature suggests that AI's growing presence in libraries is a double-edged sword—offering powerful tools for innovation while simultaneously demanding significant adaptation in librarian roles, professional ethics, and user engagement strategies.

Redefining the Roles and Responsibilities of Librarians in the AI Era

The advent of Artificial Intelligence (AI) technologies has fundamentally redefined the roles and responsibilities of librarians, moving them from traditional custodians of information to active facilitators of digital literacy and data management. According to Mupaikwa (2024), librarians are increasingly expected to develop expertise in algorithmic literacy, metadata curation, digital preservation, and ethical AI governance to stay relevant in the AI-driven information environment. Librarians are no longer solely responsible for organizing and retrieving information; instead, they are now key players in teaching users

how to critically assess AI-generated content and navigate complex digital ecosystems. Moreover, contemporary librarians must understand machine learning models, data privacy laws, and bias mitigation strategies to ensure that library services remain equitable and trustworthy (Zhang, Wang & Liu, 2020). The transformation suggests a shift toward hybrid professional identities where librarians combine their traditional values of intellectual freedom and user advocacy with emerging technical and analytical skills.

In response to these changing demands, discussions in the literature emphasize that continuous professional development and strategic re-skilling are critical for librarians to thrive in the AI era. As noted byAgim ,et al (2025), libraries must invest in structured training programs that equip staff with competencies in AI ethics, data analytics, and digital content management. Additionally, librarians are being called upon to take leadership roles in AI project development, policy-making, and community engagement within their institutions (Lee & Choi, 2018). This expanded scope of responsibility positions librarians not just as service providers but as proactive collaborators in technological innovation and societal change. While the integration of AI presents challenges, such as the risk of dehumanizing library services or reinforcing algorithmic biases, the literature agrees that with the right preparation, librarians can transform these challenges into opportunities for enhanced relevance, leadership, and advocacy in the digital age.

Essential Skills and Competencies for Librarians in the 5IR

The emergence of the Fifth Industrial Revolution (5IR), characterized by the blending of human-centered innovation with advanced technologies like artificial intelligence, robotics, and biotechnology, has dramatically shifted the skill requirements for librarians. Nwobu et al (2024) highlight that librarians need critical thinking and creativity skills to interpret complex information landscapes shaped by automation and intelligent systems. Emotional intelligence, adaptability, and leadership also emerge as crucial attributes, as librarians are increasingly expected to mediate between technology and user needs, ensuring that libraries maintain a humanistic approach while embracing advanced innovations. Without an adequately skilled and sound human resource management programmes that can enable librarians to manage AI- driven tools, development in such organizations will not be possible especially in this 5IR era (Ihejirika & Nwosu, 2025); Librarians are therefore compelled to develop key competencies in data literacy, digital curation, information ethics, and technological fluency which will enable them manage AI-driven tools and support personalized user experiences if they must thrive in this rapidly evolving landscape.

The literature also emphasizes that professional development frameworks must evolve to meet these new competency demands. As noted by Oladokun, et al (2024), librarians require continuous, interdisciplinary learning opportunities that combine AI technical training with humanistic education in ethics, diversity, and social responsibility. Training programs should focus not just on operating AI systems but also on critical evaluation, bias mitigation, and inclusive service design (Lee & Choi, 2018). These competencies enable librarians to address issues like digital divides, algorithmic discrimination, and data privacy concerns while empowering users with equitable access to knowledge. Ultimately, the 5IR demands that librarians transcend traditional roles by becoming innovators, educators, and ethical stewards within their institutions, shaping future-ready libraries that are both technologically advanced and deeply human-centered.

AI-Driven Empowerment and Professional Development for Librarians

The integration of artificial intelligence (AI) into libraries has brought about significant opportunities for the empowerment and professional development of librarians. AI technologies such as machine learning, natural language processing, and predictive analytics have allowed librarians to re-imagine service delivery, resource management, and user engagement strategies (Nwobu, et al, 2024). Through AI-driven tools, librarians are increasingly empowered to automate routine tasks, personalize information services, and enhance decision-making processes based on user data insights. This transformation requires librarians to engage in continuous professional development programs tailored to building competencies in data management, algorithm literacy, and AI ethics. As highlighted by Oladokun, et al (2024), AI not only shifts the nature of library work but also acts as a catalyst for librarians' career growth, offering new leadership, teaching, and research opportunities within the digital information ecosystem.

However, sustaining this empowerment necessitates structured professional development pathways that address both technical and human-centered skills. According to Cox and Mazumdar (2023), effective AI-focused professional development should emphasize interdisciplinary learning, including computer science basics, critical data studies, and socio-technical analysis. Moreover, these initiatives must incorporate mentorship, collaboration, and experiential learning approaches to prepare librarians to ethically and innovatively apply AI technologies in diverse library contexts (Lo, 2023). Without adequate training and continuous upskilling, the potential of AI to empower librarians may remain underutilized, reinforcing existing skill gaps and professional inequalities. Thus, AI-driven empowerment and

professional development are mutually reinforcing: as librarians become more proficient in AI, they can better leverage its capabilities to innovate library services and assert their evolving relevance in the information society of the 5th Industrial Revolution.

The Future of Libraries and Librarians in the 5IR

The emergence of the Fifth Industrial Revolution (5IR), characterized by the convergence of artificial intelligence, human-centered technologies, and ethical innovations, is reshaping the future landscape of libraries and librarianship. Libraries are transitioning from traditional information repositories to dynamic knowledge hubs that emphasize personalized user experiences, digital innovation, and collaborative learning (Azmar, 2018). As AI, robotics, and Internet of Things (IoT) become more deeply embedded into library systems, the role of libraries will increasingly focus on data stewardship, community engagement, and fostering digital literacy among users (Mamabolo&Durodolu, 2025). Librarians are expected to act as both digital curators and ethical navigators, helping users critically engage with AI-driven information environments. According to Lawal (2017), the library of the future will balance technological advancement with a renewed emphasis on human-centered services, ensuring inclusivity, privacy protection, and equitable access to information.

For librarians, the 5IR heralds a profound transformation in professional identity, requiring a fusion of traditional skills with new competencies in AI literacy, data analytics, and interdisciplinary collaboration. As Oladokun, et al (2024) observe, librarians must evolve into proactive innovators capable of designing user-centric digital services and contributing to organizational decision-making through data-driven insights. The future demands that librarians not only adapt to technological change but also lead ethical conversations around AI governance, misinformation, and digital equity (Nwobu, et al, 2024). Thus, the 5IR presents a dual challenge and opportunity: while technological disruptions may redefine traditional roles, they also offer librarians the chance to position themselves as critical agents in shaping a humanistic, knowledge-driven future. The future of libraries and librarianship, therefore, lies in an agile, ethically aware, and technologically skilled workforce committed to upholding the core values of access, equity, and lifelong learning.

Methods

The study employed a descriptive research design to capture the current state and future needs of librarians in the context of AI integration. The target population consisted of librarians across Nigeria. A sample of 40 librarians was selected from two state chapters of the Nigerian Library Association: Lagos and Rivers State. A structured questionnaire served as the primary data collection instrument. The instrument underwent face and content validity assessment by experts and achieved a Cronbach's Apha reliability coefficient of 0.79, indicating strong internal consistency. Data were analyzed using mean scores to determine the level of agreement with the questionnaire items

Results

Research Question 1: How is AI redefining the roles and responsibilities of librarians?

Table 1: Mean and Standard Deviation on how AI is Redefining the Roles and Responsibilities of Librarians

S/N	Items	Mean	Std. Dev.	Decision
1	AI has expanded librarians' roles into data analytics and digital curation.	2.76	0.88	Agree
2	Librarians are increasingly acting as digital literacy educators due to AI integration.	3.22	0.72	Strongly Agree
3	AI tools are shifting librarians' focus towards knowledge management rather than traditional cataloguing.	2.81	0.85	Agree
4	Librarians now play a key role in ethical AI use and information governance.	3.18	0.77	Strongly Agree
5	AI is influencing librarians to acquire interdisciplinary collaboration skills.	2.92	0.79	Agree
6	Librarians' advisory roles have expanded to include AI-based research guidance.	2.86	0.84	Agree
7	Librarians are becoming proactive contributors to AI-driven service innovations in libraries.	3.15	0.75	Strongly Agree
	Grand Mean	**2.99**		**Agree**

From the Table, it is evident that several items were rated as "Agree," indicating moderate acknowledgment by librarians regarding AI's impact on their roles. These include the expansion into data analytics and digital curation (item 1, Mean = 2.76), the shift toward knowledge management (item 3, Mean = 2.81), the need for interdisciplinary collaboration skills (item 5, Mean = 2.92), and the extension of advisory roles into AI-based research guidance (item 6, Mean = 2.86). Meanwhile, other items were strongly agreed upon, reflecting higher acceptance and recognition by librarians. These include librarians becoming digital literacy educators (item 2, Mean = 3.22), playing key roles in ethical AI use and information governance (item 4, Mean = 3.18), and contributing proactively to AI-driven service innovations (item 7, Mean = 3.15). Overall, the grand mean of 2.99 shows that librarians generally Agreed that AI is significantly reshaping their roles and responsibilities.

The data indicates that librarians are gradually adapting to these new demands, positioning themselves as pivotal players in the AI-powered information environment.Several empirical studies support these findings. Apriliyanti & Ilham (2022) emphasized that librarians are becoming integral to the ethical governance and strategic application of AI tools within academic institutions, aligning with the strong agreement recorded for ethical responsibilities. Similarly, librarians are expected to develop interdisciplinary and digital literacy skills to maintain their relevance in the 5IR era, which matches the agreed and strongly agreed responses related to new educational and collaboration roles. Ajakaye (2022) highlighted that librarians are increasingly participating in AI-driven service innovation and research advisory functions, reflecting the observed trends in proactive service innovation and AI-based research guidance. Collectively, these studies affirm that the redefinition of librarians' roles by AI is a well-documented and evolving reality.

Research Question 2: What essential skills do librarians require to effectively utilize AI?

Table 2: Mean and Standard Deviation on Essential Skills Librarians Require to Effectively UtilizeAI

S/N	Items	Mean	Std. Dev.	Decision
1	Data literacy and analytical skills are essential for librarians to interact with AI systems.	3.24	0.74	Strongly Agree
2	Digital literacy skills, including proficiency in AI tools and platforms, are vital for librarians.	3.18	0.78	Strongly Agree
3	Communication skills remain crucial for librarians to interpret and deliver AI-generated information.	2.76	0.84	Agree
4	Problem-solving abilities are necessary for librarians working with dynamic AI technologies.	2.81	0.87	Agree
5	Adaptability skills are required to keep pace with rapidly evolving AI tools.	2.91	0.82	Agree
6	Ethical reasoning skills are indispensable for managing AI applications responsibly.	3.10	0.79	Strongly Agree
7	Collaborative skills are needed for interdisciplinary projects involving AI applications.	2.88	0.86	Agree
	Grand Mean	**2.98**		**Agree**

The Table shows that several items were rated as "Agree," reflecting that librarians moderately recognize the importance of core soft skills in leveraging AI effectively. These skills include communication (item 3, Mean = 2.76), problem-solving (item 4, Mean = 2.81), adaptability (item 5, Mean = 2.91), and collaboration for interdisciplinary AI projects (item 7, Mean = 2.88). Meanwhile, items relating to data literacy and analytics (item 1, Mean = 3.24), digital literacy proficiency (item 2, Mean = 3.18), and ethical reasoning (item 6, Mean = 3.10) were strongly agreed upon, indicating a strong acknowledgment by librarians of the growing technical and ethical competencies needed in the AI environment. The grand mean of 2.98 suggests an overall moderate to high consensus on the necessity of these skills among librarians in academic libraries.

The results indicate that while traditional skills such as communication and problem-solving remain important, librarians overwhelmingly recognize the growing need for technical and ethical expertise in order to utilize AI effectively. Several empirical studies affirm these findings. Oladokun, et al (2024) found that data literacy and ethical competencies are critical for librarians to effectively interact with AI platforms and uphold the integrity of information services. Similarly, Nwobu, et al (2024) reported that librarians' success in AI implementation relies significantly on a balanced skill-set that includes digital literacy, adaptability, and problem-solving abilities. In another study, Cox & Mazumdar (2023) emphasized that ethical reasoning and interdisciplinary collaboration are indispensable for librarians aiming to drive AI - based innovations within academic libraries. These studies consistently highlight that an evolving combination of technical expertise, ethical consciousness, and traditional soft skills is vital for librarians navigating the 5IR landscape.

Research Question 3: What is the impact of AI-driven empowerment on library services and professional development?

Table 3: Mean and Standard Deviation onthe Impact of AI-driven Empowerment on Library Services and Professional Development

S/N	Items	Mean	Std. Dev.	Decision
1	AI technologies have enhanced service delivery speed and accuracy in academic libraries.	3.20	0.76	Strongly Agree
2	AI-driven tools have improved librarians' ability to personalize information services.	2.94	0.81	Agree
3	AI empowerment has increased librarians' efficiency in information retrieval tasks.	2.88	0.84	Agree
4	AI applications have expanded opportunities for continuous learning and skill acquisition.	2.91	0.79	Agree
5	AI integration has encouraged librarians to adopt innovative service models.	3.12	0.77	Strongly Agree
6	Professional development initiatives now increasingly focus on AI and emerging technologies.	3.08	0.80	Strongly Agree
7	AI adoption has improved collaborative practices among librarians across disciplines.	2.90	0.82	Agree
	Grand Mean	**2.99**		**Agree**

The Table shows that several items were rated as "Agree," indicating that librarians moderately perceive AI-driven empowerment as beneficial to certain aspects of service and professional development. Librarians agreed that AI tools have improved personalization of services (item 2, Mean = 2.94), increased efficiency in information retrieval (item 3, Mean = 2.88), expanded learning opportunities (item 4, Mean = 2.91), and enhanced collaborative practices across disciplines (item 7, Mean = 2.90). Meanwhile, stronger agreements were recorded on the significant impacts of AI in enhancing service delivery speed and accuracy (item 1, Mean = 3.20), encouraging innovative service models (item 5, Mean = 3.12), and promoting AI-centered professional development (item 6, Mean = 3.08). The grand mean of 2.99 suggests an overall moderately high positive perception of AI-driven empowerment on library services and librarians' professional development.

The findings imply that librarians recognize AI as a transformative force, not only streamlining operational tasks but also opening avenues for innovation, personalized services, and ongoing professional growth.Empirical studies affirm these observations. Lee and Choi (2018) revealed that AI implementation in libraries has significantly enhanced service efficiency, personalization, and resource accessibility, supporting the findings on service speed and personalization. Similarly, AI technologies are reshaping professional development initiatives by mandating continuous upskilling and the adoption of innovative practices among librarians. Das and Islam (2021) noted that the integration of AI in library operations fosters collaborative opportunities and interdisciplinary partnerships strengthening the view that AI-driven empowerment positively impacts library services and professional growth. These studies collectively substantiate the table's results, highlighting AI as a major catalyst for transformation in academic libraries.

Research Question 4: What challenges exist in empowering librarians to adapt to AI in the 5IR?

Table 4: Mean and Standard Deviation on Challenges that Exist in Empowering Librarians to Adapt to AI in the 5IR

S/N	Items	Mean	Std. Dev.	Decision
1	Lack of technical skills among librarians hampers effective AI adoption.	3.28	0.75	Strongly Agree
2	Inadequate funding limits access to AI tools and training programs.	3.21	0.78	Strongly Agree
3	Resistance to change among librarians delays AI integration.	2.91	0.82	Agree
4	Insufficient institutional support affects AI-driven initiatives.	3.15	0.80	Strongly Agree
5	Limited professional development opportunities on AI competencies.	3.10	0.79	Strongly Agree
6	Ethical concerns about AI applications create hesitation in usage.	3.05	0.81	Strongly Agree
7	Lack of awareness about AI's potential impacts strategic planning.	2.88	0.84	Agree
	Grand Mean	**3.08**		

The Table reveals that some challenges were rated as "Agree" by librarians, highlighting moderate concerns. Librarians agreed that resistance to change (item 3, Mean = 2.91) and lack of awareness of AI's potential (item 7, Mean = 2.88) are notable obstacles in adapting to AI. However, stronger agreement was found for challenges such as lack of technical skills (item 1, Mean = 3.28), inadequate funding (item 2, Mean = 3.21), insufficient institutional support (item 4, Mean = 3.15), limited professional development opportunities (item 5, Mean = 3.10), and ethical concerns (item 6, Mean = 3.05). The grand mean of 3.08 indicates that overall, librarians strongly perceive significant barriers to AI empowerment in the 5IR era.
The findings suggest that the major challenges in empowering librarians to adapt to AI are rooted primarily in systemic and infrastructural issues such as skills gaps, funding limitations, and institutional support deficits. These findings align with recent studies. According to Cox & Mazumdar (2023), librarians' lack of technical proficiency and insufficient training opportunities remain critical barriers to successful AI integration in academic libraries. Similarly, Apriliyanti & Ilham (2022) emphasized that organizational barriers such as limited funding and weak institutional commitment significantly hinder librarians' ability to adapt to AI innovations. Furthermore, ethical uncertainties around AI use in information services cause hesitation and slow down the adoption process. Together, these empirical studies reinforce the table's results, highlighting the multifaceted challenges librarians face in embracing AI during the 5IR.

Conclusion

The findings of this study underscore that while librarians are progressively aligning themselves with the demands of the 5th Industrial Revolution through AI, targeted efforts are still needed to fully empower them for future challenges. Librarians recognize their evolving roles and the skills necessary for success, embracing AI not only as a tool for operational efficiency but as a gateway to innovative services and enhanced user experiences. However, significant barriers such as lack of funding, skills gaps, and inadequate institutional support must be urgently addressed to ensure a sustainable AI-driven transformation in academic libraries.Therefore, deliberate actions from stakeholders: including university management, professional bodies, government agencies, and librarians themselvesare vital to overcoming these challenges. By equipping librarians with the requisite technical and ethical competencies, providing robust infrastructural support, and fostering a culture of innovation and continuous learning, academic libraries can fully harness AI's potential. This will not only enhance library services but also ensure that librarians remain indispensable knowledge facilitators in the ever-evolving digital landscape of the 5IR.

Recommendations

The following recommendations have been given:

1. Academic libraries should regularly organize continuous professional development workshops focusing on emerging AI technologies, ensuring librarians stay updated and agile in adapting to new responsibilities.
2. Institutions should revise job descriptions and role expectations to reflect AI-related tasks, providing clear career progression pathways for librarians embracing new technology-driven roles.
3. Library schools and training centers should update their curricula to include courses on AI literacy, machine learning, data ethics, and algorithmic accountability tailored for library professionals.
4. Academic libraries should create mentorship programs where technologically advanced librarians mentor others, fostering peer-to-peer skill development in both technical and ethical dimensions of AI usage.
5. Libraries should invest in pilot AI projects (such as chatbots, automated indexing, or predictive analytics) that allow librarians to participate in real-world AI applications, thus boosting both service delivery and professional growth.
6. Institutions should incentivize librarians who proactively engage in AI-driven initiatives with awards, promotions, or research grants, motivating continual innovation and professional development.
7. Government bodies, educational stakeholders, and library management should allocate dedicated funding for AI tools, infrastructure upgrades, and librarian training programs to eliminate financial constraints.
8. Leadership in libraries should foster a supportive culture for AI adoption by providing clear policies, ethical guidelines, and administrative backing to librarians experimenting with AI integration.

REFERENCES

Agim, E.C, Abah, A.T. &Ezejiofor, V.O. (2025). Availability And Utilization of AI-Powered Chatbots for Enhanced User Services In Academic Libraries In Anambra State. *Heartbeat Journal of Library and Information Science, 4* (1), 75-88

Agim, E. C., Adegbite, OE &Edeh E.E (2025) Evaluating Technology Ethical Practices in the Utilization of Digital Resources among Undergraduate Students of NnamdiAzikiwe University, Awka. *International Journal of Information Resource Management, 2* (2), 1-13.

Ajakaye, J. E. (2022). Applications of ArtificialIntelligence (AI) in Libraries. In I. Ekoja, E. Ogbomo, & O. Okuonghae (Eds.), *Handbook of Research on Emerging Trends and Technologies in Librarianship* (pp. 73-90), IGI Global. https://doi.org/10.4018/978-1-7998-9094-2.ch006

Anumula, V. R. B., Anumula, K. R. V. S. S., Anumula, M., &Damerla, S. (2024). Artificial Intelligence UsingLibrary Information Science Professionals. *International Journal of Progressive Research in Engineering Management and Science, 4*(1), 591-594. https://www.ijprems.com/uploadedfiles/paper/issue_1_january_2024/32611/final/fin_ijprems1706806420.pdf

Apriliyanti, M &Ilham, M. (2022) Challenges of The Industrial Revolution Era 1.0 to 5.0 : University Digital Library In Indoensia. *Library Philosophy and Practice* (e-journal). 6994. https://digitalcommons.unl.edu/libphilprac/6994

Azmar, N. J. (2018). The Future Of The Library As The Industrial Revolution Develops 4.0: Evaluate The Role Of The Librarian. *Journal of Iqra' 10*(01): 35-37.

Basak, R., Paul, P., Kar, S., Molla, I. H., & Chatterjee, P. (2024). The Future of Libraries With AI: Envisioning the Evolving Role of Libraries in the AI Era. In K. Senthilkumar (Ed.), *AI-Assisted Library Reconstruction* (pp. 34-57). IGI Global. https://doi.org/10.4018/979-8-3693-2782-1.ch003

Cox, A. M., &Mazumdar, S. (2023). *How artificial intelligence (AI) might change academic library work: applying the competencies literature and the theory of the professions*. *Library Hi Tech, 41*(1), 37–52. View at researchgate.net

Das, R. K., & Islam, M. S. U. (2021). *Application of Artificial Intelligence and Machine Learning in Libraries: A Systematic Review*. *Library Philosophy and Practice*, 6762. View at https://digitalcommons.unl.edu/libphilprac/6762

Donkor, A. B. &Afrane, D. A. (2023). Application of AI in Academic Library Services: Prospects and Implications for Quality Service Delivery. In D. Chiu & K. Ho (Eds.), *Emerging TechnologyBased Services and Systems in Libraries, Educational Institutions, and Non-Profit Organizations* (pp. 1-25). IGI Global. https://doi.org/10.4018/978-1-6684-8671-9.ch001

Ihejirika, I. C. &Nwosu, G. I. (2025).Human Resource planning in the 21st century for library staff in Nigeria. *A* paper presented during the ASUPZone D Conference, at AkwaIbomState Polytechnic, Akwa-Ibom State.

Lawal, V. (2017) Information Literacy and the Future of Digital Information Services at the University of Jos Library. *Library Philosophy and Practice* (e-journal). 1674. https://digitalcommons.unl.edu/libphilprac/1674

Lee, J., & Choi, W. (2018). A study on the application of artificial intelligence in library services. *Journal of Korean Library and Information Science Society*, *49*(2), 1-22.

Lo, L. S. (2023). *Evaluating AI Literacy in Academic Libraries: A Survey Study with a Focus on U.S. Employees*. *College & Research Libraries*, 84(1), 1–20.

Mamabolo, M. J. &Durodolu, O. O. (2025). Unlocking the Advantages: Exploring the Benefits of Accessing Digital Libraries in the Fifth Industrial Revolution Era. In S. Thanuskodi (Ed.), *Exploring Digital Metrics in Academic Libraries* (pp33-52). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-5807-8.ch002

Mupaikwa, E. (2024). The Application of Artificial Intelligence for Reference Purposes in Academic Libraries. In I. Khamis (Ed.), *Applications of Artificial Intelligence in Libraries* (pp. 166- 192). IGI Global. https://doi.org/10.4018/979-8-3693-1573-6.ch007

Nwobu, B. K., Dumbiri, R., Ibia, M. J., &Oladokun, B. D., (2024). Libraries in the Fifth Industrial Revolution: Skills and Knowledge Required in Preparing Librarians for an Uncertain Future. In U. C. Udofot et al. (Eds.), *Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria*. (pp3 – 13). Chadick Printing Press.

Oladokun, B. D., Ayinde, L., Enakrire, R. T. (2024) The fifth industrial revolution: Information professionals and skills. *Information Matters, 4*,7. https://informationmatters.org/2024/07/the-fifth-industrial-revolution-information-professionals-andskills/

Zhang, D., Wang, L., & Liu, Y. (2020). Research progress of artificial intelligence in libraries. *Library and Information Service*, *44*(10), 4-11.

Implementing Ethical AI-Powered Reference Services at Federal University Lokoja Library: A Librarian's Perspective

Omoniyi Yinka Martins
Federal University Lokoja E-Library
Federal University Lokoja
yinka.omoniyi@fulokoja.edu.ng
+2348126138695

Mohammed Saidu
Federal Teaching Hospital, Lokoja, Library
Federal Teaching Hospital, Lokoja
saidum25@yahoo.com
+234 806 565 4436
&
Dr. A. M. Rabiu
Department of Library and Information Science
Federal University Lokoja
comraderabiu@gmail.com
+234 803 588 8113

Abstract

Including Artificial intelligence (AI) in academic library services offers modern librarianship possibilities and difficulties. This paper looks at librarians' preparedness and ethical issues for using AI-powered reference services at the Federal University Lokoja Library, using the Socio-Technical Systems Theory (STS) prism. Particularly important for looking at AI integration in library services, the STS theory offers a framework for comprehending the intricate connections between human actors and technical systems in organizational contexts. The study gathered data from 32 librarians in Federal University Lokoja using a structured questionnaire via a descriptive survey research approach. The study examined librarians' technological competence, perceived ethical consequences, and expected difficulties using AI-powered reference services. Important study topics were data privacy issues, professional development requirements, and preserving human-centered service delivery in an AI-augmented context. The study reveals notable links between librarians' technological readiness and their views on AI adoption. The important elements the study find required for effective AI integration are thorough staff training, creation of ethical standards, and unambiguous human-AI cooperation in reference service protocols. The study recommends that Federal University Lokoja Library should invest in training and capacity-building initiatives to improve librarians' technological preparedness, the library create explicit ethical policies for the acceptance of artificial intelligence, and continuous monitoring and evaluation systems for artificial intelligence systems will help the library guarantee the ethical and successful application of AI-driven reference services. This study adds to the increasing information on AI use in academic libraries. It offers pragmatic suggestions for putting ethical AI-powered reference services into practice while preserving the fundamental principles of librarianship.

Keywords: *Artificial Intelligence, Reference Services, Academic Libraries, Ethics, Socio-Technical Systems Theory, Library Technology*

Introduction

Contemporary library systems have experienced a significant metamorphosis, evolving from conventional review-based repositories to digital knowledge hubs.Technological breakthroughs engender significant prospects for efficiency and innovation, although they also present intricate obstacles. A foremost concern is safeguarding data privacy in an era increasingly influenced by artificial intelligence (AI) (Bello et al., 2023). Particularly in reference delivery, including artificial intelligence (AI) in academic libraries, is fast changing the scene of information services. By improving the efficiency, accessibility, and personalization of reference services, artificial intelligence (AI) technologies, including generative AI applications like ChatGPT, Claude, and Deepseek, have shown promise to support the changing demands of academic consumers (Georgia Southern University Libraries, 2024). These developments provide creative methods to include users in academic settings, automate mundane chores, and simplify knowledge retrieval. Adopting artificial intelligence in university libraries raises ethical questions about the preparedness of library staff members to accept these technologies, which call for thoughtful attention.

Traditionally, academic libraries have been reliable knowledge keepers, enabling fair access to information and promoting academic research. Artificial intelligence techniques question preserving these fundamental values in a more automated environment. Not impartial, artificial intelligence systems can reflect and amplify biases in their training data, therefore producing discriminatory results or supporting stereotypes

(Nayyer, 2023). Furthermore, since artificial intelligence systems usually depend on large amounts of user data to operate well, data privacy, openness, and responsibility are important (Das, Mahajan, & Bobhate, 2024). These ethical issues call for strong frameworks to direct the responsible use of artificial intelligence in library environments to guarantee that technology improves user confidence and inclusiveness rather than erodes it.

Artificial intelligence has great promise, especially in developing nations like Nigeria, but its actual use in university libraries' AI-powered reference services is still somewhat limited. Adoption is hampered by several obstacles, including poor technological infrastructure, lack of digital competence among librarians, and concerns about job loss (Orubebe et al., 2024; Igbo et al., 2024). The absence of well-defined policy frameworks and strategic planning makes it more difficult to include artificial intelligence properly. These difficulties underline the necessity of thorough evaluations of librarians' technological preparedness and their views on ethical concerns relating to artificial intelligence to guide customized solutions supporting sustainable adoption.

Moreover, ethical use of artificial intelligence in libraries calls for technical answers and social and organizational issues. Socio-technical methods highlight the need to co-design artificial intelligence systems with feedback from librarians and users to guarantee that AI tools fit community requirements and institutional values (CDT, 2024). This point of view supports continuous training, open government, and cooperative policymaking to reduce hazards, including privacy violations and algorithmic biases. Academic libraries can promote a synergistic relationship, improving service quality and maintaining professional integrity by emphasizing human knowledge and artificial intelligence capabilities (Mazarakis & Peters, 2024).

Academic libraries, including AI-powered reference services, are a difficult yet hopeful frontier. Although artificial intelligence can radically change library services' access, efficiency, and personalization, its ethical and practical issues must be resolved through deliberate planning, capacity building, and policy creation.

Statement of the Problem

Particularly in reference delivery, the fast development of artificial intelligence (AI) technology can significantly improve academic library services. Adoption of artificial intelligence in academic libraries, particularly in developing nations like Nigeria, remains limited, though, by issues including inadequate technological infrastructure, lack of AI-related knowledge among librarians, and urgent ethical questions including data privacy, algorithmic bias, and transparency (Orubebe, Oloniruha, & Oladokun, 2024; Igbo et al., 2024). These issues highlight important issues regarding properly including artificial intelligence while maintaining the fundamental principles of librarianship, including fair access to material and user confidentiality (Nayyer, 2024; Tsekea & Mandoga, 2025). Understanding librarians' willingness to use AI-powered reference services and their views of related ethical concerns at the Federal University Lokoja Library shows a significant discrepancy. Ignoring these elements could compromise human-centered service delivery and lead to opposition or abuse in AI integration due to insufficient policies and training (Orubebe et al., 2024).

Research objective

The study was guided by the following research objectives.

1. To investigate the technological readiness of librarians for deploying AI-powered reference services in Federal University Lokoja.
2. To identify the perceived ethical concerns associated with AI integration in library reference services in Federal University Lokoja.
3. To identify the critical factors necessary for the successful ethical application of AI-powered references in the Federal University Lokoja.

Literature Review

Definition of Artificial Intelligence

Artificial Intelligence is significant for libraries as it may be utilized for the organization and accessibility of extensive information collections (ALA, 2019). According to Memela (2023), AI is the advancement of computer systems capable of doing activities that often necessitate human intelligence, including decision-making, object detection, and resolving complicated issues. Artificial intelligence is also seen as a comprehensive term including various technologies such business analytics, data science, natural language processing, speech recognition, text-to--speech, machine learning, deep learning, neural networks, machine reasoning, decision-making, algorithms, computer vision, and robotics (Lowendal & Calhoun Williams, 2018).

Ethical Integration of Artificial Intelligence in Library Service

Including artificial intelligence (AI) into library systems has changed access to, organization of, and

management of information. This technical change does, however, present moral questions about data privacy, justice, and responsibility. Ethical AI ideas guarantee libraries employ artificial intelligence responsibly, so preserving user rights and confidence, and avoiding abuse (Israel et al., 2020). Transparency, user permission, minimization of bias, and conformity with world data privacy rules are among the fundamental values.

Librarian's Readiness for Artificial Intelligence Integration

Recent research has examined how prepared academic librarians are to introduce AI-powered services into university libraries. Although knowledge of the possible advantages of artificial intelligence for library operations is rising, practical application differs depending on the area. Librarians in Nigeria expressed conflicting opinions on preparedness, noting issues including insufficient financing and poor knowledge base (Ajani et al., 2022). Although Indonesian academic libraries showed good opinions on accepting artificial intelligence, they also pointed out the requirement of infrastructure and competency building (Harisanty et al., 2022). Librarians in Taiwan saw artificial intelligence as unavoidable but struggled with execution; financing and technology problems were the main obstacles (Huang, 2022). The librarians of Pakistani universities recognized that artificial intelligence may improve innovative library systems and creative learning opportunities (Shahzad et al., 2024). According to Fida Ali et al. (2025), Nigerian university libraries show poor preparation for implementing artificial Intelligence technologies. However, the institutions are not ready to apply new technologies, even with their possible advantages, better operational efficiency, and enhanced customer experience. They also mentioned the obstacles to technological readiness: inadequate digital infrastructure, poor policy framework, and insufficient human development. Though they show an increasing awareness of artificial intelligence's possibilities in academic libraries overall, these studies also underline the necessity of more financing, infrastructure, and talent development to enable effective use.

Ethical Concerns in AI-Driven Library Services

Integrating artificial intelligence with library reference services raises many ethical questions about privacy, data security, and bias. These issues are important because libraries are using artificial intelligence (AI) more and more to improve their offerings, including regular work automation and information retrieval improvement (Adewojo & Amzat, 2024). The ethical consequences of artificial intelligence in libraries demand serious attention to guarantee fair and responsible application. Artificial intelligence systems in libraries often require access to large volumes of user data, raising privacy and data security issues (Johansen, Headley & Figenschou, 2024). Maintaining library service confidence depends on ensuring user data is safeguarded and utilized responsibly (Mannheimer et al., 2024). Clear policies and rules are needed to control data privacy so that user permission is gained and data is handled honestly (Kavak, 2024). If not adequately controlled, AI algorithms can reinforce prejudices, resulting in unfair treatment of particular user groups. This especially worries libraries, where fair information access is fundamental (Okoroma, 2024). Dealing with prejudice calls for constant monitoring and system modification of artificial intelligence to guarantee equitable serving of all user groups (Anele Mabona et al., 2024). The complexity of artificial intelligence systems might result in a lack of openness, making it challenging for consumers to know how decisions are made. Libraries should aim for openness in AI activities to keep responsibility (Adegboye et al., 2024). Clearly defining ethical rules and including human supervision in AI operations will help to allay some of these worries (Ikwuanusi et al., 2023). Although the ethical issues are important, integrating artificial intelligence in libraries also offers chances to improve user experiences and services. Nevertheless, these developments must be balanced with ethical issues to guarantee artificial intelligence's inclusive and responsible application. Building strong ethical frameworks and ongoing education on AI technology calls for cooperation among library professionals, researchers, and legislators (Kalbande et al., 2024).

Gap in Ethical Oversight and Risk of Harm

While underlining the necessity to solve related ethical issues, recent studies show the increasing integration of artificial intelligence (AI) in libraries, especially academic ones. Key applications are improving reference services, metadata development, and information retrieval (Mannheimer et al., 2024). However, researchers note several ethical questions, including algorithmic prejudice, privacy concerns, and the digital divide (Gajbhiye, 2024). Though other hazards need more research, the apparent risk of job loss is much addressed (Ngulube & Mosha, 2024). With only one-third of research covering more general concerns like transparency, social justice, and user permission (Mallikarjuna C, 2024), ethical factors outside of technical accuracy are sometimes disregarded. Responsible practices, multidisciplinary partnerships, and public debates on ethical implications are increasingly needed as artificial intelligence deployment in libraries develops to guarantee fair and positive AI integration (A. Subaveerapandiyan & Alfian Akbar Gozali, 2024).

Factors for Successful Implementations of Ethical Artificial Intelligence Services

The practical ethical application of artificial intelligence in institutions depends on considering important elements in several spheres. Particularly ethically, technology shows to be the most important factor impacting artificial intelligence applications (Merhi, 2022). With different significance depending on adoption levels, key success determinants are performance expectation, top management support, technical competence, ease of use, organizational compatibility, and trade partner leverage (Solaimani & Swaak, 2023). Considering development, utilization, and long-term effects (Miller, 2021), ethical AI project success hinges on turning ideas into functional deliverables and activities. Implementation of ethical artificial intelligence in service sectors presents difficulties like privacy, prejudice, openness, and responsibility. Ethical rules, human supervision, thorough training, and adaptive corporate culture enable—Vatankhah et al., 2024. These elements emphasize the requirement of responsible and reliable AI systems in many fields since they are essential for releasing the promise of artificial intelligence while reducing risk factors.

The effective ethical use of references driven by artificial intelligence depends on numerous important elements that guarantee technology reduces dangers and fits society's ideals. These elements together promote responsible artificial intelligence development by including ethical standards, governance structures, and stakeholder involvement.

Ethical Principles

Transparency: Building trust and responsibility depends on open communication about AI decision-making procedures (Balayogi et al., 2024).

Fairness: AI systems must be built to prevent the extension of the prejudices found in training data, guaranteeing fair results for every user (Shawky et al., 2023).

Accountability: Clearly defining lines of accountability for AI-generated activities is essential, so human supervision of automated judgments is necessary (Sahoo, 2024).

Governance Framework

Ethical Governance: Strong frameworks guiding AI development and use will help to solve moral conundrums and guarantee regulatory compliance (Sukumar, 2025).

Data Security and Privacy: Maintaining individual rights and trust depends on safeguarding user data through sophisticated security policies and privacy-preserving strategies (Balayogi et al., 2024).

Stakeholder Engagement

Inclusion of Diverse Perspectives: Including ethicists, technologists, and impacted communities among other stakeholders will help to improve the ethical issues in AI applications (Luize & Serafim, 2023). Although these elements are crucial for the application of ethical artificial intelligence, others contend that the fast speed of AI development could surpass the creation of thorough ethical rules, creating unexpected results and ethical conundrums in use (Shawky et al., 2023).

Theoretical Framework

This paper investigates integrating reference services driven by artificial intelligence in academic libraries using the Socio-Technical Systems (STS) Theory as its theoretical framework. According to the STS theory, the social context in which technological implementations, including artificial intelligence systems, are embedded determines their technical and general success. Emphasizing the interplay between human actors (librarians, users, and administrators) and technology systems supports a balanced and cooperative approach to system design and implementation (Clegg et al., 2020). Within the framework of this study, STS offers a means of comprehending how institutional regulations, technological readiness of librarians, and ethical issues interact to determine the effective adoption of artificial intelligence in reference services. By emphasizing the interaction between human and technology components, the STS theory enables a complete knowledge of artificial intelligence integration's opportunities and difficulties. Moreover, the philosophy emphasises the need for organizational elements and human-centered design in applying artificial intelligence technology. It implies that successful use of artificial intelligence in academic libraries calls for technological developments and efficient cooperation among all stakeholders (Harisanty et al., 2022). In line with this, the study will investigate how librarians' preparation, opinions about artificial intelligence's ethical consequences, and the organizational context influence AI systems' ethical and practical implementation in reference services. This theoretical prism fits the increasing corpus of research on the acceptance of artificial intelligence in libraries, emphasizing the requirement of a socio-technical approach combining human knowledge with technical capabilities to guarantee ethical and sustainable implementation (Orubebe et al., 2024).

Methodology

The study uses a descriptive survey research approach to investigate librarians' ethical concerns and readiness for using AI-powered reference services at the Federal University Lokoja Library. The survey guarantees thorough population coverage with 32 Federal University Lokoja Library librarians. Data are gathered using a standardized questionnaire tailored to important themes found in objectives. Every participant receives an online questionnaire asking for primary data. Descriptive statistics, including frequency distributions and mean score analyses, are used to examine correlations between variables in quantitative data from the survey. The study follows ethical research guidelines about informed consent, confidentiality, and the opportunity to withdraw from activities. Data handling practices follow accepted data security policies, safeguarding respondents' personal information.

Tables and Interpretation of Results

Table 1: Technological readiness of librarians for deploying AI-powered reference services in Federal University Lokoja.

S/N	ITEMS	SA	A	D	SD	Mean	SD
1.	Digital Literacy and ICT Proficiency	12	13	2	5	3.00	1.04727
2.	Training and Professional Development	10	20	0	2	3.18	0.73780
3.	Technological Infrastructure	14	13	2	3	3.18	0.93109
4.	Data Management Skills	18	11	2	1	3.43	0.75935
5.	Information Ethics and Data Privacy Awareness	15	11	3	3	3.18	0.96512
6.	Collaborative and Interdisciplinary Skills	11	17	2	2	3.15	0.80760
7.	User-Centered Design Thinking	20	10	1	1	3.53	0.71772
8.	Knowledge of Artificial Intelligence Applications	12	13	2	5	3.00	1.04727
9.	Readiness for Change Management	12	16	2	2	3.18	0.82060
10.	Institutional Support and Policy Alignment	17	11	2	2	3.34	0.86544

Source: Field survey, 2025

Table 1 shows that Federal University Lokoja's librarians show a modest degree of technological readiness to apply AI-powered reference services. In "User-centered Design Thinking," the highest mean score, 3.53, showcased a significant awareness of the value of user-oriented artificial intelligence methods. Furthermore, scoring 3.43, "Data Management Skills" indicated a strong command of data required for artificial intelligence activities. Though both "Digital Literacy and ICT Proficiency" and "Knowledge of Artificial Intelligence Applications" score 3.00, more work is needed to guarantee that librarians are completely ready in digital skills and AI awareness. Although most people agree that ongoing professional development is important, as shown by the mean score of 3.18 for "Training and Professional Development," there is also awareness of the need to strengthen institutional support and technological infrastructure, with "Technological Infrastructure" and "Institutional Support and Policy Alignment" also scoring 3.18. According to the report, effective AI integration will call for focused efforts in training, policy development, and building librarians' confidence in using AI technologies, as well as a more cooperative atmosphere among library services.

Table 2: Perceived ethical concerns associated with AI integration in library reference services in Federal University Lokoja.

S/N	ITEMS	SA	A	D	SD	Mean	SD
1.	Privacy and Confidentiality	15	11	3	3	3.18	0.96512
2.	Bias and Discrimination	15	14	0	3	3.28	0.88843
3.	Transparency and Explainability	14	13	4	1	3.25	0.80322
4.	Misinformation and Reliability	17	14	0	1	3.46	0.67127
5.	Informed Consent	15	12	1	4	3.18	0.99798
6.	Digital Divide and Access Inequity	15	14	2	1	3.34	0.74528
7.	Impact on Employment	24	4	2	2	3.56	0.87759
8.	Intellectual Freedom	16	8	6	2	3.18	0.96512
9.	Consent for Data Use	19	11	1	1	3.50	0.71842
10.	Dehumanization of Services	11	16	3	2	3.12	0.83280

Table 2 findings expose the Federal University Lokoja Library's observed concerns with ethics regarding the inclusion of artificial intelligence into reference services. In "Impact on Employment," the highest mean score was 3.56, indicating major worry among librarians about the possible job loss resulting from artificial intelligence adoption. Emphasizing problems about AI systems perpetuating prejudices and offering unreliable information, other important issues include "Bias and Discrimination" (3.28) and "Misinformation and Reliability" (3.46). These issues highlight the importance of open and fair artificial intelligence systems to reduce possible adverse effects on consumers and the library staff. With a mean score of 3.18 for "Privacy and Confidentiality" and "Informed Consent," demonstrating concerns over handling user data and guaranteeing informed consent for data use, privacy and data security issues are also significant. Other ethical issues, such as "Transparency and Explainability" (3.25) and "Intellectual Freedom" (3.18), underline the need for more clarity in AI operations and preservation of users' rights. The findings highlight the need for responsible AI integration with strong ethical norms to protect users and librarians, even if it can enhance library services.

Table 3: Critical factors necessary for the successful ethical implementation of AI-powered references in Federal University Lokoja.

S/N	ITEMS	SA	A	D	SD	Mean	SD
1.	Adopting globally recognized ethical AI standards (e.g., UNESCO, IFLA, IEEE).	12	16	3	1	3.21	0.75067
2.	Transparency and Explainability	13	19	0	0	3.40	0.49899
3.	Human Oversight and Librarian Involvement	14	15	2	1	3.31	0.73780
4.	Data Privacy and Security	16	12	2	2	3.31	0.85901
5.	Inclusivity and Equity	17	12	1	2	3.37	0.83280
6.	User Consent and Awareness	9	20	2	12	3.15	0.67725
7.	Continuous Monitoring and Evaluation	18	12	2	0	3.50	0.62217
8.	Professional Development and Capacity Building	17	9	2	4	3.21	1.03906
9.	Alignment with Institutional Mission	17	12	2	1	3.40	0.75602
10.	Cultural and Contextual Sensitivity	18	11	2	1	3.43	0.75935

The findings of Table 3 underline the important elements required for the effective ethical use of reference services driven by artificial intelligence at the Federal University Lokoja Library. With a mean score of 3.50, "Continuous Monitoring and Evaluation" shows the need for continuous supervision to guarantee AI systems stay ethical and practical. Highly scoring (3.50), "Consent for Data Use" reflects the necessity of explicit user permission processes to guarantee openness and respect for privacy. Furthermore, underlined by "Cultural and Contextual Sensitivity" (3.43) and "Inclusivity and Equity" (3.37) is the need to make sure AI systems give fair access to all users and are fit for local settings. Indicating the need for openness in AI decision-making procedures and ongoing human engagement in supervising AI operations, other important elements include "Transparency and Explainability" (3.40) and "Human Oversight and Librarian Involvement" (3.31). "Data Privacy and Security" (3.31) and "Professional Development and Capacity Building" (3.21) underline the requirement of strong data protection methods and continuous education for librarians even more. These findings imply that a successful ethical integration of artificial intelligence in library reference services will need a complete approach comprising transparent governance, constant monitoring, and a strong focus on inclusiveness, privacy, and cultural sensitivity.

Discussion of Findings

The results of this study provide important perspectives on librarian technological preparedness for implementing AI-powered reference services at the Federal University Lokoja Library. With the highest ratings in "User-Centered Design Thinking" (mean = 3.53) and "Data Management Skills" (mean = 3.43), the results imply a modest degree of readiness across key areas in keeping with the first objective, which intended to evaluate librarians' technological preparedness. These results coincide with earlier studies showing that librarians have strong data management abilities, essential for artificial intelligence integration, and generally understand the need to use user-oriented approaches (Shahzad et al., 2024). As Fida Ali et al. (2025) underline the need to enhance digital skills among library professionals to use AI tools in service delivery effectively, the lower score in "Digital Literacy and ICT Proficiency" reflects the need for further capacity building in technological competencies.

The second goal concentrated on spotting the moral issues related to artificial intelligence's inclusion into library reference systems. With "Impact on Employment" (mean = 3.56) ranked highest among librarians, the study found that privacy and confidentiality issues and bias and discrimination were primary ethical considerations. This result reflects worries expressed by Johansen et al. (2024) and Adewojo & Amzat (2024), who underline that artificial intelligence systems endanger user privacy and potentially support

prejudices in decision-making as they depend on such large volumes of data. Moreover, the worry about employment loss, which clearly shows in the statistics, fits the continuous discussion about artificial intelligence's capacity to replace human positions, especially in industries like libraries (Orubebe et al., 2024). These ethical issues highlight the requirement of libraries to create robust methods that guarantee AI systems are used in ways that respect privacy, advance justice, and preserve openness in decision-making through deployment.

In tackling the third objective, determining the essential elements required for the effective ethical implementation of reference services driven by artificial intelligence, the study underlined the need for ongoing observation and professional advancement. Emphasizing the requirement of continuous monitoring and explicit consent procedures to reduce hazards connected with artificial intelligence technology, the highest-rated factors, "Continuous Monitoring and Evaluation" (mean = 3.50) and "Consent for Data Use" (mean = 3.50), highlight These results align with the opinions of Kalbande et al. (2024) and Merhi (2022), who contend that thorough review systems and open governance structures are necessary for the successful integration of artificial intelligence into libraries. Moreover, the focus on "Cultural and Contextual Sensitivity" (mean = 3.43) and "Inclusivity and Equity" (mean = 3.37) supports the requirement of AI systems to be flexible enough to fit local settings and guarantee fair access for all users, as advised by Mazarakis & Peters (2020). These findings suggest that to reach the ethical and successful integration of artificial intelligence in academic library services, a multifarious approach including constant training, explicit ethical standards, and a strong emphasis on inclusion is necessary.

Conclusion

This research offers an insightful analysis of the technological readiness, ethical issues, and crucial success elements related to integrating reference services driven by artificial intelligence at the Federal University Lokoja Library. The results show that although librarians have a modest technical readiness, more digital literacy and ICT competency are needed to guarantee successful AI adoption. Furthermore, ethical questions were noted as important issues needing strong frameworks and open policies, especially concerning privacy, bias, and the possible influence on employment. The research also emphasizes the need for ongoing professional development, monitoring, and assessment to help enable the ethical application of AI technology in library services. Important components like data protection, informed consent, and cultural sensitivity were crucial for ensuring that artificial intelligence integration satisfies the needs of many users and conforms with ethical criteria. Academic libraries may effectively negotiate the potential and problems posed by artificial intelligence by stressing the human-centered approach to adoption and supporting cooperative efforts between librarians, users, and technology developers. Ultimately, this study adds to the increasing corpus of knowledge on artificial intelligence integration in academic libraries by laying a basis for future studies and presenting doable suggestions for the appropriate implementation of AI-powered reference systems. It emphasizes the importance of a well-rounded strategy combining technological innovation with a dedication to preserving the fundamental librarian values of equity, accessibility, and user privacy. Ethical issues must always be a top priority in developing and using artificial intelligence technologies in library services, as libraries change in reaction to technological developments.

Recommendations

- **Enhance Digital Literacy and Professional Development:** The Federal University Lokoja Library should invest in ongoing training and capacity-building initiatives to improve librarians' modest technological preparedness. Professional development should also concentrate on user-centered design thinking and data management techniques to help integrate AI-powered reference services properly.
- **Develop and Implement Ethical AI Frameworks:** Given the major ethical questions raised, especially regarding privacy, data security, and bias, it is advised that the library create explicit ethical policies for the acceptance of artificial intelligence. Transparency, user permission, and justice should come first in these models so that artificial intelligence technologies can be used sensibly.
- **Establish Continuous Monitoring and Inclusive AI Governance:** Continuous monitoring and evaluation systems for artificial intelligence systems will help the library guarantee the ethical and successful application of AI-driven reference services. This covers building governance systems that support diversity, fairness, and cultural sensitivity in AI implementations.

Reference

A. Subaveerapandiyan, & Alfian Akbar Gozali. (2024). AI in Indian Libraries: Prospects and Perceptions from Library Professionals. *Open Information Science*, *8*(1). https://doi.org/10.1515/opis-2022-0164

Adewojo, A. A., & Amzat, O. B. (2024). Exploring ethical considerations in AI-driven cataloguing and classification with ChatGPT. *Business Information Review*, *41*(3), 130–133. https://doi.org/10.1177/02663821241264703

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullahi, F. (2022). Perspectives of Librarians on Awareness and Readiness of Academic Libraries to Integrate Artificial Intelligence for Library Operations and Services in Nigeria. *Internet Reference Services Quarterly*, *26*(4), 1–18.

https://doi.org/10.1080/10875301.2022.2086196
Anele Mabona, Darelle Van Greunen, & Kevin, K. (2024). *Integration of Artificial Intelligence (AI) in Academic Libraries: A Systematic Literature Review*. https://doi.org/10.23919/ist-africa63983.2024.10569288
Ansovini, D., Babcock, K., Franco, T., Jung, J. A., Suurtamm, K., & Wong, A. (2022). Knowledge lost, knowledge gained: The implications of migrating to online archival descriptive systems. *KULA: Knowledge Creation, Dissemination, and Preservation Studies*, *6*(3), 1–19.
Bello, O. A., Folorunso, A., Ejiofor, O. E., Budale, F. Z., Adebayo, K., & Babatunde, O. A. (2023). Machine learning approaches for enhancing fraud prevention in financial transactions. *International Journal of Management Technology*, *10*(1), 85–108.
CDT. (2024). Applying socio-technical approaches to AI governance in practice. Retrieved from https://cdt.org/insights/applying-sociotechnical-approaches-to-ai-governance-in-practice/
Chandramani Kailash Gajbhiye. (2024). Impact of Artificial Intelligence (AI) in Library Services. *International Journal for Multidisciplinary Research*, *6*(3). https://doi.org/10.36948/ijfmr.2024.v06i03.22452
Clegg, C. W., Legge, D., & Hartley, P. (2020). *Socio-technical systems theory and its application in organizational settings*. Journal of Organizational Behavior, 41(2), 151–172. https://doi.org/10.1002/job.2411
Das, A., Mahajan, N., & Bobhate, P. (2024). Ethical use of artificial intelligence in the library. *INFLIBNET*. https://ir.inflibnet.ac.in:8443/ir/bitstream/1944/2465/1/7.pdf
Fida Ali, Shahnoor, Neha Munir, & Muhammad Abubakar. (2025). Readiness for Adopting Artificial Intelligence and Emerging Technologies in Academic Libraries of Pakistan. *The Critical Review of Social Sciences Studies*, *3*(1), 1146–1160. https://doi.org/10.59075/y8sewa87
G. Balayogi, A. Vijaya Lakshmi, & Sophie, S. L. (2024). Human-Centric Ethical AI in the Digital World. *Advances in Human and Social Aspects of Technology Book Series*, 175–196. https://doi.org/10.4018/979-8-3693-4147-6.ch008
Georgia Southern University Libraries. (2024). The future of academic reference services in the age of artificial intelligence. https://digitalcommons.georgiasouthern.edu/cgi/viewcontent.cgi?article=1305&context=lib-facpresent
Harisanty, D., Anna, N. E. V., Putri, T. E., Firdaus, A. A., & Noor Azizi, N. A. (2022). Leaders, practitioners, and scientists' awareness of artificial intelligence in libraries: a pilot study. *Library Hi Tech*. https://doi.org/10.1108/lht-10-2021-0356
Harisanty, D., Anna, N. E. V., Putri, T. E., Firdaus, A. A., & Noor Azizi, N. A. (2022). Leaders, practitioners, and scientists' awareness of artificial intelligence in libraries: A pilot study. *Library Hi Tech*, 40(3), 505-520. https://doi.org/10.1108/lht-10-2021-0356
Huang, Y. H. (2022). Exploring the implementation of artificial intelligence applications among academic libraries in Taiwan. *Library Hi Tech*. https://doi.org/10.1108/lht-03-2022-0159
Igbo, H. U., Imo, N. T., Jidere, U. J., & Ugwu, F. N. (2024). Adopting artificial intelligence in academic library services in Nigeria: Requirements and challenges. *NigerBiblios: Journal of the National Library of Nigeria*. *34*(1), 1–18. https://nigerbiblios.nln.gov.ng/index.php/nigerbiblios/article/view/145
Ikwuanusi, F., Adeyemo, P., & None Chinekwu Somtochukwu Odionu. (2023). https://orionjournals.com/ijmru/ArchiveIssue-2023-Vol6-Issue2. *International Journal of Multidisciplinary Research Updates*, *6*(2), 033–044. https://doi.org/10.53430/ijmru.2023.6.1.0063
Johansen, J. S., Headley, C., & Lars Figenschou. (2024). *Investigating Librarian Perspectives on Generative AI*. https://doi.org/10.31219/osf.io/95sdx
Kalbande, D., Suradkar, P., Chavan, S., Verma, M. K., & Yuvaraj, M. (2024). Artificial Intelligence Integration in Academic Libraries: Perspectives of LIS Professionals in India. *The Serials Librarian*, 1–12. https://doi.org/10.1080/0361526x.2024.2433262
Kavak, A. (2024). Ethical Considerations and Privacy Concerns in AI-Enabled Libraries. *Advances in Library and Information Science*, 45–77. https://doi.org/10.4018/979-8-3693-1573-6.ch003
Luize, A., & Serafim, M. C. (2023). Ethical content in artificial intelligence systems: A demand explained in three critical points. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1074787
Mallikarjuna C. (2024). Integrating Artificial Intelligence in Academic Libraries. *DESIDOC Journal of Library and Information Technology*, *44*(2), 124–129. https://doi.org/10.14429/djlit.44.2.18958
Mannheimer, S., Bond, N., Scott, Kettler, H. S., Marcus, A., Slipher, S. K., Clark, J. A., Yasmeen Shorish, Rossmann, D., & Sheehey, B. (2024). Responsible AI Practice in Libraries and Archives. *Information Technology and Libraries*, *43*(3). https://doi.org/10.5860/ital.v43i3.17245
Mazarakis, A., & Peters, I. (2024). Human-centred AI: First steps for the enrichment of library work. *ZBW MediaTalk*. https://www.zbw-mediatalk.eu/2024/01/human-centred-ai-first-steps-for-the-enrichment-of-library-work/

Memela, M.A. (2023). Artificial intelligence (AI): enlightening academic libraries on the phenomenon. Journal of Information Processing, 2(3), 1–10. https://doi.org/10.13140/RG.2.2.32481.89443

Merhi, M. I. (2022). An evaluation of the critical success factors impacting artificial intelligence implementation. *International Journal of Information Management*, *69*, 102545. https://doi.org/10.1016/j.ijinfomgt.2022.102545

Miller, G. J. (2022). Artificial Intelligence Project Success Factors—Beyond the Ethical Principles. *Lecture Notes in Business Information Processing*, 65–96. https://doi.org/10.1007/978-3-030-98997-2_4

Nayyer, K. P. (2023). Ethical implications of implicit bias in AI: Impact for academic libraries. Cornell University eCommons. https://ecommons.cornell.edu/items/b9225fc4-cce4-4dc7-a476-8e4dead63afa3

Ngulube, P., & Vincent, F. (2024). Integrating artificial intelligence-based technologies "safely" in academic libraries: An overview through a scoping review. *Technical Services Quarterly*, 1–22. https://doi.org/10.1080/07317131.2024.2432093

None Moyosore Adegboye, None Sneha Vaidhyam, & Huang, N. K.-T. (2024). Generative AI-ChatGPT's Impact on Health Science Libraries. *Proceedings of the ALISE Annual Conference*. https://doi.org/10.21900/j.alise.2024.1659

Okoroma, F. N. (2024). Artificial intelligence and libraries: Import, risks and prospects. *Journal of ICT Development Applications and Research*, *6*(2), 30–40. https://doi.org/10.47524/jictdar.v6i2.31

Orubebe, E. D., Oloniruha, E. A., & Oladokun, B. D. (2024). Adopting and utilizing artificial intelligence in academic libraries: Challenges and opportunities in developed and developing nations. *International Journal of Knowledge Content Development & Technology*, 8(5), https://ijkcdt.net/xml/42717/42717.pdf

Orubebe, E. D., Oloniruha, E. A., & Oladokun, B. D. (2024). Adopting and utilizing artificial intelligence in academic libraries: Challenges and opportunities in developed and developing nations. *International Journal of Knowledge Content Development & Technology*, 8(5), 15-28. https://ijkcdt.net/xml/42717/42717.pdf

Sahoo, M. (2024). *Ethics in AI – Critical Skills for the New World*. https://doi.org/10.2118/222249-ms

Shahzad, K., Shakeel Ahmad Khan, Iqbal, A., & Muhammed, A. (2024). Identifying university librarians' readiness to adopt artificial intelligence (AI) for innovative learning experiences and smart library services: an empirical investigation. *Global Knowledge, Memory, and Communication*. https://doi.org/10.1108/gkmc-12-2023-0496

Shawky, S., Park Thaichon, Q., S., & Lars-Erik Casper Ferm. (2023). Ethical Issues of Artificial Intelligence (AI). *Advances in Human and Social Aspects of Technology Book Series*, 283–300. https://doi.org/10.4018/978-1-6684-9591-9.ch013

Solaimani, S., & Swaak, L. (2022). Critical Success Factors in a Multi-Stage Adoption of Artificial Intelligence: A Necessary Condition Analysis. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4234144

Sukumar, R. (2025). Building Secure and Ethical AI Systems: A Comprehensive Guide. *International Journal of Scientific Research in Computer Science Engineering and Information Technology*, *11*(1), 777–785. https://doi.org/10.32628/CSEIT25111283

Suleiman, Y. (2024). Adoption Of Ai-Based Library Services: A Necessity for Nigerian Universities. *Lagos Journal of Contemporary Studies in Education*, *2*(02), 288–303. https://doi.org/10.36349/lajocse.2024.v02i02.022

Tsekea, S., & Mandoga, E. (2025). The ethics of artificial intelligence use in university libraries in Zimbabwe. *Frontiers in Research Metrics and Analytics*, *9*. https://doi.org/10.3389/frma.2024.1522423

Vatankhah S., V. Bamshad, H. E. Arici, & Duan, Y. (2024). Ethical implementation of artificial intelligence in the service industries. *Service Industries Journal*, *44*(9-10), 661–685. https://doi.org/10.1080/02642069.2024.2359077**references in Federal University Lokoja.**

Integrating the Internet of Things (IoT) towards Enhancing Operational Efficiency and User Satisfaction in Academic Libraries

By

Abubakar, Usman[1], Nura Mohammed Musa[2] and Dr. Shehu. U. Mabera[3]
College Library, Federal College of Education, Odugbo, Benue State
usmania2018@gmail.com[1], nuramusam@gmail.com2 and sumabera@gmail.com[3]
+2348034610338[1], +2347068832685[2] and +2348060001519[3]

Abstract

This paper examined the integration of the Internet of Things (IoT) towards enhancing operational efficiency and user satisfaction in academic libraries. The integration of the Internet of Things (IoT) in academic libraries has the potential to greatly enhance operational efficiency and user satisfaction. By leveraging IoT devices and technology, academic libraries can streamline processes, automate routine tasks, and improve the overall user experience. This conceptual review explored the IoT technologies available in academic libraries, IoT applications and areas of use in academic libraries, the benefits and the challenges of integrating IoT in academic libraries. Through this review, it is evident that implementing IoT in academic libraries can greatly benefit both library staff and users, leading to improved operational efficiency and increased user satisfaction. The paper also provided insights and recommendations for maximizing IoT full potential in academic libraries by prioritizing investments in IoT technologies in order to facilitate real time access to information. Strengthening these capabilities not only enhances user convenience but also supports efficient resource retrieval, thereby improving overall user satisfaction.

Keywords: Academic Libraries, IoT, Operational Efficiency, User Satisfaction

Introduction

Internet of things (IoT) is a new revolution of the Internet that is rapidly gathering momentum driven by the advancements in sensor networks, mobile devices, wireless communications, networking and cloud technologies (Suresh and Kiran, 2022). They are interrelated networks that allow devices to receive and send data with each other via Internet. Liang (2018) defined IoT as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual 'Things' have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network.

The rapid development of the IoT have greatly impacted the way academic libraries operate and provide access to information towards ensuring user satisfaction. With the advancement of this technology, academic libraries are increasingly enabling users to remotely access a wide range of distributed information resources. This means that users can access information from various sources without having to consider the physical location of the storage (Xu & Du, 2019). This has greatly expanded the scope of information that is available to users, making it easier for them to find and access the information they need.

The academic library is an important academic unit in higher education because it provides information in various formats to support the teaching, learning and research objectives of the parent institution. Omeluzor et al., (2017) posited that the academic library is an established and organised arm of an institution with a clear mandate of providing relevant and up-to-date library collections that meet the information need of users. The aim of an academic library is to acquire information resources in different formats, in various fields of human knowledge and to process, organise, disseminate and provide access to them. The information resources in the library are in both print and non-print formats. Information in print format include books, maps, theses, journals, conference papers, handbooks, dictionaries to mention but a few, while information in non-print format include online databases, e-books, e- journal and those on the website and other digital storage media (Grigar & Pisarski, 2024). These resources are rendered to library users on demand to satisfy their information need.

User satisfaction has been a major concern for academic libraries for many years because it goes a long way to explain and justify the significance of the library. Users' satisfaction with academic libraries is a complex and multifaceted concept that is influenced by a variety of factors, including the usability and design of the library's website or platform, the availability and relevance of resources, and the quality of the search and discovery tools. According to Boakye et al. (2022), user satisfaction is an exercise to assess the quality of a service or a product to determine whether it meets the user's expectations or not. Younus and Hussain (2021) view user satisfaction as the feelings the users get after using the library resources and services and the decision made to either come back to the library next time they have information needs or not to come back. An academic library mainly exists to satisfy the information needs of its users and very pivotal in justifying the continued existence of the library and the need to commit more resources to the library.

The integration of IoT technology has also greatly enhanced the operational efficiency and library experience of users, providing them with more comprehensive access to information and greater reliability of services. According to Panda and Kaur (2023), operational efficiency in academic libraries refers to the

ability of the libraries to deliver high-quality services and resources to users while minimizing waste, reducing costs and optimizing resources. Fostering operational efficiency in academic libraries through IoT is crucial for improving resource allocation, and streamlining services. The mission of the academic library is the provision of quality services and information resources to satisfy the information needs of users. This can be achieved through the adoption and use of emerging technologies such as IoTs.

Massis (2016) described the IoT as being extremely beneficial to libraries in terms of saving staff time and improving patron service as it uses patron data to make tailored recommendations, all by collecting real-time data. The academic library serves as a resource and knowledge centre, essential to learning, teaching and scientific research in an academic institution, leveraging technologies that have shaped modern lives and the IoT as one of the many promising technologies that enhance quality information service delivery such as Referral services (RS), Current Awareness Services (CAS), Selective Dissemination of Information (SDI), Internet Services (IS), Interlibrary Loan Services (ILLS), Reference Services (RS), and Circulation Services (CS), (Agoh & Omekwu, 2021).

The possibilities of integrating IoT in academic libraries are almost endless. There is no denying that the IoT vast array of possibilities help in improving library operational efficiency and user satisfaction. However, obtaining literatures on IoT integration in library operational efficiency and user satisfaction in developing country academic libraries such as Nigeria proves abortive as there is currently no systematic and comprehensive review of recent research available in this area. As a result, this serves as justification for a conceptual review on the integration of the Internet of Things (IoT) towards enhancing operational efficiency and user satisfaction in academic libraries.

Concept of IoT

The IoT is a global technology of interrelated physical devices. The concepts of IoT refer to the use of Internet connected objects and systems to obtain data gathered by embedded sensors, actuators in machines and other physical objects (Mohammadi & Yegane, 2021). The term IoT was first coined by Kevin Ashton in 1999. Firstly, the term was introduced to describe how IoT was created by adding RFID and other sensors to everyday objects (Simões et al., 2019). It is made up of devices from simple sensors to smart phones and wearable connected to each other.

Patel and Patel (2016) defined IoT into three categories as: people to people; people to machine and things and machine and things; things and machine to things, and machine interacting through the Internet. The general idea of the IoT is that everyday objects, make themselves recognizable and they obtain intelligence by making or enabling context related decisions having an ability to communicate information about themselves. Pujar and Satyanarayana (2015) posited that it is called the IoT because of its connection to any object, which may include everything from the cell phones, cars, washing machines, air conditioners, lamps wearable device and almost anything else one can think of. Objects in the IoT platforms uses sensors and have networking capabilities that enables them to communicate with each other.

Chandrashekhar (2016) argued that information that is collected by the IoT devices goes through five phases of IoT lifecycle. Firstly, create phase, where devices or sensors collect information from the physical environment around them. The data from smart connected devices can be used to generate insights that can help businesses, customers and partners; secondly, communicate phase, where the data and events generated are sent through the network to the desired destination; thirdly, aggregate phase, where data collected are aggregated by devices itself; fourthly, analyse phase, where, upon further sophisticated analytics the aggregated data can be used to generate basic patterns, control and optimize processes and finally, act phase, where suitable actions are performed based on the information created.

IoT Technologies Available in Academic Libraries

There are not many existing descriptions of IoT technology that is used solely by academic libraries, but a search of the literature and network resources revealed some intriguing initiatives, which include:

Wireless Sensor Network

This remote sensing application uses low-power integrated circuits and wireless communications. A sensor network comprises many intelligent sensors that are used for collecting, processing, analysing and disseminating valuable information gathered in various environments (Kaladhar & Raoz, 2017). This technology can be applied by academic libraries to track book locations and prevent theft.

Measure the Future

Measure the Future is a funded knight foundation project utilising IoT technologies for supporting space assessment. The project produces hardware and software solutions that provide a "Google Analytics-style" dashboard for a library building, the number of visits and time, what patrons browsed, and what parts of the library were busy, among others (Jasongriffey.net, 2022). It uses simple and inexpensive sensors to collect data about invisible building usage. Making these hidden occurrences explicit will allow librarians to make strategic decisions for more efficient and practical experiences for their patrons. Academic libraries can use it to track metrics such as library visits, programme attendance and digital resource usage to understand user behavior and preferences.

Beacon

This IoT device combines a Smartphone app and a transmitter to provide location-specific information and updates tailored to individual patrons (Sheeja & Mathew, 2019). Academic libraries can use it for event announcements, and item recommendations. For example, Bluu Beam which is an application based on ibeacon technology, commonly used in extended reality programmes. The Blu Beam is a mobile application that sends location trigger information to mobile devices of library clientele to assist them in searching for resources that match their interest. It also sends alerts about library offers and events to users. According to the company's founder, Bluu Beam is used in about 30 other libraries in the United States (Zhang et al., 2021).

Magic Mirror

This is an application technology that has been added throughout the library to sense what title the user is holding, recommend other library materials, mention related events, and give a sneak peek into books (Shah & Bano, 2020). It consists of a smart camera, sensor, and Wi-Fi-enabled interaction between people and computers that saves the information from user reviews in the database. Nag and Nikam (2016) conclude that this system will quickly find its way into daily library use. Academic libraries can use the Magic Mirror for resource promotion by showcasing library resources such as new book releases, bestsellers or databases.

Cloud Computing

Cloud computing is a catch-all term for delivering hosted services over the Internet rather than directly accessing them from a desktop or internal server (Shah & Bano, 2020). It is made up of a super storage capacity that acts as the central nervous system of the "brain" of the IoT in computing and storage capacity. IoT sensors and Internet operators exchange data with the cloud via network lines and computer terminals to provide data to the cloud and receive technical services from the cloud (Zhang et al., 2021). It provides computing services such as servers, storage, databases, networking, software, analytics, and intelligence via the Internet cloud to enable faster innovation and more flexible resources. Academic libraries may also use cloud computing to store all their catalogue entries, which can then be harvested automatically by other libraries in the same way that Mendeley harvests citations.

Radio-Frequency Identification (RFID)

RFID is part of a group of technologies known as Automatic Identification and Data Capture (AIDC), which automatically identifies objects, collect data about them and enters that data directly into computer systems, with little or no human intervention (American Barcode and RFID, 2022) American Barcode and RFID (2022) further reiterated that, at a simple level, RFID systems consist of three components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags contain an integrated circuit and antennas that transmit data to the RFID reader (also called an interrogator). The Reader then converts the radio waves to a more usable form of data. Information collected from the tags is transferred through a communications interface to a host computer system, where the data can be stored in a database and analysed later. Academic libraries can use the RFID for security, shelf and inventory management of their library collections.

IoT Applications in Academic Libraries

There are many potential areas identified by different researchers for the application of IoT in academic libraries. It can be used to track and trace library materials and promote self-check-outs. It can also be used for consulting and training, sharing of information, library marketing and promotion. The literature search shows the infinite possibilities of IoT application in academic libraries.

Academic Library Buildings

In IoT based library building can optimize the control of lighting, cooling and heating. It is also helpful for fire protection. Sheeja and Mathew (2019) proposed that IoT based buildings provide a clean and comfortable learning environment for readers. The intelligent fire and security systems can ensure the safety of personnel and buildings (Nie, 2017). IoT technology can be used for collecting data regarding the usage of printed and electronic resources, suitability of the building, the cleanliness of the restrooms and the movement of furniture in the most used areas of the library for study and research. It enables the users to know the current user denseness and accessibility of reader's cubicles, desktops and for printers. IoT enables librarians to know busy as well as less used space of the library. This will help the authorities to make strategic decisions regarding space management.

Personalized services

With the help of IoT, libraries can provide a number of personalized services. Wojcik (2016) explained that IoT can be used to deliver contextual hints and information about resources connected with current user interest. Mobile applications can be integrated with existing library systems. IoT would be able to communicate to a user about the commencement of new additions in his area of interest as well as related works. Users can receive notifications about their account status, about library events or search through catalogs.

Locating Books and other Materials
The misplacement of books is a burden for professionals. IoT book tracking facility is very helpful for searching books on the shelf and locating misplaced books. Sheeja and Mathew (2019) proposed an IoT based smart library system, which provides the luxury of fetching a book from its place with the assistance of an IoT based interconnected system using a Wi-Fi based Local Positioning System (LPS) and Near Field Communication (NFC) tags. NFC enabled smart phone authenticates a user along with his biometric fingerprint. LPS enables a user to trace a book and its exact location from Online Public Access Catalogue (OPAC) and to get the information on his smart phone. NFC scanners located at the library doors are triggered if an unissued book is taken out (Sheeja & Mathew, 2019). This system is helpful for the users and librarians to easily locate and issue books in large libraries.

Library orientation and Information Literacy
Library orientation programme ensures the familiarization of library resources, services and facilities to new members. IoT applications enhance the power of librarians in teaching users about library services using mobile applications, making virtual tours and exploring video contents. When users visit particular sections of a library, wireless devices recognize the users and play audio or video guiding the users on the various services in the library (Mohammadi & Yegane, 2018). IoT can be used for obtaining data on users by which library can customize several services.

Smart Circulation Control
IoT can give alert to users about their current holdings and overdue dates and fine details. Patrons can pay fine by online. Liang (2018) designed an IoT system for library materials management using Android based UHF mobile reader. It can be installed with library application software at the entrance of IoT system for efficiently managing library collections. It enables searching, self-help borrowing, returning and renewing library materials with Android mobile readers anytime and anywhere. Users are authenticated with an ID and password to log in to the system. The user interactive interface of the Android mobile reader helps the users to borrow/return books on their own.

Inventory Control
The library resources can be controlled by applying sensors on them. IoT enables academic libraries to easily trace library resources. Liang (2018) reviewed that IoT enables searching and finding mis-shelved/misplaced library materials within no time. Using RFID tags on library materials shelf, Android mobile readers read the tags' serial numbers, which are keys to the library database. A detailed list of materials available on the shelf is shown on the user interface of Android mobile reader. The misplaced books are highlighted and it will help reduce the amount of work involved in stock verification.

Areas of Use of the IoT Technologies in Academic Libraries
The areas of use of the IoT as identified by Bansal et al. (2018) include a virtual library and book tracking. It allows mobile app users to take a virtual library tour on their mobile devices. It also keep and track the availability of books on the respective shelves or check other resources regardless of location, thereby familiarizing new users with the library.

Technical and Reader Services
The Radio Frequency Identification Device (RFID) is an IoT technology that is used in academic libraries to aid data identification and tracking by attaching an RFID tag containing bibliographic information and transaction logs to each item in the acquisition department (Kaladhar & Rao, 2017). The circulating unit may use RFID to charge and discharge books by combining the library card with RFID tags. As a result, academic libraries will be able to notify users of overdue items and allow them to pay fines online. The study conducted by Kaladhar and Rao (2017) in India revealed that RFID helps academic libraries market library holdings more effectively by utilising IoT technologies to detect user behaviours in the library and transact data to help them locate books inside the library using RFID and Near Field Communication.

Availability of Various Machines
IoT assists patrons in the library in determining which Personal Computers (PCs), printers, photocopiers, and scanners among others are available within the library building. The study conducted by Eiriemiokhale & Olutola (2023) on the application of IoT for quality service delivery in Nigerian university libraries revealed that IoT helps users find available seats in common reading areas, discussion rooms, meeting rooms, research scholar's cabins, and faculty rooms all of which are quick to check from patron's phones as they enter the library.

Inventory Control
Besides books, journals and magazines, various other library sources, such as microfiche, video and audio can also be controlled by applying sensors. It provides all the real-time data on the mobile of the librarian. According to Bansal et al. (2018), better inventory control can assist the library personnel in doing less stock verification work.

Theft Management
With tags on each item of the library inventory (scanners, printers, hard disks, and CDs), library collection can be tracked at all-time to prevent theft from the library gate using high-end sensors and transponders, which, apart from signaling the authorities on their mobiles or by loud alarm, can also block the theft by taking automatic prompt action like shutting the door (Bansal et al., 2018). It also lets the library staff remotely see camera views of their homes and sends a warning when something is not suitable for emergency service for people to take action.

Circulation Desk
The circulation desk in libraries involves activities such as issuing and return of books and other library material, maintaining records, creating and updating library cards and overdue reminders among others. IoT enables demanding users receive notifications of returned books using RFID (Purnik, 2019). In the case of e-books, the required book will be issued automatically as the computers at the desk can provide options for their needs and take action accordingly. Users can also use library Smartphone applications to locate resources, reserve books and research spaces, follow library events, and participate in user education initiatives (Kerr & Pennington, 2018).

User Identification
The sensors at the library gate can do face recognition of all visitors and will match the face with the available databases. Then, the gate will allow only authorized users to enter. Otherwise, an electronic message will be sent to the librarian in charge, who can take action from a distance whether to open the door for the unknown face or not (Bansal et al., 2018).

Reservation of Books
One potential use of the IoT is that it enables the patron to search for the desired book from the Online Public Access Catalogue (OPAC) of the library available on the Internet through their Smartphone and also make reservations. The desired book available on the library's shelf uses sensors through a network to show its presence through a beep or may start flashing light for the librarian to quickly identify the required books to be issued to the patrons. This way, IoT helps in saving the human resources and time of both the librarians and the users (Bansal et al., 2018).

Fire Detection and Prevention
According to Bansal et al. (2018), suppose there is a fire in the library, and no one notices it, the fire detection devices will alarm and automatically send a message to the Fire Department responsible for taking action. This way, the Internet of Things (IoT) will help take action automatically at an early stage and prevent further damage.

Tracking the Movement of Resources and Inventory
IoT allow users to be categorized based on the criteria for accessing library resources. Some libraries offer access rights to faculties, students, staff, and regular and non-regular students. Bansal et al. (2018) argued that in case a book/magazine was wrongly issued to a non-authorized user; IoT makes tracking possible on the mobile of the librarian where the library resource is physically present inside or outside the library. With the Internet of Things (IoT), it is possible to track the location of the inventory outside the library.

Internet of Things (IoT) and User Satisfaction in Academic Libraries
Integrating the IoT in academic libraries can significantly enhance user satisfaction by improving real-time access, providing more personalized services, improving operational efficiency and offering a more interactive environment. By leveraging the IoT technologies, academic libraries can automate tasks, track resources, monitor user activity, and personalize services, ultimately leading to a better overall experience and satisfaction of library users.

IoT Technologies and Real-Time Access
Patel and Sharma (2019) discovered that IoT technologies significantly improved user satisfaction by providing real-time access to information and automating routine tasks. Libraries reported increased user satisfaction due to these enhancements. Similarly, Wilson and Lee (2018) noted that IoT technologies positively impacted user engagement by offering real-time information, which increased user visits and interactions with library resources.

Efficiency and Personalized Services
Bansal and Singh (2018) highlighted the convenience and efficiency of IoT enabled services, though the researchers also pointed out concerns about data privacy, underscoring the need for robust security measures. Kumar and Verma (2020) observed that users reported positive experiences with smart library systems, citing improved access to resources and personalized recommendations as key benefits. These findings are echoed by Kaur and Gill (2021), who demonstrated that IoT-enabled services significantly enhanced user satisfaction due to their efficiency and personalized nature.

Operational Efficiency
IoT integration has also been associated with increased operational efficiency. Jain and Singh (2017) recognised that the integration of IoT in libraries resulted in better service delivery and enhanced user satisfaction, recommending further investment in IoT infrastructure to sustain these benefits. Venugopal, K. (2024) found that IoT technologies created more efficient and user-friendly library spaces, improving overall user satisfaction and engagement.

Benefits of the Internet of Things (IoT) to Academic Libraries
Academic libraries, in addition to classrooms, play an essential role in the learning process. In a study conducted by Hussain (2019) in Islamabad, Pakistan revealed that formerly, students borrowed books, went to the library, and copied information for class work but with the advent of the IoT, students now do the same thing via their smartphones, which connect them with librarians to aid strategic academic decisions. Even though the IoT is still in its early stages, it has enormous potential for academic libraries. The study conducted by Pujar and Satyanarayana (2015) in India revealed that IoT provides more value in addition to its services. It provides patrons with a rich library experience, as the IoT is all about connecting objects uniquely identifiable to each other online. Pujar and Satyanarayana (2015) further stated that, since libraries have books, journals, CDs/DVDs, theses, and many other physical objects, the IoT can be a Godsend in overcoming some of the perennial library problems, such as object misplacement and usage. In addition, the IoT can make it easier to access academic libraries and their resources. Most academic libraries provide their members with a virtual library card, which allows them to gain access to the library and its resources. When a user accesses the library catalogue to find the help they need, the library app on their mobile device displays a library map, guiding the user to the resources (Mohammed &Yegane, 2018).

Challenges of the Integrating of IoT in Academic Libraries
The IoT no doubt is a potent technology that will change the service structure and pattern of academic libraries in the coming years. However researchers have identified a number of issues as possible challengers that libraries will face in adopting this novel technology. Bansal et al. (2018) and Echedom et al. (2020) identified the following possible challenges in the application of IoT in library services:
Privacy and Security: The privacy of patrons' document is under serious treat since IoT has a possibility of having access to connected and enabled devices, which could lead to hacking. Users may be uncomfortable with the amount of personal information collected by IoT devices and the potential for misuse or unauthorized access. According to Echedom and Kakiri (2021), implementing privacy preserving measures such as data anonymization, consent management, and transparent data practices is crucial to address these concerns.
Budget Cut and High Cost of IoT Installation: With the problem of budget cost confronting a number of libraries and the increase in the price of ICT enabled devices and network services, most academic libraries may not be able to provide adequate fund to cater for the establishment of IoT enabled library services (Echedom et al., 2020). In addition, since IoT is a progressive innovation most academic libraries may not be able to cope with the evolving trends in the IoT infrastructure, given that IoT requires time and technically competent manpower.
Technology Inclined Users/User Training: The use of IoT will require users who are technology inclined to be able to utilise adequately the resources and services of IoT, otherwise the whole essence of establishing IoT will be an exercise in futility (Bansal et al., 2018). Hence, budgetary provisions should be made for continuous training and re-training of users owing to the ever evolving nature of IoTs. This training will also involve the library staff due to the ever changing nature of IoT.
Decline in the use of Physical Manpower and Library: Since IoT is technology based, the services previously done by humans can be taken over by Robots or machines with inbuilt routine service intelligence and this may lead to progressive downsizing of human's (professional and para- professional librarians) working in the library (Echedom et al., 2020). Similarly, since most resources can be retrieved through network enabled devices and appliance, most library users may not need to visit the library physically, as these resources can be access just anywhere within the network.

Conclusion
In conclusion, academic libraries are always at the forefront in adapting new technologies. By integrating the IoT, academic libraries can significantly enhance user satisfaction by improving real-time access, providing more personalized services, improving operational efficiency and offering a more interactive environment. There are many challenges encountered by academic libraries in the application of IoT technologies ranging from privacy and security, budget cut and high cost of IoT installation to decline in the use of physical manpower and library. As such, academic libraries should explore new IoT applications and technologies and develop strategies to address these challenges.

Recommendations
1. Academic libraries should prioritize robust measures to safeguard user data and ensure privacy. Implementing stringent security protocols and transparent data handling practices can help build trust among users and mitigate concerns related to privacy issues. Moreover, investing in

comprehensive user training programs is crucial. Educating both staff and users on how to effectively utilise IoT functionalities can maximize the benefits of these technologies, ultimately enhancing user satisfaction.

2. Academic libraries should provide training to library staff and users by organising conferences, seminars and symposia to ensure they are equipped to effectively utilise IoT technologies. Ensuring that both library staff and users are well-versed in using IoT-enabled services is crucial for achieving high levels of satisfaction.
3. Academic libraries should prioritize investments in IoT technologies that facilitate real time access to information. Strengthening these capabilities not only enhances user convenience but also supports efficient resource retrieval, thereby improving overall user satisfaction. Additionally, focusing on enhancing operational efficiency and personalized services is essential.

References

Agoh, J. A. & Omekwu, C. O. (2021). Library and information services delivery and researchers' scholarly communication outputs in agricultural research institutes in North-central, Nigeria, *International Journal of Library and Information Science Studies,* 7(1), 9-24.

American Barcode and RFID (2022). What is RFID, and how does RFID work? AB&R. Retrieved from https://www.abr.com/what-isrfid-how-does-rfid-work.

Bansal, A., Arora, D. & Suri, A. (2018). Internet of things: Beginning of new era for libraries. *Library Philosophy and Practice (e-journal).* Retrieved from http://digitalcommons.unl.edu/libphilprac/2081.

Bansal, M., & Singh, K. (2018). User perception of IoT-enabled services in Indian academic libraries. *Journal of Library & Information Technology*, 38(4), 256-270.

Boakye, S. A., Boakye, B. & Kuffour Adjei, K. O. (2022). User satisfaction with resources and services of Kumasi Technical University Library during the COVID-19 pandemic. *Ghana Library Journal,* 27(1), 45-59.

Chandrashekhar, K. (2016). Internet of things (IoT) characteristics. Available at http://linkedin.com/pulse/internet-things-oit-charateristics-kavyahree-g-c.

Echedom, A. U. & Kakiri, I. F. (2021). Prospects and challenges of internet of things application in library services.

Echedom, A. U. Kakiri, I. F. & Oyadonghan, J. C. (2020). Internet of things: Application and challenges in libraries. Paper presented at the International conference on next generation libraries, December, 2020 at National Institute of Technology, Rourkela, India.

Eiriemiokhale, K. A. & Olutola, J. B. (2023). Application of the internet of things for quality service delivery in Nigerian university libraries. *Indian Journal of Information Sources and Services*, 13(1), 17-25.

Grigar, D. & Pisarski, M. (2024). The challenges of born-digital fiction: editions, translations, and emulations. Elements in digital literary studies.

Hussain, A. (2019). Role of Internet of Things (IoT) in library services. Retrieved from https://dailytimes.com.pk/488476/role-of Internet of Things (IoT)-in-library-services.

Jain, R. & Singh, A. (2017). Enhancing library services with IoT: An Indian perspective. *SRELS Journal of Information Management*, 54(6), 367-379.

Jasongriffey.net. (2022). Measure the future: Nex-Gen uses metrics for libraries. Retrieved from http://jasongriffey.net/mtf/homepage /feed/index.html.

Kaladhar, A. & Rao, S. K. (2017). Internet of things: A route to smart libraries. *Journal of Advancement of Libraries*, 04(01), 29-34.

Kerr, A. & Pennington, D. R. (2018). Public library mobile apps in Scotland: Views from the local authorities and the public. *Library Hi Tech*, 36(2), 237–251.

Kumar, S., & Verma, P. (2020). Smart libraries in India: A study on user experience with IoT integration. *DESIDOC Journal of Library & Information Technology*, 40(5), 376-388.

Liang, X. (2018). Internet of things and its applications in libraries: A literature review. *Library Hi Tech*. Available at https:// doi.org/10.1108/LHT-01-2018-0014.

Massis, B. (2016). The internet of things and its impact on the library. *New Library World*, 117, 289-292. Retrieved from https://www.emerald.com/insight/content/doi/10.1108/NLW-12-2015 - 0093/full/html.

Mohammadi, M. & Yegane, M. (2018). Internet of Things (IoT): Applied new technology in academic libraries. *International Conference on Distributed Computing and High-Performance Computing (DCHPC2018),* 1-22.

Nag, A. & Nikam, K. (2016). Internet of things application in academic libraries. International *Journal of Information Technology and Library Science*, 05(01), 01-07.

Nie, W. (2017). The application of internet of things in the university library. In 2016 7th International Conference on Education, Management, Computer and Medicine (EMCM 2016). Atlantis Press,

24-27.
Panda, S. & Kaur, N. (2023). Enhancing user experience and accessibility in digital libraries through emerging technologies. International symposium on digital libraries: Sustainable development in education at: IIT Kharagpur, West Bengal, India.
Patel, K. K. & Patel, S. M. (2016). Internet of things- IOT: Definition, characteristics, architecture, enabling technology, application & future challenges. *International Journal of Engineering Science and Computing*, 6(5), 82-102.

Patel, P., & Sharma, R. (2019). IoT in Indian libraries: Enhancing user engagement. *Library Herald,* 57(3), 321-335.
Pujar, S. & Satyanarayana, K. V. (2015). Internet of things and libraries. Annals of library and information studies, 62 (86-190). Available at https://op.niscair.res.in/index.php/ALIS/articles/viewfile/9806/439.
Purnik, A. (2019). The internet of things serving libraries. Available at: http://www.ifla.org/noe/92356.
Shah, A. & Bano, R. (2020). Smart library: Need of 21st century. *Library Progress (International),* 40(1), 1-11. DOI: 10.5958/2320-31 7X.2020. 00001.X.
Sheeja, N. K. & Mathew, S. K. (2019). Internet of Things (IoT) in academic libraries. *12th International CALIBER*, 45-51.
Simões, D., Filipe, S. & Barbosa, B. (2019). An overview on IoT and its impact on marketing. *In Simões, D., Barbosa, B. & Filipe, S. (Eds). Smart Marketing with the Internet of Things* (pp. 1-20). Hershey: IGI Global.
Suresh, C. J. & Kiran, K. G. (2022). Impact of the internet of things on academic libraries and its users. *International Journal of Multidisciplinary Research and Development,* 9(8), 25-28.
Wilson, P. & Lee, M. (2018). The impact of IoT on library user engagement. *Library Hi Tech*, 36(4), 652-665.
Wojcik, M. (2016). Internet of things-potentials for libraries. *Library Hi-Tech,* 34(2), 404-420.
Xu, F. & Du, J. T. (2019). Examining differences and similarities between graduate and undergraduate students' user satisfaction with digital libraries. *The Journal of Academic Librarianship,* 45(6), 102-122.
Younus, M., & Hussain, M. (2021). Users' satisfaction with library resources and services in health sciences institutes in Punjab, Pakistan. *Library Philosophy and Practice (e-journal).* 6083. https://digitalcommons.unl.edu/libphilprac/608.
Zhang, J., Xu, J. & Wang, P. (2021). Smart libraries: Concept, development, and challenges. *Journal of Academic Librarianship*, 47(1), 102292.

Integration of Artificial Intelligence Technologies in Libraries for Inclusive Information Provision in a Changing World

Vincent C. Opara (CLN)
University library
David Umahi Federal University of Health Science, Ebonyi State, Nigeria
oparachima77@gmail.com, oparavc@dufhus.edu.ng
&
Doreen Ebelechukwu Omofomwan (CLN)
Federal Technical College Ahoada
Doreena32@gmail.com
&
Ikegwuiro Patience Uloaku
National Water Resources Institute, Kaduna
bankike2@gmail.com

Abstract

Artificial intelligence technologies are remarkable trends in the field of library and information science that comes with the capability to facilitate library routine, stimulate engagement, and offer participatory experiences for both librarians and library users. This article investigated the actual and potential implications of artificial intelligence technologies in libraries for inclusive information provision in a changing world. The researchers conducted a systematic literature review, collecting secondary data that aligns with the study's objectives from Google Scholar, Research Gate and Library Philosophy and Practice databases. The study revealed realistic advances to integrating AI technologies in library services to promote inclusive information provision. From the literature reviewed, there is a fast growing rate of the implementation of AI technologies in library services to provide information services for people from diverse works of life. The findings revealed that the impact of AI technologies for the promotion of inclusive information provision is very commendable. However, the integration of AI technologies is mired by inadequate librarians' expertise on how to use AI technologies to meet diverse users information needs, algorithm bias, data quality, security, intellectual and ethical implications. Ultimately, the research recommended that librarians and libraries should work with relevant information technology developers to ensure that AI technologies are more inclusive. Also, libraries should invest in training their staff on how to manipulate AI technologies to serve diverse learners in order to promote equity, diversity, and inclusion in information services.

Keywords*; AI Technologies, Changing World, Libraries, Integration, Inclusive Information,*

Introduction

The term “changing world” relates to the state of constant influx and increase in technological advancements, shifting global power dynamics, and evolving societal value transforming the way we live, work and interacts. The drivers of this change are technological advancements, globalization, demographic shifts and environmental concerns. More so, the development and growth of science, innovation and technologies have evolved over the years resulting to technological transformation of intelligent machines performing various human functions. Unlike any other age, the 21st century has witnessed a rapid advancement in technology, strengthening the landscape for smooth transiting into the 5th Industrial Revolution that is characterized by the full adoption of AI in various facets of human endeavour. As this advancement integrates into the society, an output of transition automatically set in, changing the way and manner institutions particularly libraries operate. This transformation extends library's role in providing socially and technologically inclusive information materials for all. As a result, libraries are expected to act in compliance to the changing world by integrating various useful and user-friendly AI technologies to support the different user's needs. According to Eiriemiokhale and sulyman (2023), libraries have been age long referred to be as bastions of knowledge and learning, serving as community hubs that provides access to information resources and services. In libraries AI technologies holds unprecedented opportunities. This is because AI technologies are transforming the way information is created, acquired access, processed, stored, organized and disseminated to diverse user communities. Therefore libraries are required to adapt to these changes in order to survive and remain relevant.

AI is as an aspect of computer science aims to create intelligent machines capable of performing tasks that imitates human-like cognitive abilities such as perception, logic, learning, decision-making, and language processing. UNESCO (2022) defined AI as machines that imitate some features of human intelligence, such as perception, learning, reasoning, problem-solving, language interaction and creative work. The essence of integrating AI technologies in libraries is important for several reasons. First, AI technologies have the potential to enhance library services, improve user experience and increase user's expectations. By integrating AI technologies, libraries can streamline their operations, automate routine tasks, and provide personalized services to clientele. Second, AI help to improve librarian's management of libraries vast

amount of collections and data available in digital forms which make it easier to organize, retrieve and disseminate information. It enables libraries to engage with new and developing technologies in order to stay informed of emerging trends in information managements and services.

Given these reasons analyses, libraries are not just to be aware of AI technologies, but to harness AI tools to provide an inclusive information provision. One of the implications of AI technologies on libraries is the function of providing inclusive information in this changing world. This is why weijia, (2022) noted that libraries are expected to adapt to the changing needs and expectations of patrons in the digital age. Of course, this requires that libraries should invest in new technologies such as AI and providing training and support to librarians to ensure they are equipped to navigate the complexities of the digital landscape (Enakrire & Oladokun, 2023). Consequently, failure to do so, risk the marginalized, underserved communities; who may not have access to the resources and services offered by libraries. Inclusive information therefore address the practice of providing information and access to data in way that considers and caters to the needs of all individuals regardless of abilities, backgrounds or circumstances ensuring everyone can access and utilise the information equally. According to Muhammed and Nwachukwu (2023), inclusive information address diverse members of community. It is an approach to providing information services where people with various disabilities and abnormalities can access, receive and share information in an equitable way. Providing a background to the need of libraries to do this, ALA bill of Rights state that "a person's right to use a library should not be denied or abridged because of origin, age, background or views (ALA, 1939) in Muhammed and Nwachukwu (2023). Chigwala and Chisita (2021), explained that current industrial age is changing and will continue to affect the way libraries and librarians conduct their daily activities in ensuring that the dynamic and diverse need of users are met.

Despite the high recognition of the importance of AI in library practice, there is a noticeable gap in existing literature. Several studies reveal that while some libraries have begun to incorporate AI into their services, many are still lagging (Adjei, 2023, Samah et al., 2020). There exists extensive literature on the impact of AI on various industries, while there is a lack of in-depth exploration into how AI technologies are improving libraries and librarian's provision of inclusive information. Existing studies have only covered the awareness, readiness, skills and competences required for utilizing AI in libraries. There is a notable absence of research that examines the integration of AI technologies in providing inclusive information, hence, the need for this study.

Finally, this gap in the literature is a pointer to the need for further research to address this critical issue. The outcome of this paper would not only contribute to our understanding of the evolving role of libraries in this changing world; characterized by unprecedented growth in technologies, but will provide valuable insight into AI technologies and impact of AI technologies in libraries in providing inclusive information. In doing this, this study will harvest and analyse relevant literature to fill this identified gap and provide a foundation for future research and practice in libraries.

Research objectives

1. To identify AI technologies that can promote inclusive information in libraries.
2. To assess the level of integration of AI technologies in libraries for inclusive information provision.
3. To know the impact of integrating AI technologies in libraries for inclusive information provision.
4. To identify challenges in integrating AI technologies in libraries for inclusive information provision.

Research questions

The following research questions served as a tool to refine the study's focus and guide the analysis of finding using systematic literature review (SLR). These questions were instrumental in filtering the research results and drawing relevant conclusions from the selected literature. By formulating a general research question and breaking it down into specific questions (Q1, Q2, Q3 and Q4), the study maintain a clear focus on various aspects. Table 1 outlines the proposed research questions for conducting the SLR and their respective purposes.

Table 1: research questions and their purposes

General questions	Specific research question	Purpose
What benefits does the integration of AI technologies in libraries for inclusive information provision have in this chang ing world of information technologies?	Q1: What are AI technologies that can promote inclusive information in libraries?	To identify and know the various AI technologies that can promote inclusive information in libraries.
	Q2: What is the level of integration of AI technologies in libraries for inclusive information provision?	To assess the current level of integration of AI technologies in libraries for inclusive information provision.

	Q3: What is the impact of integrating AI technologies in libraries for inclusive information provision?	To know the impact of integrating AI technologies in libraries for inclusive information provision.
	Q4: What are the challenges to integrating AI technologies in libraries for inclusive information provision?	To iden tify challenges to integrating AI technologies in libraries for inclusive information provision.

Methodology

The paper employed a qualitative research approach of systematic literature review. Articles published between 2019-2025 were considered for this exploration. Focusing on articles published within these six years window ensures that the review captures the most current trends, methodologies, and findings in the field. A systematic literature review is a rigorous research approach that involves following a specific review protocol and quality procedures to select relevant studies, extract information, and analyze data to answer specific research questions (Tjebane et al., 2022). This method has been widely used in various fields to explore different topics, including the use of technologies and library services.

For this research, the SLR was conducted by searching for literature sources through the journal databases of google scholar, library philosophy and practice, and researchGate. The SLR opened up the possibility of synthesizing the findings on integration of AI technologies in libraries and inclusive information provision. This becomes evident that a systematic approach is crucial for understanding the concepts.

Keywords and criteria used for research

Having established the research questions, we looked through journal databases selected for this study with the use of series of keywords that helped to gather enough information while keeping the research within the same field. For this research, the series of keywords used to filter the search results in each of the different journal databases selected were the following: ((“integration or adoption” AND (“AI technologies in libraries” OR “AI technologies for inclusive learning” AND “inclusive information provision”) AND (“5IR”) OR “changing world”)).

The keywords facilitated the sorting of literature retrieved from databases and the review of articles relevant to the study subject. However, for a more comprehensive understanding, additional criteria were employed to exclude articles not aligned with the research's objectives. Table 2 outlines the criteria used to refine the selection process.

Table 2: **Article Inclusion and Exclusion Criteria**

Criteria	Criterion description	Inclusion and exclusion status
Language	Articles written in English	Article is included
Year of publication	Articles published within 6 years	Article is included
Field	Articles that are related to AI and libraries	Article is included
	Articles that are related to inclusive information and learning	Article is included
	Articles that are related to library services	Article is included
	Articles that are related to the 5IR	Article is included
Relevance of content	Articles on AI technologies that can promote inclusive information in libraries	Article are included
	Articles that talks about the level and impact of integrating AI technologies in libraries for inclusive information provision	Article is included
	The articles that talks about the challenges to integrating AI technologies in libraries services with reference to inclusive information provision	Article is included

After applying these criteria, a series of articles were collected. The number of articles found in each database searched is shown below;

Table 3: **Number of Articles Found in Each Journal Database Searched**

Journal database	Number of article
Google Scholar	13
ResearchGate	8
Library Philosophy and Practice	4
Total	25

Result and discussion

The data collected for this SLR created a better understanding of objectives of this study. Through a comprehensive analysis of existing studies, this SLR uncovered valuable insights into AI technologies that can promote inclusive information in libraries, the current level of integration of AI technologies in libraries for inclusive information provision, the impact of integrating AI technologies in libraries for inclusive information provision and the challenges to integrating AI technologies in libraries for inclusive information provision. The analysis and answers to the questions are represented in the following sections of this paper.

AI technologies that can promote inclusive information in libraries

The emergence of AI technologies in various works of life including library have necessitated its adoption, integration and application to solve problems and aid solution. The adoption of AI technology can provide personalized recommendations, automate routine tasks, enable data-driven decision-making and promote inclusive information services. Generally, AI has gone through periods and can be divided into two types: general AI, which aims to match human intelligence, and narrow AI, which is limited to specific domains (House of Lords Select Committee on Artificial Intelligence, 2019). As AI technologies become more sophisticated and

accessible, libraries are expected to leverage AI to address diverse learning needs and create more inclusive learning environments (Alam, 2021; Pham & Sampson, 2022; Rane, Choudhary & Rane, 2023).

A study by Williams (2019) discussed how AI technologies like personal assistants such as Siri, Alexa, Cortana, and Google Assistant have changed how people expect to get answers to their questions. As a result, users' expectations for database search functions have changed, and they expect databases to know and understand what they are searching for. However, AI personal assistants can have limitations. To convince researchers to use databases, librarians need to emphasize the value and legitimacy of information found in them and continue to provide training on effective search strategies.

Shelton (2019) identified the use of robotic AI, and machine learning (ML) on libraries and professions. He said that the Fourth Industrial Revolution driven by AI, robots, and connectivity. He highlighted the disruptive potential they pose to libraries and the extent it expanded the services of librarians. More so, he discussed the benefits of robots and AI in libraries, such as robotic retrieval systems and AI-powered chat services.

A study by Wei (2019) study on the Application of Virtual Reality Technology in Medical University Libraries in the Era of Artificial Intelligence provided a comprehensive overview of the research on virtual reality technology and it application in medical university libraries. The paper explored the impact of virtual reality technology on collection resource construction, knowledge management, cultural heritage preservation, and reader service. The paper offers valuable insights into the potential benefits and difficulties of integrating virtual reality technology in libraries, making it a valuable resource for researchers. Eneh and Idiodi (2023) pointed that the use of artificial intelligence in virtual reference services is thought to offer libraries a new online service paradigm. They identified some of the legitimate innovations that librarians are continually utilising to engage and improve services for their consumers which include virtual realities, which help users become more information literate.

More so, Morriello (2020) in his research on three main technological evolutions: The Internet of Things (IoT), Blockchain, and Artificial Intelligence (AI). The study explains the development, importance and applications of these technologies in the library. The research cited its practicability in Italy for various library activities such as cataloguing, collection development, information literacy, scientific communication, and academic librarianship.

Ţundrea et al. (2020) describe web client application for library management that utilises artificial intelligence (AI) and machine learning (ML) technologies to meet the needs of library patrons without discrimination. The goal of the application is to simplify the process of print and non-print resources and to make the work of library staff easier through various functionalities such as searching for users or books using QR codes while promoting inclusive library services. Integrating AI and ML technologies in the application opens up new opportunities, allowing librarians to analyse readers' individual information need, create a more automated system of recommendations, and acquire new books of interest to readers.

Mallikarjuna, (2024) identified four AI tools which are: **Google Cloud Vision, Unpaywall, Semantico** and **Overleaf**

Google Cloud Vision : it is to automate, digitising and indexing historical documents. The tool uses AI-powered image recognition and OCR (Optical Character Recognition) to extract text and data from scanned documents.

Unpaywall: it is a browser extension that helps user's access scholarly articles that is freely available online. The tool uses AI to identify and locate open-access versions of articles, making it easier for researchers to access the needed resources.

Semantico: it is a publishing technology company that offers AI-powered solutions for academic publishers and libraries.

Overleaf: is an AI-powered tool that assist with document formatting, citation management, and manuscript editing tasks.

The level of integration of AI technologies in libraries for inclusive information provision

AI technologies hold the promise of transforming inclusive education and information provision by offering tailored support, flexible content, and groundbreaking tools that address diverse learning requirements (Adeleye et al., 2024). AI is reshaping the educational landscape, from smart tutoring platforms to assistive technologies, providing innovative solutions to persistent challenges in libraries ensuring inclusive learning opportunities. Current research on AI in inclusive education demonstrates an increasing focus on harnessing these technologies to foster equal education and accessibility of information. Investigations have probed AI applications in areas such as individualized learning, adaptive evaluation, and supportive tools for students with disabilities (Shivani et al., 2024).

AI influence on teaching and learning environments such as higher institutions and libraries have been substantial. AI technologies have paved the way for intelligent tutoring systems (ITS) that deliver personalized instruction and feedback, sometimes matching the efficacy of human tutors (Mohammed & Watson, 2019). These systems have demonstrated particular efficacy in supporting learners with special educational needs, offering customized assistance and modifications to accommodate various disabilities (Shivani et al., 2024).

Furthermore, AI has facilitated the creation of advanced assistive technologies that enhance accessibility for students with disabilities. For example, AI-driven speech recognition and text-to-speech technologies have transformed learning experiences for students with visual impairments or dyslexia (Garg & Sharma, 2020). AI algorithms have also been utilized in developing augmented and virtual reality applications, providing immersive and interactive learning experiences for a wide range of learners (UNESCO, 2019).

A study carried out by Samah et al. (2020) showed that Malaysian research-support exhibit a medium level of AI integration, indicating a baseline understanding and adoption of AI technologies in library services. Similarly, Ali et al. (2020) identified librarians have a working knowledge of AI with high tendencies of smooth applications to foster library services. However, a recent survey carried out by Research Planning and Review Committee (2022), indicated that about 80% of research libraries including librarians are exploring the use of AI and machine learning.

More so, there is a growing interest and optimism among librarians and libraries towards the integration of AI for diverse and inclusive provision of information, position libraries as early adopters of AI technologies (Lund et al., 2020). This align with the notion of Adeleye, Eden & Adeniyi, (2024) that AI improve Personalized information and learning, a pedagogical approach that customizes instruction to meet individual student needs and preferences which support the fundamentals of inclusive library services. Ali et al. (2020), study on the application of artificial intelligence in university libraries in Pakistan emphasized the potential benefits of integrating AI for libraries to support all kinds of researcher.

While there is the recognition of the integrating level of AI technologies in libraries, there is need to emphasis the impact, it will have on promoting library services across all social classes in the society. In the light of these findings, it is evident that libraries and librarians are aware and at the forefront of promoting the integrating of AI technologies to facilitate library operations. Nevertheless, there is room for more integration and development to ensure inclusive provision of information provision.

The impact of integrating AI technologies in libraries for inclusive information provision

The integration of Artificial Intelligence (AI) and its affiliate technologies into library services marks a new chapter in the pursuit of inclusive and tailored information provision. The breakthroughs in machine learning, natural language processing, and data analytics have propelled the swift expansion of AI applications in information science. The 21st century, predominately the wake of 5IR has witnessed the advent of AI-powered adaptive learning platforms that offer bespoke library services and library experiences customized to each user unique information needs (Eneh & Idiodi, 2024). These systems

scrutinize extensively users' data to pinpoint knowledge gaps and deliver targeted interventions, fostering inclusivity by catering to diverse learning requirements. AI-facilitated personalized learning has the potential to foster inclusivity by providing all students and researchers, regardless of background or abilities, access to high-quality, individualized instruction (Adeleye, Eden & Adeniyi, 2024). By addressing specific learning needs and preferences, this approach can boost engagement, motivation, and academic performance.

Cox and Mazumdar (2022), provided a conceptual exploration of artificial intelligence for librarians from a strategic perspective, which can be valuable in understanding how AI may Impact librarianship as a profession. Adeleke, et. al., (2024), Alamri, et. al., (2020) and Odonkor, et. al., (2024) affirm that the integration of AI technologies promote Personalized learning approach that aims to tailor query to meet individual needs and preferences of each user. Their research maintained that students, researcher and library users have different learning styles, interests, and abilities, and seeks to provide them with learning experiences that are meaningful, relevant, and engaging. The principles of AI personalized information describe that users query are tailored to each user unique needs, interests, and learning styles. Users have the flexibility to retrieve information and learn at their own pace and in ways that work best for them. Users can receive personalized support and feedback from librarians to help them achieve their information needs and goals.

Salas-Pilco, Xiao and Oshima (2022) in their research identified six categories of AI and new technologies that have been used in inclusive education for minority students. The findings revealed that AI improved student performance, encouraged student interest in STEM, promoted student engagement amongst others. The impact of the integration of AI in academic libraries have enhanced user experience through; Improved efficiency by automating routine tasks like cataloging and data management, Data analysis for informed decision-making and collection development, AI-powered content creation and curation for better discoverability and accessibility, predictive analytics to anticipate user needs and trends, text and data mining for research trend analysis and evidence-based decision-making, accessibility for users with disabilities through AI-powered tools, digital preservation automation for long-term resource accessibility, collaboration and knowledge sharing through AI-powered chatbots and recommendation systems, Improved accuracy and efficiency in searching, retrieval of information, competitive advantage, cost-effectiveness, and adaptability for future-proofing and social impact (Zubiri-Esnaola, et. al., 2020; Su & Zou, 2022; Jarrahi, et. al., 2023; Oguejiofor, et. al., 2023; Akindote, et. al., 2023,;Anyanwu, et. al., 2023).

The Thalaya and Puritat (2022) study aimed to apply AI technology to raise the calibre of library services and increase user happiness. The trial results showed that employing AI to respond to queries regarding book locations, opening times, and other pertinent information saved the librarian's time and enhanced the management of library services. The satisfaction survey findings revealed an increase of 0.45% among nursing students and instructors, which improved library service management. In the future, AI technology will help users be more satisfied with the library's services.

Wheatley et al. (2019) also discussed the impact of AI in academic libraries, particularly in improving efficiency and enhancing diverse user's experiences. The authors emphasized the need for organizations particularly libraries to invest in developing employees' skills and competencies to adapt to changing technologies and remain relevant.

The challenges of integrating AI technologies in libraries for inclusive information provision

The emergence of AI technologies and it application in library services especially for inclusive information is not without integration challenges. Ajani et al. (2022) investigated librarians' perceptions of academic libraries in Nigeria's awareness of and readiness for adopting artificial intelligence (AI) in their processes and offerings. The study discovered that there are significant issues that academic libraries in Nigeria encounter some of such are finance, a shortage of expertise, an unstable power supply, and constrained employee training and acquisition budgets. The report suggests allocating enough funds for acquiring AI technology and employing librarians with the necessary skills to work with the technology. In similar study by Ali et al., (2020), AI adoption in libraries are confronted with challenges related to funding and the lack of technological skills necessary for successful AI implementation. These challenges stem from various factor such as the technical complexity of implementing AI, the significant resources, and the requirement for new skills and competencies (Amzat & Adewojo, 2023).

One significant challenge faced by libraries is the need of librarians to develop skills to utilize technologies to provide services for people with disabilities (Horsefall & Opara, 2022). Lin et al. (2023) explores the role of artificial intelligence (AI) in transforming library services, specifically focusing on digital reading promotion. With the emergence of the era of great intelligence, libraries face challenges and opportunities for remodelling their services to suit the new development. Librarians need to integrate into the 5IR evolving socio-technical challenges and update their core professional competences

The efficacy of AI hinges on the analysis of library users' data, which raises substantial privacy and security concerns, particularly for vulnerable users' populations (OECD, 2024). Requiring that adopting AI technologies for inclusive information provision adopt “privacy-by-design” approach which can foster personalized learning systems. The algorithm bias, data quality and security, privacy and intellectual property rights, and ethical implications of AI in libraries pose a challenge that libraries need to address to promote inclusive library services.

Conclusion

The integration of AI technologies in libraries has and can transform the way information is provided to users. By leveraging AI powered tools and services, libraries can offer more individualized, efficient, and inclusive information provision, catering to the diverse needs of their users. As the world continues to evolve, it is important that libraries of the now should adopt and adapt to changing user needs and technological advancements such as AI powered tool which is very viable for libraries to stay ahead the curve, providing innovative solution for information discovery, access and delivery for people from diverse background. This can be done by investing in infrastructure, training and collaborative efforts with stakeholders such as the library and librarians, affiliate institutions and governments.

Recommendation

As modern libraries navigate the complexities of a changing world, embracing artificial intelligence in providing information services to diverse population can be a game- changer. This research therefore recommends that;

- Libraries should advocate for the use of AI technologies for improved library service and inclusive information provision such as the adoption and implement the use of AI-powered chatbots that provide 24/7 support to users.
- There is need for libraries and librarians to work with information technology personnel so as to make AI technologies more inclusive for diverse library users.
- There is need for libraries and library associations to create awareness on the benefits and importance of AI technologies for inclusive services.
- There is need for training and if need be retraining of staff to comply with new AI technologies that promote inclusive information provision.
- Libraries should make available infrastructure, equipment and funds to implement the integration of AI technologies for inclusive information provision.

References

Adeleke, A.K., Montero, D.J.P., Olajiga, O.K., Ani, E.C. & Olu-lawal, K.A., (2024). Evaluating the impact of precision engineering education on industry standards and practices. *International Journal of Science and Research Archive, 11(1), pp.2336-2345.*

Adeleye, O. O., Eden, C. A., & Adeniyi, I. S. (2024). Innovative teaching methodologies in the era of artificial intelligence: A review of inclusive educational practices. *World Journal of Advanced Engineering Technology and Sciences*, *11*(02), 069-079.

Al-Aamri, J., & Osman, N. E. (2022). The Role of Artificial Intelligence Abilities in Library Services. *The International Arab Journal of Information Technology*, *19*(3A), 566–573. https://doi.org/10.34028/iajit/19/3A/16

Adjei, N. D. (2023). The readiness in selected academic libraries towards the fourth industrial revolution: Comparative study between Ghana and South Africa.

Akindote, O.J., Adegbite, A.O., Dawodu, S.O., Omotosho, A. and Anyanwu, A., (2023). Innovation in data storage technologies: from cloud computing to edge computing. Cosmputer Science & IT Research Journal, 4(3), pp.273-299

Ali, M. Y., Naeem, S. B., Bhatti, R., & Richardson, J. (2022). Artificial intelligence application in university libraries of Pakistan: SWOT analysis and implications. *Global Knowledge, Memory and Communication*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/GKMC-12-2021-0203

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullahi, F. (2022). Perspectives of Librarians on Awareness and Readiness of Academic Libraries to Integrate Artificial Intelligence for Library Operations and Services in Nigeria. *Internet Reference Services Quarterly*, *26*(4), 213–230. https://doi.org/10.1080/10875301.2022.2086196

Alam, A. (2021, November). Possibilities and apprehensions in the landscape of artificial intelligence in education. *In 2021 International Conference on Computational Intelligence and Computing Applications (ICCICA) (pp. 1-8). IEEE.*

Alamri, H., Lowell, V., Watson, W., & Watson, S. L. (2020). Using personalized learning as an instructional approach to motivate learners in online higher education: Learner self-determination and intrinsic motivation. *Journal of Research on Technology in Education*, *52*(3), 322-352.

Amzat, O., & Adewojo, A. A. (2023). Metaverse-infused academic libraries: A glimpse into the future. *Library Hi Tech News, 40*(10). https;//doi.org/10.1108/ihtn-10-2023-0187

Anyanwu, A., Dawodu, S.O., Omotosho, A., Akindote, O.J. and Ewuga, S.K., 2023. Review of blockchain technology in government systems: Applications and impacts in the USA

Bond, M. & Bedenlier, S. (2019). Facilitating Student Engagement through Educational Technology: Towards A Conceptual Framework.J. *Interaction Media Education*. 1–14

Cox, A. & Mazumdar, S. (2022). Defining artificial intelligence for librarians. *Journal of*

librarianship and information science, 096100062211420. https://doi.org/10.1177/09610006221142029

Eiriemiokhale, K. A., & Sulyman, A.S. (2023). Awareness and perceptions of artificial intelligence among librarians in university libraries in Kwara State, Nigeria. *Indonesian Journal of Librarianship*, 107-118.

Enakrire, R. T., & Oladokun, B. D. (2023). Artificail intelligence as enabler of future library services: how prepared are librarians in African university libraries. *Library Hi Tech News.*

Garg, S., & Sharma, S. (2020). Impact of artificial intelligence in special need education to promote inclusive pedagogy. *International Journal of Information and Education Technology*, 10(7), 523-527.

Gupta, V. (2025), "From hype to strategy: navigating the reality of experimental strategic adoption of AI technologies in libraries", Reference Services Review, 53(1) pp. 1-14. https://doi.org/10.1108/RSR-08-2024-0042

Horsfall, M. & Opara, V. C. (2022). Availability of Information Resources for Visually Impaired Students in University Libraries in Nigeria: A Tool for Inclusive University Education. *International Journal of knowledge content and development*. 2(4).

Li, Danyang (2024). "Adoption of Artificial Intelligence in Public and Private Libraries of China: Determinants, Challenges, and Perceived Benefits". *Profesional de la información*, 33(4), e330416. https://doi.org/10.3145/epi.2024.ene.0416

Lin, X., Sun, Y., Zhang, Y., & R, K. M. (2023). Application of AI in Library Digital Reading Promotion Service. *2023 IEEE International Conference on Integrated Circuits and Communication Systems (ICICACS)*, 1–6. https://doi.org/10.1109/ICICACS57338.2023.10100096

Luca, E.; Narayan, B. & Cox, A. Artificial intelligence and robots for the library and information professions. *J. Australian Library and Information Association*, 2022, **71**(3), 185-88. https://doi.org/10.1080/24750158.2022.2104814.

Lund, Brady D.; Omame, Isaiah; Tijani, Solomon; Agbaji, Daniel. (2020). "Perceptions toward Artificial Intelligence among Academic Library Employees and Alignment with the Diffusion of Innovations' Adopter Categories". *College & Research Libraries,* 81(5), pp. 865. https://doi.org/10.5860/crl.81.5.865

Mallikarjuna, C. (2024). An analysis of integrating artificial intelligence in academic libraries. Journal of Library & Information Technology, 44(2), pp.124-129, https://doi.org/10.14429/djlit.44.02.18958

Morriello, R. (2019). Intelligenza artificiale e internet delle cose in biblioteca. *AIB studi*, *59*(1–2), Article 1–2. https://doi.org/10.2426/aibstudi-11927

Mohammed, P. S., & 'Nell'Watson, E. (2019). Towards inclusive education in the age of artificial intelligence: Perspectives, challenges, and opportunities. *Artificial Intelligence and Inclusive Education: Speculative futures and emerging practices*, 17-37.

Odonkor, B., Kaggwa, S., Uwaoma, P.U., Hassan, A.O. and Farayola, O.A., (2024). A review of US management accounting evolution: Investigating shifts in tools and methodologies in light of national business dynamics. *International Journal of Applied Research in Social Sciences, 6*(1), 51-72

Oguejiofor, B.B., Omotosho, A., Abioye, K.M., Alabi, A.M., Oguntoyinbo, F.N., Daraojimba, A.I. and Daraojimba, C., (2023). A review on data-driven regulatory compliance in Nigeria. *International Journal of applied research in social sciences, 5*(8), 231-243

Pham, S. T., & Sampson, P. M. (2022). The development of artificial intelligence in education: A review in context. *Journal of Computer Assisted Learning*, 38(5), 1408-1421.

Rane, N., Choudhary, S., & Rane, J. (2023). Education 4.0 and 5.0: Integrating Artificial Intelligence (AI) for personalized and adaptive learning. Available at SSRN 4638365.

Salas-Pilco, S. Z., Xiao, K. & Oshima, J. (2022). Artificial Intelligence and New Technologies in Inclusive Education for Minority Students: A Systematic Review. *Sustainability*, 14, 13572. https://doi.org/10.3390/su142013572

Samah, N., Talib, R., & Latif, A. (2020). Malaysian research-support librarians self-directed learning traits: Examining demographic differences and their relationship with competences. *Journal of Librarianship and Information Science,* 53(4), 630-644. https//doi.org/10.1177/096100062097072.

Shelton, S. D. (2019). Robots Stole My Job—AI and Robotics Libraries. *Computers in Libraries*, *39*(1), 22–27.

Shivani, Gupta, M., & Gupta, S. B. (2024). A Systematic Analysis of AI-Empowered Educational Tools Developed in India for Disabled People. *Information Technologies and Learning Tools,* 100(2), 199-215.

Subaveerapandiyan, A. (2023). Application of Artificial Intelligence (AI) In Libraries and Its Impact on Library Operations Review. *Library Philosophy and Practice (e-journal)*. 7828. https://digitalcommons.unl.edu/libphilprac/7828

Su, F., & Zou, D. (2022). Technology-enhanced collaborative language learning: theoretical foundations, technologies, and implications. *Computer Assisted Language Learning, 3*5(8), 1754-1788.

Thalaya, N., & Puritat, K. (2022). BCNPYLIB CHAT BOT: The artificial intelligence Chatbot for library services in college of nursing. *2022 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON)*, 247–251. https://doi.org/10.1109/ECTIDAMTNCON53731.2022.9720367

Tjebane, M., Musola, I., &Okoro, C. (2022). A systematic literature review of influencing and strategies of artificial intelligence adopting in the construction industry. *Iop Conference series materials Science and Engineering*. 1218(1), 012001. https://doi.org/10.1088/1757-899x/1218/1/012001.

Țundrea, E., Turcuț, F., & Fotea, S. L. (2020). Challenges and Opportunities When Integrating Artificial Intelligence in the Development of Library Management Systems. In S. L. Fotea, I. Ș. Fotea, & S. A. Văduva (Eds.), *Challenges and Opportunities to Develop Organizations Through Creativity, Technology and Ethics* (pp. 369–382). Springer International Publishing. https://doi.org/10.1007/978-3-030-43449-6_22

UNESCO. (2019). Artificial intelligence in education*: Challenges and opportunities for sustainable development*. UNESCO.

Wei, Q. (2019). Application of Virtual Reality Technology in Medical University Libraries in the Era of Artificial Intelligence. *Agricultural Library and Information*, *31*(8), 63–70. https://doi.org/10.13998/j.cnki.issn1002-1248.2019.08.19-0261

Williams-Dobosz, D.; Azevedo, R.F.L.; Jeng, A.; Thakkar, V.; Bhat, S.; Bosch, N.; Perry, M. (2021). A Social Network Analysis of Online Engagement for College Students Traditionally Underrepresented in STEM. In Proceedings of the LAK21: 11th International Learning Analytics and Knowledge Conference, Irvine CA: USA; pp. 207–215.

Wheatley, A. & Hervieux, S.(2019)Artificial intelligence in academic libraries: An environmental scan. *Information Services & Use*, **39**(4), 347-56. doi: 10.3233/isu-190065.

Zubiri-Esnaola, H., Vidu, A., Rios-Gonzalez, O., & Morla-Folch, T. (2020). Inclusivity, participation and collaboration: Learning in interactive groups. *Educational Research*, *62*(2), 162-180.

Weijia, G. U. O (2022). Influencing factors of artificial intelligence readiness in libraries. *Journal of Library and Information Science in Agriculture*, 34(5), 47.

Integration of Big Data Analytics for Fraud Detection in Nigerian Financial Institutions: A Case Study of Central Bank of Nigeria, Kano Branch

ESEW, Michael[1]; WHONG, Fidelia Mbowheing[1]; LARNYOH, Wilhemina[2] & OLUWATOBI Victor Ogunsemi[3]
1 Kashim Ibrahim Library, Ahmadu Bello University, Zaria
1yaw4mi@gmail.com + 234 802 572 6783
1fideliawhong@gmail.com +234 8035 9276 24
[2]University of Ghana, Accra City Campus DC 1, Dansoman Accra Ghana.
[3]Department of Library and Information Science, Ahmadu Bello University, Zaria

Abstract

This work examines the integration of big data analytics for fraud detection in Nigerian Financial Institutions using CBN Kano Branch as a Case Study. To achieve this, three research questions were raised in order to actualize the objectives of this study as follows; what types of Big Data Analytics Strategies are available in Central Bank of Nigeria (CBN), Kano Branch for Fraud Detection? How effective has big data analytics been integrated into the fraud detection framework at the Central Bank of Nigeria's Kano branch? and What are the key operational challenges encountered with the integration of big data analytics into the fraud detection framework at the Central Bank of Nigeria's Kano branch? The study used a quantitative approach with descriptive survey design, population of the study consists of 155 staff of CBN Kano Branch. Questionnaire was the instrument used for data collection. Findings of the study revealed that big data analytics significantly enhanced fraud detection capabilities by identifying anomalies and patterns indicative of fraudulent activities. However, it also highlights key operational challenges, including data privacy concerns, regulatory compliance issues, and the need for skilled data analysts. The findings further indicated that the effectiveness of big data analytics in fraud detection depends on data quality, timeliness, and the strength of analytical models used. The study concludes that big data analytics is a vital tool for improving fraud detection in Nigerian financial institutions, particularly at the Central Bank of Nigeria's Kano branch. The findings provide valuable insights into operational dynamics, regulatory considerations, and technological advancements. The study recommended that appropriated technologies be put in place in order to detect fraud, ensuring data privacy, and fostering a safer financial environment.

Keywords: Big Data Analytics, Fraud Detection, Central Bank of Nigeria, Kano, Nigerian Financial Institutions, Integration

Introduction

Given the rapidly changing technological landscapes and sophisticated fraudulent schemes, the fight against fraud could be an upward struggle for financial institutions worldwide, including those in Nigeria. Fraud threatens system stability and also reduces public confidence in banking systems (Ikenna, 2024). In this regard, Nigerian financial institutions, especially the Central Bank of Nigeria (CBN), have a significant role in guarding the integrity of the banking sector and securing stability within it. The CBN is the apex regulatory body overseeing monetary policies and ensuring the soundness of financial institutions in Nigeria (Okodugha, 2021).

Big data analytics has created a revolution in many sectors including finance by facilitating unprecedented new opportunities in operational efficiencies and decision-making (Srivastava & Gopalkrishnan, 2015). Big data analytics is applied systematically to collections of large volumes of data for the discovery of patterns and trends, as well as information, that can help policymakers make strategic decisions (Mikalef et al., 2018). Regarding fraud detection, big data analytics enables financial institutions to go through vast amounts of transactional information in real time, which helps them identify and block fraudulent activities (Saxena & Vafin, 2019). Big data analytics in fraud detection remains one of the most essential strategies in fighting against financial fraud. Using advanced techniques for analytics, machine learning, and predictive modeling, for example, financial institutions in Nigeria will stand a better chance of thinking ahead and detecting patterns and anomalies that might emanate to signify fraudulent behavior (Rizvi, 2021). Their integration into the operations of the CBN, particularly at its Kano branch, makes a statement in the strategic line toward strengthening the fraud detection capability while maintaining regulatory compliance and operational efficiency (Lottu et al., 2023).

Notwithstanding, implementing big data analytics in fraud detection in Nigerian financial institutions is not devoid of challenges. Among these are the enormous challenges, such as data privacy issues, complexities in data integration, and the necessity of skilled data analysts (Shoetan et al., 2021). More importantly, the effectiveness of applying big data analytics to perform fraud detection depends on data input quality and timeliness and the strength of analytical models used for this process (Hariri et al., 2019).

The Central Bank of Nigeria's Kano branch serves as an illustrative case study for examining the practical application of big data analytics in fraud detection within a Nigerian regulatory framework. Being one of the essential branches of CBN, the Kano branch is instrumental in supervising banking operations in the Kano State which is in the northwestern region of Nigeria. This offers monitoring and enforcement of

compliance with regulatory standards for financial fraud reduction (Okodugha, 2021). Understanding how big data analytics is used at the Kano branch provided valuable insights into operational dynamics and challenges of rolling out such technologies in a developing economy context.

The utilization of big data analytics in fraud detection at the CBN's Kano branch to improve its capacity as an institution in securing financial transactions, among many other initiatives is designed to spur resilience in Nigeria's financial sector. Data driven insights will enable the CBN Kano branch to reduce potential risks posed by fraudulent activities and thus fortify a safer, more trustworthy environment for banking (Adesina & Olayinka, 2019). The lessons learned from this case study of the Kano branch will therefore, provide policy recommendations and best practices toward a strategic ladder that would enhance the fraud detection capabilities of other Nigerian financial institutions through technology-driven approaches.

Statement of the Problem

One of the pervasive problems within financial institutions in Nigeria is financial fraud, which has called into question the credibility and integrity of banking organizations and instigated public distrust. Despite efforts by the Central Bank of Nigeria to regulate such actions, fraudulent activities abound, demanding greater efforts in its detection and prevention methods (Alinno, 2023). Big data analytics holds better promises for fraud detection by using advanced computational methods that analyze enormous transactional data volumes in real time. The extent to which the technologies have been adopted and optimized within Nigerian financial institutions, especially at the CBN Kano branch, is relatively unexplored.

The traditional fraud detection methods have not been effective in Nigerian financial institutions because they are reactive and accommodating of manual processes (Beekee & Osuagwu, 2019). Indeed, the reactive approach to fraud detection in banks is not only tardy but also makes financial institutions and their clients vulnerable to substantial financial losses and sometimes reputation damage (Adeabah et al., 2021). Big data analytics creates the possibilities for shifting from the reactive to the proactive fraud detection strategy, whereby detection of suspicious patterns and behaviors that may indicate fraudulent activity is achieved (Madhuri et al., 2023). However, applying these technologies within the Nigerian context is faced with challenges in many ways: privacy concerns over data, a lack of enough skilled data analysts, and lacking infrastructure (Oladeinde et al., 2023).

This is more complicated by how Nigerian financial institutions, like its CBN Kano branch, are controlled and run, thus creating other challenges that arise regarding how big data analytics can be adopted and integrated for fraud detection purposes. As was observed by Lottu et al. (2023), understanding these challenges is very important in developing strategies to overcome barriers to effective implementation in a bid to reap the preponderance of benefits from big data analytics towards deterring financial fraud, as put forward by Vassakis et al. (2018).

However, the scarcity of empirical studies on the practical application and outcome of big data analytics in fraud detection within Nigerian financial institutions underscores the need for targeted research (Aderemi et al., 2024). Given the gaps identified above, it is important to contribute to the existing body of knowledge on how big data analytics are utilized in fraud detection, particularly in the CBN Kano branch. It will help gain insight into operational challenges, regulatory considerations, and strides in technological capability for fraud detection in safeguarding financial stability in Nigeria (Adeyemo & Obafemi, 2024).

Even though big data analytics has tremendous potentials for fraud detection in majorly transforming Nigerian financial institutions, especially CBN Kano branch, there exist significant barriers to its effective execution. Given this, this study will therefore, bridge these gaps and add empirical evidence that can help educate policy recommendations and best practices for the leveraging of big data analytics in fighting financial fraud effectively.

Research Questions

The research seeks to answer the following research questions:

1. What types of Big Data Analytics Strategies are available in Central Bank of Nigeria, Kano Branch for Fraud Detection?
2. How effective has big data analytics been integrated into the fraud detection framework at the Central Bank of Nigeria's Kano branch?
3. What are the key operational challenges encountered with the integration of big data analytics into the fraud detection framework at the Central Bank of Nigeria's Kano branch?

Literature Review

Types of Big Data Analytics Strategies for Fraud Detection

In the realm of fraud detection within financial institutions, big data analytics strategies can be broadly categorized into descriptive, predictive, and prescriptive analytics, each playing a crucial role in identifying and preventing fraudulent activities. Descriptive analytics, the most fundamental type, involves the examination of historical data to understand past patterns and behaviors. In the context of fraud

detection, descriptive analytics provides insights into what has happened, offering a retrospective view of fraudulent activities that have already occurred. For instance, it might involve analyzing transaction logs to identify unusual patterns or summarizing the characteristics of known fraudulent transactions. At the Central Bank of Nigeria's Kano Branch, descriptive analytics could be employed to generate reports on the frequency and types of fraud incidents, helping to establish a baseline understanding of the fraud landscape. This approach is particularly useful for detecting anomalies that deviate from normal behavior patterns, such as sudden spikes in transaction volumes or unusual geographic patterns of account access (Akinwande et al., 2023). While descriptive analytics alone may not prevent future fraud, it forms the foundation for more advanced analytics strategies by providing the historical context necessary for identifying trends and patterns that may be indicative of fraudulent behavior.

However, the success of predictive analytics heavily depends on the quality and comprehensiveness of the data used to train the models, as well as the ability to continuously update and refine these models to adapt to evolving fraud tactics.

Prescriptive analytics represents the most advanced form of big data analytics, going beyond prediction to provide recommendations for actions that can optimize outcomes. In the context of fraud detection, prescriptive analytics not only identifies potential fraudulent activities but also suggests the most effective course of action to prevent or mitigate the fraud. This approach typically involves complex algorithms and decision models that consider multiple variables and potential scenarios to determine the best possible solution. For instance, a prescriptive analytics system might not only flag a suspicious transaction but also recommend specific steps to verify the transaction's legitimacy, such as contacting the account holder or temporarily freezing the account.

However, it is important to note that the effectiveness of prescriptive analytics relies heavily on the accuracy of the underlying predictive models and the quality of the data inputs.

The integration of machine learning and artificial intelligence (AI) has further revolutionized fraud detection capabilities across all types of analytics strategies. Machine learning algorithms, such as decision trees, neural networks, and support vector machines, can analyze vast amounts of data to identify complex patterns and relationships that may be indicative of fraudulent activity. These algorithms have the ability to learn and improve over time, adapting to new fraud tactics as they emerge. AI-powered fraud detection systems can process and analyze data from multiple sources in real-time, including transaction records, customer behavior patterns, and external data sources, to detect anomalies and predict potential fraud with high accuracy. For example, deep learning models can be used to analyze unstructured data such as text messages or social media posts to identify potential fraud indicators that might be missed by traditional rule-based systems. At the Central Bank of Nigeria's Kano Branch, the implementation of AI and machine learning in fraud detection could significantly enhance the accuracy and efficiency of fraud prevention efforts, enabling the detection of sophisticated fraud schemes that might elude conventional methods (Oluwatosin et al., 2024). However, the adoption of these advanced technologies also presents challenges, including the need for significant computational resources, the complexity of model interpretability, and the potential for algorithmic bias. As such, the successful integration of AI and machine learning into fraud detection frameworks requires careful consideration of these factors, as well as ongoing monitoring and refinement of the models to ensure their effectiveness and fairness in detecting fraudulent activities.

Integration of Big Data Analytics into Fraud Detection Frameworks

The integration of big data analytics into fraud detection frameworks has become increasingly crucial for financial institutions, particularly in the context of the Central Bank of Nigeria's (CBN) Kano branch. Existing fraud detection frameworks in Nigerian financial institutions have traditionally relied on rule-based systems and statistical models to identify potential fraudulent activities. However, these approaches have limitations in handling the complexity and volume of modern financial transactions.

The role of big data in enhancing these frameworks is multifaceted, offering improved accuracy, real-time detection capabilities, and the ability to uncover complex fraud patterns. According to a recent study by Nwosu et al. (2023), the adoption of big data analytics in Nigerian banks has led to a 30% increase in fraud detection rates. These strategies include machine learning algorithms for anomaly detection, network analysis for identifying fraudulent networks, and natural language processing for analyzing unstructured data from customer communications (Okonkwo et al., 2022). The integration of these big data analytics strategies into the existing fraud detection framework is a gradual process, influenced by various organizational and external factors. Organizational readiness, technical capacity, and the availability of skilled personnel have been identified as critical factors in the successful implementation of big data analytics for fraud detection (Nnamani et al., 2022).

The effectiveness of integrating big data analytics into fraud detection frameworks is influenced by a complex interplay of organizational and external factors. Organizational factors such as the institution's readiness to adopt new technologies, its existing technical capacity, and the skill set of its workforce play crucial roles in determining the success of big data integration. A study by Eze and Chukwu (2023) found that financial institutions with a strong culture of innovation and continuous learning were more successful in implementing and benefiting from big data analytics in fraud detection. External factors, including economic conditions and competitive pressures, also significantly impact the integration process.

Operational Challenges in Integrating Big Data Analytics for Fraud Detection

The integration of Big Data Analytics (BDA) for fraud detection in Nigerian financial institutions, particularly at the Central Bank of Nigeria's (CBN) Kano branch, presents a complex array of operational challenges that must be addressed to ensure effective implementation and utilization. One of the primary obstacles identified in recent studies is the significant resource constraints faced by financial institutions in Nigeria. A comprehensive survey conducted by Nwosu et al. (2023) revealed that inadequate technical infrastructure remains a critical bottleneck in the seamless adoption of BDA for fraud detection by financial institutions. The study highlighted that only 45% of the surveyed bank branches had the necessary high-performance computing systems capable of processing the vast volumes of data required for effective fraud analysis.

This infrastructural gap not only limits the scope and depth of analytics that can be performed but also impacts the real-time detection capabilities crucial for preventing sophisticated fraud schemes. Moreover, the shortage of skilled personnel proficient in both data science and financial fraud detection emerges as another significant challenge. Okafor and Eze (2022) conducted an in-depth analysis of the workforce composition at the various bank branches and found that while there was a growing awareness of the importance of BDA in fraud detection, only 30% of the relevant staff possessed the advanced analytical skills necessary to effectively leverage these tools. This skills gap poses a substantial hurdle in fully harnessing the potential of BDA for fraud detection and prevention.

Data integration issues represent another layer of operational challenges in implementing BDA for fraud detection at the CBN Kano branch. The financial sector in Nigeria, like many other countries, grapples with the legacy of disparate systems and data silos that have evolved over decades of technological advancement. A study by Ibrahim et al. (2023) revealed that the financial institutions faces significant difficulties in integrating data from various sources, including traditional banking systems, modern digital platforms, and external data providers. The study found that approximately 60% of the bank's critical data for fraud detection was scattered across different systems with limited interoperability.

Research Methodology

This study adopted a quantitative research method to investigate the integration of big data analytics in fraud detection at the Central Bank of Nigeria, Kano Branch using a descriptive research design. The population for this study consisted of one hundred and fifty-five (155) staff of the Central Bank of Nigeria, Kano Branch working in different units and departments, since the population is small and manageable, the entire population was used as the sample of the study. Self-developed questionnaire was used as the instrument for data collection. The instrument was presented to colleagues to ensure its face and content validity. The researchers with three (3) research assistants distributed copies of the questionnaire to the respondents and collected same within a period of two weeks. Google link of the questionnaire was also designed and sent to those staff who were not physically available. The data collected was analysed using mean and standard deviation. The benchmark of the mean was set at 3.0.

Data Presentation and Analysis

Response Rate

Out of the 155 questionnaires distributed to participants in the study, 147 questionnaires were adequately filled and returned. This led to a response rate of 94.84% of the questionnaire retrieved and found worthy for the analysis.

Table 1: Response Rate

Questionnaires Distributed	Questionnaires Returned	Response Rate
155	147	94.84%

Big Data Analytics Strategies for Fraud Detection

The study sought to enumerate the types of Big Data Analytics Strategies available in Central Bank of Nigeria, Kano Branch for Fraud Detection. Table 2 gives the result of this survey.

Table 2: Big Data Analytics Strategies for Fraud Detection

S/No.	Item	Mean	SD	Remark
1	The Central Bank of Nigeria, Kano Branch employs descriptive analytics for fraud detection.	3.75	0.56	Agree
2	Predictive analytics is an essential tool in the bank's fraud detection strategy.	4.12	0.68	Agree
3	The bank effectively uses prescriptive analytics to improve decision-making in fraud prevention.	3.85	0.72	Agree

4	Real-time data analysis is integrated into fraud detection processes at the bank.	4.25	0.7	Agree
5	The bank utilizes machine learning algorithms to detect fraudulent activities.	4.05	0.62	Agree
6	Big data analytics strategies at the bank focus on identifying unusual patterns in transactional data.	4.21	0.74	Agree
7	The use of artificial intelligence enhances the bank's ability to detect fraud.	4.01	0.65	Agree
8	Predictive modeling techniques are regularly updated to adapt to new fraud detection challenges.	3.95	0.81	Agree
9	The bank employs anomaly detection systems as part of its big data analytics strategy.	3.73	0.6	Agree
10	Visualization tools are used to simplify the interpretation of complex fraud detection data.	3.94	0.59	Agree

Source: Researchers Computation, 2025

The first item indicates that the Central Bank of Nigeria, Kano Branch employs descriptive analytics for fraud detection, with a mean of 3.75 and a standard deviation of 0.56, reflecting agreement among respondents. This finding is consistent with the literature, where descriptive analytics is often recognized as foundational in fraud detection for summarizing historical data and identifying trends (Adamu, Bello, & Nwankwo, 2022).

The second item reveals that predictive analytics is considered an essential tool in the bank's fraud detection strategy, with a mean of 4.12 and a standard deviation of 0.68. This high mean suggests a strong consensus on the importance of predictive analytics for forecasting potential fraudulent activities, which aligns with Adebayo, Oluwadare, and Kolawole's (2019) emphasis on predictive models for enhancing fraud detection capabilities.

For the third item, the bank's effective use of prescriptive analytics to improve decision-making in fraud prevention is reflected by a mean of 3.85 and a standard deviation of 0.72. The agreement indicates that prescriptive analytics is valued for providing actionable recommendations to prevent fraud, as supported by Afolabi, Adegoke, and Oluwatosin (2024), who highlight the role of prescriptive analytics in optimizing decision-making processes.

The fourth item shows that real-time data analysis is integrated into fraud detection processes at the bank, with a mean of 4.25 and a standard deviation of 0.70. This suggests a robust implementation of real-time analytics, which is crucial for timely fraud detection, corroborating the findings of Ibrahim, Lawal, and Adebayo (2023), who argue for the transformative impact of real-time monitoring in detecting fraudulent transactions.

The fifth item indicates that the bank utilizes machine learning algorithms to detect fraudulent activities, with a mean of 4.05 and a standard deviation of 0.62. This result underscores the significance of machine learning in enhancing fraud detection accuracy, aligning with Nwankwo, Adeyemi, and Ogunbiyi's (2021) observation of AI and machine learning applications in financial fraud detection.

The sixth item shows that big data analytics strategies at the bank focus on identifying unusual patterns in transactional data, with a mean of 4.21 and a standard deviation of 0.74. This focus on pattern recognition is critical for detecting anomalies, consistent with Ogundele, Babatunde, and Ajayi's (2023) emphasis on leveraging big data for identifying irregular transaction patterns.

The seventh item reflects that the use of artificial intelligence enhances the bank's ability to detect fraud, with a mean of 4.01 and a standard deviation of 0.65. This aligns with the broader literature suggesting that AI significantly augments fraud detection capabilities (Adeleke & Johnson, 2022).

The eighth item, showing that predictive modeling techniques are regularly updated to adapt to new fraud detection challenges, has a mean of 3.95 and a standard deviation of 0.81. This indicates a commitment to evolving predictive models, consistent with Ezeoke, Afolabi, and Okafor's (2023) argument about the necessity of updating predictive models to keep pace with changing fraud tactics.

The ninth item, which states that the bank employs anomaly detection systems as part of its big data analytics strategy, has a mean of 3.73 and a standard deviation of 0.60. This reflects a strong agreement on the value of anomaly detection systems, supported by Akinwande, Balogun, Ogunleye, Akinwande, and Olatunji (2023) research on operationalizing anomaly detection for effective fraud management.

Finally, the tenth item shows that visualization tools are used to simplify the interpretation of complex fraud detection data, with a mean of 3.94 and a standard deviation of 0.59. This supports the use of visualization for enhancing data comprehension and decision-making, aligning with Okafor, Nnamani, and Eze's (2023) findings on the role of visualization in interpreting complex data sets. Overall, the results indicate a comprehensive and integrated approach to employing various big data analytics strategies for fraud detection at the Central Bank of Nigeria, Kano Branch, consistent with contemporary research in the field.

Integration of Big Data Analytics

The study sought to assess the level of integration of big data analytics into the fraud detection framework at the Central Bank of Nigeria's Kano branch and determine factors influencing its effectiveness. Table 3 gives the result of this survey.

Table 3: Integration of Big Data Analytics

S/No.	Item	Mean	SD	Remark
1	Big data analytics is fully integrated into the fraud detection framework at the Central Bank of Nigeria, Kano Branch.	4.22	0.45	Agree
2	The bank's fraud detection system is seamlessly connected to its big data analytics infrastructure.	4.05	0.52	Agree
3	There is effective communication between the bank's fraud detection team and data analytics team.	4.18	0.48	Agree
4	The integration of big data analytics has improved the speed of fraud detection at the bank.	4.31	0.4	Agree
5	The bank's IT infrastructure supports the integration of big data analytics for fraud detection.	4.24	0.5	Agree
6	Employees receive adequate training on the integration of big data analytics into fraud detection processes.	3.87	0.55	Agree
7	The integration of big data analytics has reduced the number of undetected fraud cases at the bank.	4.10	0.49	Agree
8	The bank continuously updates its fraud detection systems to incorporate the latest big data analytics tools.	4.03	0.6	Agree
9	The integration of big data analytics in fraud detection is aligned with the bank's overall risk management strategy.	4.26	0.47	Agree
10	Management provides sufficient support for the integration of big data analytics in fraud detection.	4.39	0.43	Agree

Source: Researchers Computation, 2025

The survey results presented in Table 4.4 provide insights into the integration of big data analytics into the fraud detection framework at the Central Bank of Nigeria, Kano Branch. The item stating that big data analytics is fully integrated into the fraud detection framework at the Central Bank of Nigeria, Kano Branch, received a mean of 4.22 with a standard deviation of 0.45, indicating strong agreement. This suggests that the integration of big data analytics is perceived as a key component of the fraud detection framework. This aligns with findings from Okafor et al. (2023), who noted that effective integration of analytics significantly enhances fraud detection capabilities.

The item regarding the seamless connection between the bank's fraud detection system and its big data analytics infrastructure achieved a mean of 4.05 and a standard deviation of 0.52. This high score suggests that respondents view the connection between these systems as robust. This result supports the observation by Akinwumi et al. (2022) that seamless integration is crucial for maximizing the effectiveness of big data in fraud detection.

Effective communication between the bank's fraud detection team and data analytics team, with a mean of 4.18 and a standard deviation of 0.48, highlights that respondents believe there is good collaboration between these groups. This finding resonates with Adewale et al. (2023), who emphasized the importance of communication in leveraging big data analytics for effective fraud detection.

The integration of big data analytics improving the speed of fraud detection received a mean of 4.31 and a standard deviation of 0.40. This result reflects a strong agreement that big data analytics contributes to faster fraud detection. This finding is consistent with Uwakwe et al. (2023), who reported that advanced analytics can significantly expedite the fraud detection process.

The bank's IT infrastructure supporting the integration of big data analytics for fraud detection, with a mean of 4.24 and a standard deviation of 0.50, indicates that the IT infrastructure is seen as well-suited for this purpose. This supports findings by Adeleke et al. (2023), who found that robust IT infrastructure is essential for the successful implementation of big data analytics.

Employees receiving adequate training on integrating big data analytics into fraud detection processes scored a mean of 3.87 with a standard deviation of 0.55. This suggests that while training is considered adequate, there may still be room for improvement. This is in line with Oladipo et al. (2022), who highlighted the need for continuous training to keep pace with evolving analytics technologies.

The reduction in undetected fraud cases due to the integration of big data analytics, with a mean of 4.10 and a standard deviation of 0.49, indicates that respondents believe this integration has positively impacted fraud detection outcomes. This finding aligns with Adebayo et al. (2019), who noted that big data analytics can effectively reduce instances of undetected fraud.

The bank's continuous updating of its fraud detection systems to include the latest big data analytics tools, with a mean of 4.03 and a standard deviation of 0.60, shows that respondents view the bank as proactive in adopting new technologies. This finding is supported by Ugoani (2023), who emphasized the importance of regularly updating fraud detection systems to maintain effectiveness.

The alignment of big data analytics in fraud detection with the bank's overall risk management strategy, receiving a mean of 4.26 and a standard deviation of 0.47, reflects that respondents perceive this integration as well-aligned with broader risk management goals. This is consistent with Eze et al. (2024), who found that integrating analytics into overall risk management strategies enhances fraud detection effectiveness.

Finally, management providing sufficient support for the integration of big data analytics in fraud detection, with a mean of 4.39 and a standard deviation of 0.43, indicates strong agreement that management support is adequate. This is supported by Ibrahim et al. (2023), who highlighted the critical role of management support in the successful implementation of big data analytics.

Overall, the results indicate a strong agreement that big data analytics is well-integrated into the fraud detection framework at the Central Bank of Nigeria, Kano Branch, with effective communication, support, and infrastructure contributing to its effectiveness.

Key Operational Challenges in Implementing Big Data Analytics

The study sought to identify and analyse key operational challenges associated with integrating big data analytics into the fraud detection framework at the Central Bank of Nigeria's Kano branch. Table 4 gives the result of this survey.

Table 4: Operational Challenges in Implementing Big Data AnalyticsS/NoItemMeanSDRemark1The integration of big data analytics into existing systems at the bank presents significant technical challenges.4.120.58Agree2There are difficulties in acquiring and maintaining the necessary infrastructure for big data analytics.4.050.6Agree3Staff shortages and skill gaps hinder the effective implementation of big data analytics at the bank.4.220.55Agree4The bank faces challenges in managing the volume and complexity of data generated by big data analytics.4.180.57Agree5High costs associated with big data analytics technologies are a barrier to effective implementation.4.250.62Agree6Ensuring data quality and consistency is a major operational challenge in big data analytics.4.130.59Agree7The integration of new big data technologies with legacy systems causes compatibility issues.4.290.56Agree8There are regulatory and compliance challenges related to the use of big data analytics.4.150.61Agree9Limited internal support and resistance to change impact the successful implementation of big data analytics.4.080.63Agree10The need for continuous updates and maintenance of big data analytics systems poses operational difficulties.4.120.64AgreeSource: Researchers Computation, 2025

The study aimed to identify and analyze the key operational challenges associated with integrating big data analytics into the fraud detection framework at the Central Bank of Nigeria's Kano branch. The findings, summarized in Table 4.9, highlight several significant challenges faced by the bank. The integration of big data analytics into existing systems at the bank presents significant technical challenges, with a mean score of 4.12 and a standard deviation of 0.58.

This result aligns with previous studies that emphasize the complexity of merging new analytics technologies with legacy systems, which often results in technical difficulties (Okonkwo & Nwankwo, 2021). Such integration challenges can hinder the smooth operation of fraud detection systems and affect their overall effectiveness.

Difficulties in acquiring and maintaining the necessary infrastructure for big data analytics, reflected in a mean of 4.05 and a standard deviation of 0.60, further underscore the operational hurdles faced by the bank. This finding is consistent with Adebayo et al. (2019), who noted that infrastructure constraints are a common barrier to implementing effective big data analytics solutions in Nigerian banks.

Staff shortages and skill gaps, with a mean of 4.22 and a standard deviation of 0.55, also significantly hinder the effective implementation of big data analytics. This issue is widely recognized in the literature, which highlights the need for skilled personnel to manage and utilize big data tools effectively (Okafor & Eze, 2022). Without adequate training and staffing, the potential of big data analytics to enhance fraud

detection may be underutilized. The challenges in managing the volume and complexity of data generated by big data analytics, evidenced by a mean score of 4.18 and a standard deviation of 0.57, reflect the difficulties in handling large datasets and extracting meaningful insights from them. This finding is supported by Adamu et al. (2022), who discuss the challenges banks face in processing and analyzing vast amounts of data.

High costs associated with big data analytics technologies, with a mean of 4.25 and a standard deviation of 0.62, are a significant barrier to effective implementation. This is corroborated by Adegoke et al. (2022), who identify cost constraints as a major challenge for financial institutions adopting big data solutions. Ensuring data quality and consistency, indicated by a mean of 4.13 and a standard deviation of 0.59, remains a major operational challenge. This challenge is consistent with findings from Oladimeji et al. (2022), who emphasize the importance of maintaining high data quality to ensure reliable analytics outcomes.

The integration of new big data technologies with legacy systems, causing compatibility issues, is reflected in a mean of 4.29 and a standard deviation of 0.56. This challenge is highlighted in Okonkwo et al. (2022), who note the difficulties in aligning new technologies with existing systems, which can impact the efficiency of fraud detection processes. Regulatory and compliance challenges related to the use of big data analytics, with a mean of 4.15 and a standard deviation of 0.61, are also significant. This aligns with Ezeoke et al. (2023), who discuss the complex regulatory landscape that financial institutions must navigate when implementing big data analytics.

Limited internal support and resistance to change, with a mean of 4.08 and a standard deviation of 0.63, impact the successful implementation of big data analytics. This finding is supported by Adeleke et al. (2023), who describe how internal resistance can impede the adoption of new technologies. Finally, the need for continuous updates and maintenance of big data analytics systems, reflected in a mean of 4.12 and a standard deviation of 0.64, poses operational difficulties. This is consistent with Ugoani (2023), who highlights the ongoing maintenance requirements and updates necessary to keep big data systems functional and effective.

Overall, the results underscore the significant operational challenges faced by the bank in integrating big data analytics into its fraud detection framework. These challenges reflect broader trends observed in the literature and highlight areas for improvement and strategic focus in implementing big data analytics solutions.

Summary of the study

1. The study identified several big data analytics strategies at the Central Bank of Nigeria's Kano branch, including predictive analytics, machine learning algorithms, and real-time data processing technologies, which enhance fraud detection capabilities.
2. The bank has a high level of integration of big data analytics into its fraud detection framework, but effectiveness is influenced by factors such as technological infrastructure, staff expertise, and system compatibility.
3. Key operational challenges identified include technical difficulties, high implementation costs, staff shortages, and system compatibility issues, which must be addressed for more effective fraud detection integration.

Conclusion

The study concludes that the integration of big data analytics into the fraud detection framework at the Central Bank of Nigeria's Kano branch has significantly advanced the bank's capabilities in identifying and mitigating fraudulent activities. The enumeration of big data analytics strategies revealed a diverse array of tools and techniques, including predictive analytics and real-time data processing, which have been effectively tailored to meet the bank's specific needs.

Recommendations

1. It is recommended that the Central Bank of Nigeria's Kano branch continues to explore and integrate advanced big data analytics strategies, such as machine learning and artificial intelligence, to enhance fraud detection. Investing in these cutting-edge technologies will help in identifying more sophisticated patterns of fraudulent activities and improving overall detection accuracy.
2. To improve the effectiveness of big data analytics in fraud detection, the bank should focus on further integrating these systems into its existing fraud detection framework. This includes optimizing data flow, improving system interoperability, and ensuring that the analytics solutions are aligned with the bank's specific needs and operational goals.
3. To overcome operational challenges, the bank should invest in upgrading its infrastructure and addressing skill gaps among staff. This involves providing training programs, enhancing technical support, and ensuring that the necessary resources are available for the successful integration and maintenance of big data analytics systems.

References

Adeabah, D., Andoh, C., Asongu, S., & Gemegah, A. (2023). Reputational risks in banks: A review of research themes, frameworks, methods, and future research directions. *Journal of Economic Surveys*, *37*(2), 321-350.

Aderemi, S., Olutimehin, D. O., Nnaomah, U. I., Orieno, O. H., Edunjobi, T. E., & Babatunde, S. O. (2024). Big data analytics in the financial services industry: Trends, challenges, and future prospects: A review. *International Journal of Science and Technology Research Archive*, *6*(1), 147-166.

Adesina T. & Olayinka, P. (2019). Big data analytics. *TDWI best practices report, fourth quarter*, *19*(4), 1-34.

Adeyemo, K., & Obafemi, F. J. (2024). A Survey on the Role of Technological Innovation in Nigerian Deposit Money Bank Fraud Prevention. *South Asian Journal of Social Studies and Economics*, *21*(3), 133-150.

Akinwande, B. A., Oluwadare, S. A., & Adekoya, A. F. (2023). Descriptive analytics for fraud detection in Nigerian banks: Insights and challenges. *Journal of Financial Crime*, 30(2), 567-582.

Alinno, F. C. (2023). Central Bank of Nigeria's Digital Currency (e-Naira) And Fraud Detection/Prevention: Implications For Nigeria's Economic Growth. *Nigerian Journal of Management Sciences Vol*, *24*(2a).

Eze, C. C., & Chukwu, B. I. (2023). Regulatory challenges in the adoption of big data analytics for fraud detection: Perspectives from Nigerian banks. *International Journal of Banking Regulation*, 42(1), 78-95.

Hariri, R. H., Fredericks, E. M., & Bowers, K. M. (2019). Uncertainty in big data analytics: survey, opportunities, and challenges. *Journal of Big data*, *6*(1), 1-16.

Ibrahim, M. A., Lawal, Y. O., & Adebayo, O. A. (2023). Real-time transaction monitoring systems: A game-changer in fraud detection for Nigerian banks. *Journal of Banking Technology*, 29(2), 312-328.

Ikenna, M. (2024). Operational Risks Faced by Financial Institutions in the Digital Age: A Case of Nigeria. *International Journal of Modern Risk Management*, *2*(1), 34-43.

Lottu, O. A., Abdul, A. A., Daraojimba, D. O., Alabi, A. M., John-Ladega, A. A., & Daraojimba, C. (2023). Digital transformation in banking: a review of Nigeria's journey to economic prosperity. *International Journal of Advanced Economics*, *5*(8), 215-238.

Madhuri, T. S., Babu, E. R., Uma, B., & Lakshmi, B. M. (2023). Big-data driven approaches for real-time detection and prevention of fraud. *Materials Today: Proceedings*, *81*, 969-976.

Mikalef, P., Pappas, I. O., Krogstie, J., & Giannakos, M. (2018). Big data analytics capabilities: a systematic literature review and research agenda. *Information systems and e-business management*, *16*, 547-578.

Nnamani, C. E., Okafor, G. O., & Eze, U. C. (2022). Balancing data privacy and fraud detection: A case study of Nigerian financial institutions. *Information & Management*, 59(4), 103-122.

Nwosu, A. C., Okafor, G. O., & Eze, P. C. (2023). Prescriptive analytics in financial fraud prevention: A study of Nigerian banking sector. *Decision Support Systems*, 165, 113862.

Okafor, I. C., & Eze, N. M. (2022). Bridging the skills gap in big data analytics for fraud detection: A study of Nigerian banking sector. *International Journal of Bank Marketing*, 40(5), 1021-1039.

Okodugha, N. (2021). *Central bank of Nigeria, corporate governance and the quest for sustainable banking system in Nigeria: an exploratory analysis* (Doctoral dissertation, University of East London).

Okonkwo, I. C., Nwankwo, C. E., & Bello, S. K. (2022). Advanced analytics strategies for fraud detection in Nigerian banks: A comparative analysis. *Journal of Money Laundering Control*, 25(2), 341-356.

Oladeinde, M., Hassan, A. O., Farayola, O. A., Akindote, O. J., & Adegbite, A. O. (2023). Review of it innovations, data analytics, and governance in Nigerian enterprises. *Computer Science & IT Research Journal*, *4*(3), 300-326.

Oluwatosin, E. A., Adebayo, F. O., & Babajide, R. T. (2024). *Cloud-based fraud detection in Nigerian financial institutions: A case study of operational efficiency and cost reduction*. Journal of Financial Technology and Innovation, *18*(2), 112-129.

Rizvi, S. R. Z. (2021). Role of Big Data in Financial Institutions for Financial Fraud. *Available at SSRN*, *3800777*.

Shoetan, P. O., Oyewole, A. T., Okoye, C. C., & Ofodile, O. C. (2024). Reviewing the role of big data analytics in financial fraud detection. *Finance & Accounting Research Journal*, *6*(3), 384-394.

Srivastava, U., & Gopalkrishnan, S. (2015). Impact of big data analytics on banking sector: Learning for Indian Banks. *Procedia Computer Science*, *50*, 643–652. https://doi.org/10.1016/j.procs.2015.04.098

Vassakis, K., Petrakis, E., & Kopanakis, I. (2018). Big data analytics: applications, prospects and challenges. *Mobile big data: A roadmap from models to technologies*, 3-20.

Integration of Blockchain Technology for Library Security: Prospects and Challenges

By
Yusuf Bako
Federal University of Education Kano.
yusufbako35@gmail.com
0806 494 2194

&
Abubakar Muhammad Sadauki
Federal University of Education, Kano.
abubakarsadauki220@gmail.com
07062767518

Abstract

The integration of blockchain technology into library systems presents innovative solution for enhancing security, transparency, and data integrity in the management of library resources and patron information. Blockchain's decentralized nature and cryptographic features offer significant advantages for protecting sensitive data, including patron privacy, the preservation of digital archives, and safeguarding intellectual property rights. This paper covers the prospects of integrating blockchain technology for library security, emphasizing its potential to ensure secure access to digital resources, prevent unauthorized alterations of records, and improve transparency in library operations. Furthermore, the integration of blockchain in smart contracts offers opportunities to modernize library management processes by automating transactions, optimizing interlibrary loans, and enhancing trust between libraries and users. Despite these prospects, the integration of blockchain in library settings is not without challenges. Key barriers include technical issues such as scalability limitations, high energy consumption, and the complexities of integrating blockchain with legacy library management systems. Additionally, concerns about compliance with legal and regulatory frameworks, the costs of implementation, the need for specialized training for library staff, and potential user resistance also hinder integration. This paper critically examines these challenges and provides actionable recommendations to address them, highlighting the importance of pilot projects, cross-disciplinary collaboration with blockchain experts, and phased implementation approaches. The research seeks to offer a comprehensive understanding of the opportunities, challenges, and practical solutions for integrating blockchain technology to revolutionize library security systems. Conclusion and way forward were provided.

Keywords: *Blockchain Technology, Library Security, Prospects, Challenges.*

Introduction

Blockchain technology, initially developed for financial transactions, has gained widespread recognition for its potential applications beyond cryptocurrencies. Its core attributes, including decentralization, immutability, and cryptographic security, make it an attractive option for enhancing the security and efficiency of library management systems (Nakamoto, 2008). Libraries handle vast amounts of data, including digital archives, patron records, and intellectual property, which require stringent security and integrity measures (Koutroumpouchos et al., 2021). Traditional library management systems often face challenges related to data breaches, unauthorized modifications, and lack of transparency. Blockchain technology offers a viable solution to address these issues, providing secure access to digital resources, ensuring data integrity, and streamlining operational workflows (Meyer & Koster, 2020). By leveraging decentralized ledger technology, libraries can maintain tamper-proof records of transactions, enhance authentication protocols, and improve the reliability of information services. Additionally, blockchain facilitates the protection of intellectual property rights by ensuring that digital assets remain unaltered and properly attributed to their creators (Zhang & Lee, 2022). Smart contracts further enable automation in library operations, optimizing interlibrary loan services, digital content licensing, and automated access permissions.

This paper explores the transformative potential of blockchain in library security, highlighting key opportunities, challenges, and strategies for successful implementation. By addressing these factors, libraries can enhance their service efficiency, bolster security, and remain resilient in an evolving digital landscape. The following sections will delve into the practical applications of blockchain in library settings, examining case studies and recommendations for integrating blockchain-based solutions effectively.

Libraries are fundamental institutions dedicated to the preservation, organization, and dissemination of knowledge. In the digital era, the role of libraries has expanded beyond physical collections to include vast repositories of electronic resources, digital archives, and user data (Smith, 2020). However, this evolution has introduced significant security challenges. Ensuring the integrity of information, protecting user confidentiality, and maintaining operational efficiency are now critical issues for modern libraries. Traditional security measures, such as centralized databases and firewalls, are increasingly inadequate

against sophisticated cyber threats. Centralized systems are particularly vulnerable to single points of failure, data tampering, unauthorized access, and information loss (Brown & Martin, 2021). These vulnerabilities undermine trust and compromise the mission of libraries as reliable stewards of information.

Blockchain technology presents a promising solution to these challenges. With its core features of immutability, decentralization, and transparency, blockchain can fundamentally strengthen library security. Information recorded on a blockchain ledger cannot be altered without network consensus, thereby preventing unauthorized modifications (Zhang & Xie, 2018). The decentralized structure also mitigates the risks associated with single points of failure, enhancing the resilience and reliability of library management systems. In practice, blockchain can be utilized in libraries to secure digital archives, authenticate user records, protect intellectual property rights, and transparently manage circulation and access logs (Murray, 2019). For instance, blockchain-enabled systems can create tamper-proof records of document histories, promoting accountability and protecting against data manipulation.

Despite its potentials, the adoption of blockchain in library settings faces several challenges. These include technical complexities, high implementation costs, compatibility issues with existing legacy systems, and a shortage of skilled personnel (Kumar & Singh, 2020). Legal uncertainties, particularly concerning compliance with data protection regulations like the General Data Protection Regulation (GDPR), further complicate integration (Yaga et al., 2019). To effectively implement blockchain solutions, libraries must pursue a phased, strategic approach. Initiating pilot projects, investing in staff training, collaborating with IT and legal experts, and securing institutional support are critical steps. Gradual integration allows for troubleshooting and system adjustments before full-scale deployment, minimizing risks and ensuring smoother transitions (Rahim & Anwar, 2021).

In conclusion, strengthening library security in the digital era demands embracing innovative technologies like blockchain, coupled with strategic planning and a commitment to institutional transformation. Libraries that successfully navigate these changes will not only enhance their operational security but also reinforce their role as trusted custodians of knowledge in an increasingly digital world.

Statement of the Problem

Libraries today face growing challenges in ensuring the security, integrity, and transparency of their digital resources and user data. Traditional library management systems are increasingly vulnerable to data breaches, unauthorized modifications, and operational inefficiencies due to centralized structures and outdated security protocols. These weaknesses undermine user trust, threaten the preservation of digital archives, and complicate compliance with evolving data protection regulations. While blockchain technology offers promising solutions—such as immutable ledgers, decentralized networks, and enhanced transparency—its adoption within library environments remains limited. Libraries encounter significant barriers, including technical complexities, high implementation costs, legal uncertainties, and difficulties integrating blockchain with existing legacy systems. Furthermore, the lack of specialized expertise among library staff and unclear regulatory frameworks further complicate the adoption process.

Without a strategic and phased approach to blockchain integration, libraries risk falling behind in securing their digital assets and adapting to the technological demands of the future. Addressing these challenges is critical to unlocking the full potential of blockchain technology in strengthening library security and management practices.

Blockchain Technology and Its Role in Library Security

Blockchain technology is a decentralized and tamper-proof digital ledger that records transactions securely across multiple nodes. Initially developed for cryptocurrency, it has expanded into various sectors, including finance, healthcare, and education. Its key features—immutability, transparency, and security make it an ideal solution for enhancing information management. In libraries, blockchain can revolutionize security by ensuring data integrity, preventing unauthorized modifications, and enhancing transparency in record-keeping. It can safeguard digital archives, protect patron information, and streamline access control. Despite its potential, challenges such as high implementation costs, regulatory compliance, and technical complexities must be addressed for successful adoption.

1. Fundamentals of Blockchain Technology

Blockchain is a distributed ledger technology that records transactions in a decentralized and tamper-resistant manner. Each transaction is stored in a block, linked cryptographically to the previous block, creating an immutable chain (Swan, 2015). This structure enhances data security, prevents unauthorized alterations, and ensures data authenticity. Key features of blockchain include:

a. Decentralization removes intermediaries, reducing risks of single points of failure (Ostrom, 1990). In Nigeria, it enhances governance, fintech (e.g., Binance), and energy (e.g., mini-grids) by improving efficiency and security (Nakamoto, 2008). However, governance decentralization faces challenges like weak institutions and political interference (Agba & Ocheni, 2017), while fintech and energy sectors show successful applications of decentralized models.

b. Immutability prevents data modification once recorded, securing digital archives and records (Nakamoto, 2008). In Nigeria, blockchain enhances financial security (e.g., Bitmama), while e-

governance strengthens record integrity. However, challenges like cybersecurity threats and regulatory gaps persist (Agba & Ocheni, 2017), despite its potential to prevent fraud and enhance trust in digital systems.

c. Transparency allows all network participants to verify transactions, fostering trust (Ostrom, 1990). In Nigeria, blockchain-based fintech (e.g., Binance) ensures financial transparency (Nakamoto, 2008), while e-governance initiatives enhance accountability. However, challenges like weak regulatory frameworks hinder full adoption (Agba & Ocheni, 2017), despite its potential to reduce fraud and improve public trust.

2. Applications of Blockchain in Library Security

Libraries require robust security mechanisms to protect patron information, prevent unauthorized access, and maintain the integrity of digital resources (Koutroumpouchos et al., 2021). Blockchain can be integrated into library systems to address these needs in the following ways:

a. Blockchain-based identity management secures patron records from breaches and unauthorized access (Zhang & Lee, 2022). In Nigeria, fintech platforms (e.g., VerifyMe) use blockchain to enhance data security, while e-governance applications protect citizen records. However, challenges like regulatory uncertainty and adoption barriers persist (Agba & Ocheni, 2017), despite its potential to improve data protection and trust in digital systems.

b. Blockchain ensures the authenticity and long-term preservation of digital collections by preventing tampering (Meyer & Koster, 2020). In Nigeria, its application in e-governance and libraries enhances record integrity. However, challenges like high implementation costs and technical limitations persist (Agba & Ocheni, 2017), despite its potential to safeguard historical and legal archives.

c. Blockchain offers a transparent and immutable ledger for managing copyrights and digital rights (Swan, 2015). In Nigeria, it can protect creative works in music, literature, and film industries. However, challenges like legal enforcement and adoption barriers persist (Agba & Ocheni, 2017), despite its potential to combat piracy and ensure fair compensation for creators.

3. Challenges of Blockchain Integration in Libraries

Despite its benefits, integrating blockchain into library systems presents several challenges:

a. Technical Challenges

i. Blockchain networks may face challenges in handling large transaction volumes efficiently (Zhang & Lee, 2022). In Nigeria, fintech adoption, such as cryptocurrency trading, highlights scalability concerns, leading to slow processing times and high fees. While solutions like Layer 2 scaling exist, regulatory uncertainties and infrastructure limitations hinder widespread (Agba & Ocheni, 2017)

ii. Proof of Work (PoW) blockchain protocols demand high computational power, leading to significant energy consumption (Koutroumpouchos et al., 2021). In Nigeria, cryptocurrency mining faces sustainability concerns due to electricity shortages. While alternatives like Proof of Stake (PoS) offer efficiency, infrastructure challenges and regulatory uncertainties hinder widespread adoption (Agba & Ocheni, 2017).

iii. Existing library management systems may face compatibility issues with blockchain technology (Meyer & Koster, 2020). In Nigeria, integrating blockchain into academic and public libraries could enhance record security, but challenges like outdated infrastructure and technical expertise gaps persist (Agba & Ocheni, 2017), limiting its seamless adoption and effectiveness.

b. Legal and Regulatory Concerns

i. Libraries must ensure blockchain applications comply with data protection regulations like GDPR and HIPAA (Swan, 2015). In Nigeria, adherence to data privacy laws remains a challenge, especially in academic institutions. Regulatory gaps and lack of clear guidelines (Agba & Ocheni, 2017) hinder effective implementation, despite blockchain's potential to enhance data security and transparency.

ii. Using blockchain for copyright management raises legal ownership and enforcement concerns (Zhang & Lee, 2022). In Nigeria, artists and content creators could benefit from transparent digital rights management, but challenges like weak enforcement mechanisms and regulatory uncertainties (Agba & Ocheni, 2017) limit its effectiveness in protecting intellectual property and preventing unauthorized use.

c. Financial and Human Resource Constraints

i. Setting up and maintaining blockchain infrastructure requires significant financial investment (Meyer & Koster, 2020). In Nigeria, limited funding in sectors like libraries and fintech hampers

adoption, despite blockchain's potential to enhance security and transparency. High costs of hardware, software, and expert training (Agba & Ocheni, 2017) further challenge its widespread implementation.

ii. Library staff may require specialized training to manage blockchain-based systems effectively (Koutroumpouchos et al., 2021). In Nigeria, the lack of technical expertise and limited professional development opportunities hinder adoption. Without adequate training programs and institutional support (Agba & Ocheni, 2017), implementing blockchain in library management remains a significant challenge.

4. Future Directions and Recommendations

To address these challenges and facilitate blockchain adoption in libraries, the following recommendations are proposed:

i. Pilot Projects: Libraries should conduct small-scale blockchain implementations to assess feasibility and refine applications before full adoption (Zhang & Lee, 2022). In **India,** the National Digital Library explores blockchain for secure academic credential verification. **Kenya's** Ajira Digital Program pilots blockchain for digital identity management, enhancing trust in public records. **Ghana** has experimented with blockchain in land registry, demonstrating its potential for securing library archives. In **Nigeria**, testing blockchain in academic libraries could improve record integrity, but challenges like funding and expertise must be addressed. Pilot projects help developing nations evaluate blockchain's benefits before large-scale deployment (Agba & Ocheni, 2017).

ii. Engaging blockchain developers and IT professionals enhances successful integration (Swan, 2015). In **Nigeria**, collaboration with tech hubs like CcHub can support blockchain adoption in libraries. **India's** partnership with blockchain firms aids secure digital certifications. **Kenya** works with developers to implement blockchain in e-governance. In **the U.S.**, MIT uses blockchain for academic credential verification. Despite funding and expertise challenges, partnerships can drive blockchain adoption in developing nations (Agba & Ocheni, 2017).

iii. Phased Implementation: Gradual adoption, starting with non-critical applications, can ease blockchain integration and allow troubleshooting before full deployment (Meyer & Koster, 2020). In **Nigeria**, libraries could first use blockchain for cataloguing before expanding to user records. **India** has phased blockchain adoption in academic credential verification. **Kenya** applies it in land registries before broader governance use. In **Germany**, phased implementation in supply chain management ensures smooth transitions. Despite financial and technical challenges (Agba & Ocheni, 2017), a step-by-step approach reduces risks and enhances adoption success.

iv. Regulatory Compliance Strategies: Libraries should collaborate with policymakers to ensure blockchain adoption aligns with legal and ethical standards (Koutroumpouchos et al., 2021). In **Nigeria**, aligning blockchain use in academic libraries with data protection laws is essential. **India** integrates blockchain in governance while ensuring compliance with IT regulations. **Kenya** develops legal frameworks for blockchain in financial services. In **the EU**, the GDPR guides blockchain implementation. Despite regulatory uncertainties (Agba & Ocheni, 2017), proactive engagement with authorities can facilitate lawful and ethical blockchain integration in libraries.

Conclusion

Blockchain technology has the potential to transform library security by ensuring data integrity, transparency, and operational efficiency. Its immutable ledger system prevents unauthorized modifications, while decentralized networks reduce risks of single points of failure. By securing digital archives and user records, blockchain enhances trust and reliability in library management systems.

However, adopting blockchain in libraries comes with challenges, including technical complexities, legal uncertainties, and high implementation costs. Compatibility with legacy systems, compliance with data protection laws, and the need for specialized training further hinder adoption. Addressing these barriers requires strategic planning, institutional support, and regulatory frameworks to ensure seamless integration.

To maximize blockchain's benefits, libraries should adopt pilot projects, collaborate with IT experts, and implement changes gradually. Phased implementation allows troubleshooting before full deployment, reducing risks. Future research should explore real-world applications and case studies to develop best practices for effective blockchain adoption in library security and management.

Way Forward

To harness the transformative potential of blockchain technology in library security and management, libraries must adopt a proactive, strategic approach. Institutions should begin with pilot programs targeting specific areas like digital archives or user authentication systems to build practical experience and demonstrate feasibility.

Cross-disciplinary collaboration is critical—libraries should partner with blockchain specialists, legal

advisors, and IT departments to address technical, legal, and compliance challenges early in the adoption process. Capacity building through staff training and professional development initiatives will equip librarians with the necessary skills to manage and maintain blockchain systems effectively.

Additionally, institutional support from leadership is essential to secure funding, drive policy changes, and champion blockchain initiatives across the organization. Libraries should also advocate for the development of clear regulatory frameworks that align blockchain operations with national and international data protection standards.

A phased integration strategy—starting with low-risk applications and gradually expanding to core library systems—will minimize disruptions and allow for continuous evaluation and adjustment. Moreover, fostering a community of practice among libraries experimenting with blockchain can facilitate the sharing of best practices, lessons learned, and collaborative research opportunities.

Finally, continuous monitoring and evaluation of blockchain implementations, coupled with scholarly research into emerging use cases, will inform future improvements and solidify blockchain's role in enhancing library security, transparency, and operational efficiency.

References

Agba, M. S., & Ocheni, S. (2017). An assessment of the challenges and prospects of local government autonomy in Nigeria. *International Journal of Political Science and Development*, 5(6), 192-200.

Brown, A., & Martin, P. (2021). *Cybersecurity for information systems: Strategies for digital protection*. Information Today.

Koutroumpouchos, N., Kalloniatis, C., Gritzalis, S., & Kavakli, E. (2021). Blockchain and GDPR compliance: Challenges, opportunities, and future research directions. *Computers & Security*, 104, 102248.

Koutroumpouchos, P., Alexopoulos, C., & Vassilakaki, E. (2021). *Blockchain applications in digital libraries: Enhancing security and access control.* Library Hi-Tech, 39(4), 543-560.

Kumar, R., & Singh, M. (2020). Blockchain integration in libraries: Opportunities and challenges. *Journal of Library Innovation*, 11(2), 45-58.

Meyer, D., & Koster, L. (2020). *Smart contracts and blockchain security in libraries.* Journal of Digital Information Management, 18(2), 30-47.

Meyer, E. T., & Koster, L. (2020). Preserving digital heritage: The role of blockchain technology in ensuring authenticity and long-term access. *Library & Information Science Research*, 42(1), 101002.

Murray, K. (2019). Libraries and blockchain technology: Emerging applications and future trends. *Library Technology Reports*, 55(8), 1-35.

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Retrieved from https://bitcoin.org/bitcoin.pdf

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.

Rahim, N., & Anwar, M. A. (2021). Strategies for adopting blockchain in academic libraries: A roadmap. *The Journal of Academic Librarianship*, 47(6), 102403. https://doi.org/10.1016/j.acalib.2021.102403

Smith, J. (2020). *The evolving role of libraries in the digital age*. Oxford University Press.

Swan, M. (2015). *Blockchain: Blueprint for a New Economy*. O'Reilly Media.

Yaga, D., Mell, P., Roby, N., & Scarfone, K. (2019). Blockchain technology overview. *National Institute of Standards and Technology* (NIST). https://doi.org/10.6028/NIST.IR.8202

Zhang, Y., & Lee, W. (2022). Blockchain applications in digital libraries: Opportunities and challenges. *Journal of Information Science and Engineering*, 38(2), 123-140.

Zhang, Y., & Xie, S. (2018). Blockchain technology in digital information services: Opportunities and challenges. *Library Hi Tech*, 36(2), 254-265. https://doi.org/10.1108/LHT-10-2017-0211

Internet-Based Adaptive Pedagogies for Effective Utilization of Open Educational Resources: Enhancing Collaboration and Learning Communities among Distance Learners in the National Open University of Nigeria

Dr. Lucy Ndidiamaka Okonkwo
lnebeolise@noun.edu.ng +2348033613301
Dr. Angela Ebele Okpala
Aokpara@noun.edu.ng +2348136260702
Dr. Mercy Enefu Okwoli
Mokwoli@noun.edu.ng +2348033173383
Mr. Babarotimi Opeyemi Oluwaseun
boluwaseun@noun.edu.ng +2348179594943

National Open University of Nigeria
University Village, Plot 91,
Cadastral zone, Nnamdi
Azikiwe Express Way, Jabi, Abuja

Abstract

This study examined the access, utilization, and perceived effectiveness of Internet-Based Adaptive Pedagogies (IBAPs) and Open Educational Resources (OERs) among distance learners at the National Open University of Nigeria (NOUN). Adopting a quantitative research design, data were collected via a structured questionnaire administered through Google Forms. A multistage sampling technique was used to select 925 undergraduate students from the Awka, Enugu, and Umudike study centres, of which 862 valid responses were analyzed (93.2% response rate). The questionnaire, validated through expert review and pilot testing ($\alpha = 0.85$ for IBAP access; $\alpha = 0.90$ for OER utilization), captured student experiences with digital learning tools, including challenges, engagement levels, and collaboration. Findings revealed high levels of awareness of OERs (81.9%) and adaptive learning tools (77.4%). While platforms like the NOUN student portal and Moodle were widely used, daily engagement remained limited, with only 17.9% and 26.5% reporting daily use of OERs and adaptive tools, respectively. Challenges such as poor internet connectivity, high data costs, and lack of training significantly hindered effective usage. However, most respondents perceived the tools as effective in enhancing learning and fostering collaboration. The study concludes that while digital pedagogies have gained traction at NOUN, infrastructural and support-related barriers persist. It recommends improving internet accessibility, enhancing digital literacy, and expanding training and institutional support. These actions are essential for maximizing the transformative potential of IBAPs and OERs in distance education and achieving equitable, student-centered learning experiences.

Keywords:*Internet-Based, Adaptive Pedagogies, Open Educational Resources (OER), Collaboration, Distance Learners*

Introduction

Open Educational Resources (OERs) are essential in broadening access to quality education, especially within Open and Distance Learning (ODL) systems. As free and adaptable materials, OERs facilitate "5R activities"—retaining, remixing, revising, reusing, and redistributing—thereby encouraging collaboration and innovative teaching practices (Clinton-Lisell, 2021; Hewlett, 2024). Endorsed by organizations such as UNESCO (2019), OERs promote inclusive and participatory learning environments, aiming to reduce the high costs associated with commercial textbooks, which often hinder student access and performance (Hilton et al., 2019). At institutions like the National Open University of Nigeria (NOUN), OERs support affordable education for diverse learners; however, challenges such as low digital literacy, inadequate infrastructure, and insufficient integration into pedagogical frameworks limit their effective use (Njeze, 2020). Emerging adaptive pedagogies—leveraging AI, learning analytics, and recommendation systems—offer promising strategies for personalizing learning experiences and fostering collaborative communities, thereby enhancing OER adoption and student engagement (El-Sabagh, 2021).

Recent research emphasizes the importance of integrating technological innovations to address barriers and optimize OER utilization in distance education contexts. Tools like Moodle and TPACK-based platforms are instrumental in promoting collaboration and improving learning outcomes, especially when combined with adaptive pedagogies that tailor content to individual learner needs. Building on these advances, institutions like NOUN can develop more effective strategies to foster active engagement, peer interaction, and community building, ultimately contributing to more inclusive and effective open education ecosystems.

Problem Statement

Although Open Educational Resources (OERs) hold significant promise for broadening access to learning in distance education, many students at NOUN struggle to navigate and fully utilize these resources. A lack of adaptive learning support and limited opportunities for collaborative learning have led to low engagement and high dropout rates. Both practice and research reveal a gap in understanding how adaptive, internet-based pedagogical strategies can enhance OER usage and strengthen the sense of community among learners. This study responds to this critical need by designing and implementing pedagogical frameworks that not only tailor learning experiences to individual needs but also promote active collaboration and community building within open and distance learning (ODL) environments.

Research Objectives

1. To examine the extent of access to Internet-Based Adaptive Pedagogies and Open Educational Resources (OERs) among distance learners at the National Open University of Nigeria (NOUN), Awka study centre.
2. To investigate how Internet-Based Adaptive Pedagogies enhance collaboration and the development of learning communities among distance learners.
3. To identify the challenges affecting the effective utilization of Internet-Based Adaptive Pedagogies and OERs and propose strategies for improvement.

Research Questions

1. What is the level of access and utilization of Internet-Based Adaptive Pedagogies and OERs among distance learners at NOUN, Awka study centre?
2. How do Internet-Based Adaptive Pedagogies facilitate collaboration and the formation of learning communities among distance learners?
3. What are the challenges hindering the effective utilization of Internet-Based Adaptive Pedagogies and OERs, and what strategies can be implemented to overcome them?

Literature review

Access and Utilization of Internet-Based Adaptive Pedagogies and OERs among Distance Learners

Internet-Based Adaptive Pedagogies (IBAPs) have significantly reshaped global education by leveraging technology to enhance access to knowledge (Khosravi, Kitto & Buckingham Shum, 2020). The internet, as a central tool, supports academic engagement, learner autonomy, and broad educational accessibility (Onah, Altinay & Altinay, 2021). In Nigeria, it aids in research and teaching, helping universities provide timely and relevant information beyond traditional libraries. However, persistent issues such as high data costs, poor connectivity, and infrastructural gaps hinder full utilization. At the National Open University of Nigeria (NOUN), IBAPs and Open Educational Resources (OERs) are increasingly integrated to create flexible, student-centered learning environments (UNESCO, 2020). Yet, access and utilization remain uneven due to factors like electricity instability, low internet penetration, limited digital literacy, and varying awareness levels (Afolabi, 2019; Okonkwo and Yusuf, 2021; Eze, 2021). Although platforms like Moodle and Coursera are available, many learners use them primarily to download materials, neglecting interactive features such as quizzes and forums. Key barriers at NOUN Awka Study Centre include limited internet access, insufficient devices, and inadequate institutional support (Okonkwo & Chiemeka, 2022). Jegede (2021) notes that despite learners' familiarity with online learning, actual engagement with adaptive and open resources remains moderate due to technical and infrastructural constraints.

Facilitation of Collaboration and Learning Communities through Internet-Based Adaptive Pedagogies

Internet-Based Adaptive Pedagogies (IBAPs) play a vital role in fostering collaboration and building learning communities in distance education by promoting interactive, personalized, and peer-supported environments. They enable real-time learner-instructor and peer-to-peer engagement through tools like forums, group projects, social media, and virtual classrooms (Eze, Chinedu-Eze, and Bello, 2022). As universities globally invest in internet infrastructure, the benefits include quicker access to knowledge, multidisciplinary collaboration, and reduced reliance on costly hardcopy resources (Adeola, & Okonkwo, 2025). According to Connectivism theory, the internet supports dynamic knowledge networks, making collaborative learning more decentralized (Udo and Nwachukwu, 2024). In Nigeria, the internet is indispensable for students and staff, providing access to up-to-date scholarly content and enhancing intellectual and professional development (Khosravi, Kitto & Buckingham Shum, 2020). At the National Open University of Nigeria (NOUN), tools like Moodle, Zoom, and WhatsApp groups have strengthened collaboration and engagement (Adewuyi & Okonkwo, 2020; NOUN Directorate of Learning Content Management Systems, 2022). However, Eze (2021) noted that participation is often low without instructor motivation and structured tasks. IBAPs support learning communities by encouraging peer interaction, enabling feedback, and facilitating co-construction of knowledge (Okonkwo, & Oluwaseun, 2023; Ojedokun & Owolabi, 2021), thus mitigating the isolation typical of distance learning.

Challenges Faced by Distance Learners and the Impact on the Effective Utilization of Internet-Based Adaptive Pedagogies and Open Educational Resources (OERs).

Distance learners face numerous challenges that hinder the effective use of Internet-Based Adaptive Pedagogies (IBAPs) and Open Educational Resources (OERs). Technological barriers, such as limited high-speed internet, inadequate hardware, and lack of digital literacy, especially in rural areas, significantly impact access and navigation of learning platforms (López et al., 2022; Alvarez et al., 2021). Personal factors, including time constraints from balancing work, family, and education, reduce learner engagement, while low motivation and self-discipline further impede the use of IBAPs and OERs (Kebritchi et al., 2020; Moore et al., 2021; Wang, 2023). Social isolation due to limited face-to-face interaction affects learners' sense of connection, lowering satisfaction and retention (Garrison et al., 2021). Inadequate support systems, such as academic advising and peer interaction, also hinder engagement (Bennett et al., 2022). Additionally, concerns about the quality and curriculum alignment of OERs, along with inconsistent updates, reduce learners' trust and reliance on them (Hew et al., 2021; Cronin & MacLaren, 2022). Institutional barriers, including misalignment of pedagogies with curricula and lack of faculty training, further affect outcomes (Bishop et al., 2023; Pérez & Sampaio, 2022). Addressing these interrelated challenges requires strategic institutional, policy, and technological interventions to enhance equitable and effective distance education.

Methodology

Research Design

This study adopted a quantitative research design, utilizing a structured questionnaire to collect data on students' access to and utilization of Internet-Based Adaptive Pedagogies (IBAPs) and Open Educational Resources (OERs) among distance learners. This design enabled the researcher to objectively measure variables and analyze trends using statistical methods.

Research Setting

The research was conducted across three study centres of the National Open University of Nigeria (NOUN): Awka, Enugu, and Umudike. These centres were selected due to their strategic relevance in serving a diverse population of distance learners, providing a suitable setting for investigating digital learning practices.

Population and Sample

The target population consisted of 7,254 undergraduate students enrolled across nine faculties at the selected NOUN study centres. A multistage sampling technique was employed to select a representative sample of 925 students. The sampling process involved stratification by study centre and faculty to ensure proportional representation.Random sampling within each stratum to select participants across varying academic backgrounds and demographics.Of the 925 distributed questionnaires, 862 completed responses were received via Google Forms, representing a 93.2% response rate, which was deemed sufficient for robust analysis.

Data Collection Instrument

Data were collected using a structured questionnaire titled Internet-Based Adaptive Pedagogies for Effective Utilization of Open Educational Resources (IBAPEUOER). The instrument consisted of closed-ended questions designed to gather data onInternet access and connectivity, Awareness and usage of OERs and adaptive tools, Frequency and platforms of use, Perceived effectiveness of digital learning tools, Participation in online collaborative learning, and Challenges encountered in digital learning environments

Validity and Reliability

To ensure content validity, the questionnaire was reviewed by subject-matter experts in educational technology and distance learning. A pilot test was also conducted, and items were refined based on feedback. Reliability was evaluated using Cronbach's Alpha, yielding access to IBAPs: $\alpha = 0.85$, OER Utilization: $\alpha = 0.90$. These coefficients reflect high internal consistency, indicating that the instrument reliably measured the intended constructs.

Data Analysis

The responses were analyzed using the Statistical Package for the Social Sciences (SPSS). The analysis included descriptive statistics (frequencies, percentages) to summarize demographic data and usage patterns of IBAPs and OERs.

Presentation of result

Table 1: Respondents' Age Range

Age Range	Frequency	Percent	Valid Percent	Cumulative Percent
18–24	225	26.1	26.1	26.1
25–34	302	35	35	61.1
35–44	214	24.8	24.8	86
45 and above	121	14	14	100
Total	**862**	**100**	**100**	**—**

Table 1 reveals that the majority of NOUN respondents (61.1%) are young adults aged 18–34, with 35% in the 25–34 age group and 26.1% aged 18–24. Middle-aged learners (35–44) account for 24.8%, while only 14% are aged 45 and above. This indicates that NOUN primarily serves a younger adult population, yet still attracts a substantial number of older learners, highlighting its broad appeal across age groups. The age distribution suggests a diverse learner demographic, which may influence the design and delivery of digital learning tools and support services to meet varied generational needs.

Table 2: Respondents' Gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	379	44	44	44
Male	483	56	56	100
Total	**862**	**100**	**100**	—

Table 2 details the gender distribution of the respondents. Males represent a slight majority, comprising 56% of the sample, while females account for 44%. Although the gender distribution is not perfectly balanced, it indicates a reasonably equitable level of participation among both genders. The moderate male predominance may reflect broader trends in access to or interest in distance learning programs among different gender groups within the Nigerian educational context.

Table 3: Level of Study at the National Open University of Nigeria

Level of Study	Frequency	Percent	Valid Percent	Cumulative Percent
Undergraduate	765	88.7	88.7	88.7
Postgraduate	97	11.3	11.3	100
Total	**862**	**100**	**100**	**—**

As reflected in Table 3, the overwhelming majority of respondents are enrolled in undergraduate programs, comprising 88.7% of the sample. In contrast, postgraduate students make up only 11.3% of the respondents. This distribution underscores the National Open University of Nigeria's primary focus on undergraduate education. The relatively low proportion of postgraduate students may be attributed to limited program availability at the postgraduate level or a greater demand for undergraduate qualifications among the broader population.

Table 4: Duration of Study at NOUN

Duration	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 1 year	347	40.3	40.3	40.3
1–3 years	447	51.9	51.9	92.1
4–6 years	68	7.9	7.9	100
Total	**862**	**100**	**100**	**—**

As shown in Table 4, a majority of respondents (51.9%) have been enrolled at NOUN for between one and three years. Those with less than one year of study account for 40.3%, while only 7.9% have studied for four to six years. This suggests that most students are in the early or intermediate stages of their academic journey, indicating potential for ongoing engagement with institutional resources such as OERs.

Table 5: Familiarity with Open Educational Resources (OERs)

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	706	81.9	81.9	81.9
No	156	18.1	18.1	100
Total	**862**	**100**	**100**	**—**

Table 5 reveals a high level of awareness regarding OERs among respondents, with 81.9% indicating familiarity and only 18.1% reporting unfamiliarity. This widespread recognition underscores the growing role of OERs in the academic environment at NOUN.

Table 6: Frequency of OER Use in Learning

Frequency of Use	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	154	17.9	17.9	17.9
Weekly	285	33.1	33.1	50.9
Occasionally	250	29	29	79.9
Rarely	173	20.1	20.1	100
Total	**862**	**100**	**100**	**—**

As shown in Table 6, usage patterns of OERs vary among students. While only 17.9% use OERs daily, 33.1% report weekly use, and 29% access them occasionally. A notable 20.1% of respondents rarely use OERs. This distribution suggests that although awareness is high, consistent utilization remains uneven, pointing to opportunities for increased integration of OERs into regular learning activities.

Table 7: Platforms Used to Access OERs

Platform	Frequency	Percent	Valid Percent	Cumulative Percent
NOUN Student Portal	408	47.3	47.3	47.3
YouTube	92	10.7	10.7	58
OER Commons	121	14	14	72
NOUN Student Portal, YouTube	34	3.9	3.9	76
NOUN Student Portal, YouTube, OER Commons	59	6.8	6.8	82.8
NOUN Student Portal, YouTube, OER Commons, MIT OpenCourseWare	148	17.2	17.2	100
Total	**862**	**100**	**100**	**—**

The data presented in Table 7 indicates that the NOUN Student Portal is the most frequently used platform for accessing Open Educational Resources (OERs), with nearly half of the respondents (47.3%) relying on it. A significant minority also utilize comprehensive platform combinations, notably NOUN Student Portal, YouTube, OER Commons, and MIT OpenCourseWare (17.2%). Use of single platforms like YouTube (10.7%) and OER Commons (14%) was less common, suggesting that while centralized institutional access points are preferred, some students diversify their sources to broaden their learning resources.

Table 8: Awareness of Adaptive Learning Platforms or Tools at NOUN

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	667	77.4	77.4	77.4
No	66	7.7	7.7	85
Not sure	129	15	15	100
Total	**862**	**100**	**100**	**—**

Table 8 shows that a substantial majority of students (77.4%) are aware of adaptive learning platforms or tools available at the National Open University of Nigeria (NOUN), though a small segment remains unaware (7.7%) or uncertain (15.0%). This high level of awareness sets a favourable context for the integration and effectiveness of such tools.

Table 9: Frequency of Adaptive Learning Tool Use

Frequency	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	228	26.5	26.5	26.5
Weekly	314	36.4	36.4	62.9
Occasionally	235	27.3	27.3	90.1
Rarely	85	9.9	9.9	100
Total	**862**	**100**	**100**	**—**

Usage frequency data in Table 9 shows that 36.4% use adaptive tools weekly, 26.5% daily, and 27.3% occasionally. Only 9.9% reported rare use, suggesting that adaptive tools are regularly integrated into students' learning routines.

IBAPs and the Facilitation of Collaboration and Learning Communities

Table 10: Participation in Online Learning Communities Through NOUN

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	580	67.3	67.3	67.3
No	282	32.7	32.7	100
Total	**862**	**100**	**100**	**—**

Table 10 shows that engagement in online learning communities through NOUN is robust, with 67.3% of respondents participating. This level of involvement suggests that online peer interaction is a prominent feature of the learning environment and potentially contributes to collaborative knowledge building.

Table 11: Perception of Group Collaboration Support by Adaptive Tools

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	630	73.1	73.1	73.1
No	109	12.6	12.6	85.7
Not sure	123	14.3	14.3	100
Total	**862**	**100**	**100**	**—**

Finally, Table 11 shows that a substantial majority (73.1%) believed adaptive tools have supported group collaboration. Only 12.6% disagreed, while 14.3% were unsure. This affirms the perceived value of adaptive technologies in facilitating interactive learning experiences among peers.

Table 12: Platforms Used for Collaboration

Platform	Frequency	Percent	Valid Percent	Cumulative Percent
WhatsApp groups	224	26	26	26
NOUN Moodle forums	69	8	8	34
Google Classroom	9	1	1	35
Telegram groups	40	4.6	4.6	39.7
WhatsApp groups, NOUN Moodle forums	100	11.6	11.6	51.3
WhatsApp groups, Google Classroom, Telegram groups	43	5	5	56.3

WhatsApp, NOUN Moodle, Google Classroom, Microsoft Teams, Telegram	37	4.3	4.3	60.6
NOUN Moodle forums, Telegram groups	150	17.4	17.4	78
WhatsApp groups, Telegram groups	38	4.4	4.4	82.4
WhatsApp, NOUN Moodle, Google Classroom, Telegram	75	8.7	8.7	91.1
WhatsApp groups, Google Classroom	24	2.8	2.8	93.9
WhatsApp, NOUN Moodle, Google Classroom, Microsoft Teams	8	0.9	0.9	94.8
WhatsApp, NOUN Moodle, Google Classroom	30	3.5	3.5	98.3
None	15	1.7	1.7	100
Total	**862**	**100**	**100**	**—**

Table 12 reveals that WhatsApp groups (26.0%) and NOUN Moodle forums in various combinations (e.g., Moodle + Telegram at 17.4%) are the most used platforms for collaboration. The preference for informal tools such as WhatsApp, even in multi-platform combinations, reflects a student-driven trend toward accessible and mobile-friendly collaboration environments, although formal platforms like Google Classroom and Microsoft Teams remain underutilized.

Challenges affecting the effective utilization of IBAPs and OERs

Table 13: Major Challenges in Using OERs and Adaptive Tools

Challenges	Frequency	Percent	Valid Percent	Cumulative Percent
Inadequate internet connectivity	137	15.9	15.9	15.9
High cost of internet/data	184	21.3	21.3	37.2
Lack of training or technical support	59	6.8	6.8	44.1
Insufficient or irrelevant content	8	0.9	0.9	45
Inadequate internet connectivity, Lack of training or technical support	119	13.8	13.8	58.8

Inadequate internet, High cost, Lack of support, Navigation issues, Insufficient/irrelevant content	23	2.7	2.7	61.5
Lack of support, Insufficient/irrelevant content	188	21.8	21.8	83.3
Inadequate internet, High cost of internet/data	86	10	10	93.3
Inadequate internet, High cost, Navigation issues	10	1.2	1.2	94.4
Inadequate internet, High cost, Lack of support	20	2.3	2.3	96.8
Inadequate internet, Lack of support, Navigation issues	28	3.2	3.2	100
Total	**862**	**100**	**100**	—

Table 13 outlines the major challenges faced in using OERs and adaptive tools. High cost of internet/data (21.3%) and inadequate internet connectivity (15.9%) were the most frequently reported standalone challenges. Notably, 21.8% cited a combination of lack of training and insufficient or irrelevant content as significant barriers. This highlights persistent infrastructural and capacity issues affecting digital learning adoption.

Table 14: Training Received to Use Adaptive Learning Tools

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	394	45.7	45.7	45.7
No	309	35.8	35.8	81.6
Not sure	159	18.4	18.4	100
Total	**862**	**100**	**100**	**—**

Despite high awareness and perceived effectiveness, Table 14 highlights a gap in capacity building, as only 45.7% of respondents reported receiving adequate training on using adaptive learning tools. A notable 35.8% indicated they had not received any training, while 18.4% were unsure. This underscores the need for structured orientation and continuous support mechanisms.

Discussion of findings

The study highlights key trends and challenges in the use of Internet-Based Adaptive Pedagogies (IBAPs) and Open Educational Resources (OERs) among distance learners at NOUN. Most learners (61.1%) are aged 18–34, a digitally literate demographic and gender distribution is nearly balanced (56% male), reflecting inclusive access (UNESCO, 2020). A majority (88.7%) are undergraduates, with over 92% enrolled for less than three years, indicating a cohort in need of orientation (Afolabi, 2019).

OER awareness is high (81.9%), largely introduced by lecturers (54.2%) (Ellore et al., 2014), yet only 17.9% use them daily, reflecting underutilization. The NOUN Student Portal is the main access point (47.3%) with increasing multi-platform usage. While 77.4% are aware of adaptive tools, only 45.7% received formal training, echoing concerns on preparedness (Pérez & Sampaio, 2022). Despite this, perceived effectiveness is strong—79.6% find them effective, and 74.8% report improved learning outcomes.

Collaboration is robust, with 67.3% active in learning communities and 73.1% affirming group work benefits, mainly via WhatsApp and Moodle (Adewuyi & Okonkwo, 2020), supporting Connectivism (Siemens, 2005). Challenges include high internet costs (21.3%) and limited access (15.9%) (López et al., 2022; Okonkwo & Chiemeka, 2022), along with digital illiteracy and time constraints (31.1%) (Garrison et

al., 2021; Kebritchi et al., 2020). Learners prefer videos (21.8%) and e-textbooks (18.3%) and Moodle is the dominant platform (62.6%) with emerging AI tool use (10.8%).
Despite high awareness, effective utilization is limited by infrastructure, skills, and institutional support, requiring strategic investment in connectivity, training, and learner services (Jegede, 2021; Bishop et al., 2023).

Summary of findings

The study at NOUN found high awareness of OERs (81.9%) and IBAPs (77.4%), but daily usage remains low. Lecturers are key in introducing OERs, with platforms like Moodle and the student portal being most used. Adaptive tools are seen as effective, yet challenges like poor internet access, high data costs, and limited training hinder usage. Collaboration through WhatsApp and other platforms is common, though also affected by digital skill gaps and connectivity issues. Most learners are undergraduates in early academic years, favoring multimedia resources like videos and e-textbooks for learning.

Conclusion

IBAPs and OERs at NOUN improve engagement and performance, yet usage remains limited due to technological, institutional, and personal barriers. Despite high awareness, actual adoption is low. Success depends on addressing these challenges and enhancing support systems to promote digital inclusion and sustained academic participation.

Recommendations

1. To enhance the use of IBAPs and OERs at NOUN, key strategies include improving internet access and affordability, providing structured digital literacy training, and increasing institutional support through onboarding and helpdesks.
2. The university should curate updated, curriculum-aligned OERs and promote collaborative learning via both formal and informal platforms.
3. Faculty engagement and AI-based adaptive technologies should be encouraged to support diverse learning needs. Finally, regular monitoring of usage patterns is essential to identify challenges and inform targeted interventions, ensuring sustained engagement and academic success.

References

Adewuyi, O., & Okonkwo, L. (2020). Enhancing learning engagement through collaborative activities in open and distance education: A case study of NOUN. Journal of E-Learning and Online Education, 8(2), 44–56.

Adeola, F. & Okonkwo, L. (2025). *Designing effective collaborative platforms for distance learners in Nigeria: Opportunities and challenges.* Nigerian Journal of Open and Distance Education, 8(1), 34–50.

Afolabi, A. (2019). Utilization of Open Educational Resources by distance learners in Nigeria: An empirical study. Open Learning, 34(1), 25–38.

Alvarez, A., Rodriguez, V., & Torres, C. (2021). Digital literacy challenges for remote learners: A study of online education during the pandemic. International Journal of Educational Technology, 15(3), 201–215.

Bennett, S., Dunne, E., & Carré, C. (2022). The role of peer networks in supporting distance learning: A study of student experiences. Distance Education, 43(1), 105–120.

Bishop, A., Anderson, D., & Roberts, P. (2023). Institutional support for adaptive learning environments: Challenges and opportunities. Education and Information Technologies, 28(2), 875–895.

Clinton-Lisell, V. (2021). Open pedagogy: A systematic review of empirical findings. Journal of Learning for Development, 8(2), 255–268. https://jl4d.org/index.php/ejl4d/article/view/511

Cronin, C., & MacLaren, I. (2022). Quality assurance in open educational resources: Insights from educators and learners. Open Learning: The Journal of Open, Distance and e-Learning, 37(1), 25–40.

El-Sabagh, H. A. (2021). Adaptive e-learning environment based on learning styles and its impact on development students' engagement. International Journal of Educational Technology in Higher Education, 18(1), 1–24. https://doi.org/10.1186/s41239-021-00289-4

Eze, S. C. (2021). Digital competence among distance learners at NOUN: Implications for online learning. Nigerian Journal of Distance Education, 22(1), 78–94.

Garrison, D. R., Anderson, T., & Archer, W. (2021). The first generation of Community of Inquiry: A tool for

distance education. Distance Education, 42(2), 211–230.
Hew, K. F., Wijaya, A., & Ng, W. (2021). The role of quality in open educational resources and distance education: Perspectives from educators. Education Tech Research Development, 69(1), 5–24.
Hewlett, (2024). Open educational resources. https://hewlett.org/strategy/open-education/
Hilton, J., Larsen, R., Wiley, D., & Fischer, L. (2019). Substituting open educational resources for commercial curriculum materials: Effects on student mathematics achievement in elementary schools. Research in Mathematics Education, 21(1), 60–76.
Jegede, O. J. (2021). *Challenges in the use of adaptive and open educational resources in online learning environments.* Journal of Open and Distance Education, 18(2), 45–58.
Kebritchi, M., Lipschuetz, A., & Santiague, L. (2020). Issues and challenges for teaching successful online courses in higher education: A literature review. Journal of Educational Technology Systems, 48(1), 23–45.
Khosravi, H., Kitto, K., & Buckingham Shum, S. (2020). Personalized learning analytics: A review of the literature. *Journal of Learning Analytics*, 7(3), 50–71.
López, M., Ramirez, J., & Calderon, A. (2022). Bridging the digital divide: Internet access issues among distance learners in rural areas. International Review of Research in Open and Distributed Learning, 23(4), 34–51.
Moore, M. G., Anderson, W. G., & Smith, C. (2021). Balancing work and distance learning: An exploration of student challenges. International Journal of Lifelong Education, 40(3), 293–310.
NOUN Directorate of Learning Content Management Systems. (2022). Annual report on student engagement with e-learning tools at NOUN. Abuja: NOUN Press.
Okonkwo, C. A. (2020). A needs assessment of ODL educators to determine their effective use of open educational resources. International Review of Research in Open and Distance Learning, 13(4), 293–312.
Okonkwo, L., & Oluwaseun, B. O. (2023). *Digital competencies and adaptive learning systems in distance education: A Nigerian perspective.* Journal of Open Learning, 12(4), 112–129.
Okonkwo, L. & Yusuf, M. (2021). Bridging the Digital Divide in Distance Education: A Case Study of NOUN Students. *Journal of Open Learning and Digital Innovation*, 3(2), 67–84.
Onah, D. F., Altinay, F., & Altinay, Z. (2021). *Barriers to internet-based learning in Africa: A study of open distance learners.* Education and Information Technologies, 26(1), 47–67.
Pérez, A., & Sampaio, M. (2022). Faculty preparedness in integrating OERs into the curriculum: A case study. Journal of Open Educational Resources, 8(2), 121–132.
Udo, G., & Nwachukwu, B. (2024). *Social presence and learning satisfaction in virtual communities of Nigerian distance learners.* Open Learning: The Journal of Open, Distance and e-Learning, 39(1), 23–39.
UNESCO (2020). Open educational resources: Policy, costs, transformation and advocacy. Paris: UNESCO.
United Nations Educational, Scientific, and Cultural Organization (2019). UNESCO recommendation on open educational resources (OER). https://www.unesco.org/en/legal-affairs/recommendation-open-educational-resources-oer
Wang, Y. (2023). Self-regulation in distance learning: Factors influencing student engagement with online resources. Education Research International, 2023, 1–15.

Knowledge Management in Nigerian Libraries in the 5th Industrial Revolution

BY
Prof. Basil Onyeoziri Edom Cln.
Department Of Library And Information Science
Imo State University, Owerri
Onyeoziriedom@gmail.com
And
Dr. Eunice Uchechi Edom Cln.
Prof. G.m.umezurike Library
Imo State Polytechnic, Omuma
euniceedom@gmail.com

Abstract

Knowledge Management (KM) is the process of identifying, creating, storing and effectively sharing organizational knowledge to boost Productivity in the system. Knowledge management is very critical in every organization that wants to function effectively. It is the surest means of ensuring that the system remains viable to meet the goals of the organization. Libraries and other information centres adopt knowledge management strategies to ensure that critical information needed for the efficiency of the library is not lost. The 5th Industrial Revolution (5TH IR) introduced significant transformation in library operations and services through the use of artificial intelligence, internet of things, cloud computing, big data, etc. and this calls for a critical review of the knowledge management strategies adopted in libraries. This paper therefore presents a critical review of knowledge management in Nigerian libraries in the 5th industrial revolution. It highlighted the meaning and reasons for KM in libraries; stages of KM process and tools for effective KM in libraries in the 5th IR. The challenges of KM in libraries were also discussed. Due to the transformation introduced in libraries in the 5th IR, the paper concludes that every type and size of library in Nigeria should adopt good KM strategy which will help it to improve and sustain its functions and services to library patrons.

Key words: *Knowledge, Knowledge management, Industrial revolution, Libraries, knowledge sharing, Library technologies.*

Introduction

Knowledge simply means facts, information and skills acquired through experience, training or education. According to Gilanie (2022), knowledge is a familiarity, awareness or understanding of someone or something, such as facts, information, description or skills which is acquired through experience or education by perceiving, discovering, or learning. Again, Igwe, et al (2015) see knowledge as what an individual possessed after assimilating facts and putting them into context. Ipan and Scarbrouch as cited by Lin (2019) perceived knowledge as the sum of human idea and the sum of peoples' concepts of nature, society and thinking phenomena and essence. Documenting knowledge makes it accessible and transferable among colleagues and users.

Knowledge Management (KM) is the systematic process of capturing, storing, organizing, and sharing of organizational knowledge to enhance productivity, innovation and decision-making. According to Gatobu (2025), knowledge management is the creation, storage and collaborative sharing of employee information within the business environment. The author further stated that through sharing and collaboration, an organisation's efficiency, productivity and profitability is enhanced. Andrew (2025) also defined KM as the conscious process of defining structuring, retaining and sharing the knowledge and experience of employees within an organization.

Similarly, Jennex (2007) defined KM as the practice of selectively applying knowledge from previous experiences of decision-making to current and future decision-making activities with the express purpose of improving the organisation's effectiveness. Knowledge management involves organizing and disseminating information to ensure that valuable knowledge is accessible, which can enhance efficiency and decision-making. KM also focuses on fostering work environment that encourages knowledge sharing and retaining the expertise and experience of employees. Knowledge management is a multi-disciplinary approach aimed at maximizing the use of knowledge to achieve organizational goals.

When knowledge is not shared freely within an organization, it can be incredibly costly to the organisation as valuable time is spent seeking for relevant information to complete a given tasks. Knowledge management includes different, interdependence process of knowledge creation, knowledge storage, knowledge transfer and knowledge application (Lin, 2019). The author further stated that the complexity of the knowledge management process, resource requirements and potential tools and methods will vary depending on the type, scope and characteristics of knowledge management process.

There are different types of knowledge management. According to Davenpor as cited by Lai and Chu (2001), there are four types of knowledge management namely; creating knowledge repositories in which

knowledge can be reviewed easily; improving knowledge access to facilitate its transfer between individuals; enhancing a knowledge environment to conduct more effective knowledge creation, transfer and use and managing knowledge as an asset and concern about how to increase the effective use of knowledge assets over time.

In the 5th Industrial Revolution (IR), knowledge management will take a different dimension. This is because most conceivable human tasks hitherto performed by man will be carried out using technologically assisted process. With the introduction of Artificial Intelligence (AI), most humanly performed tasks may be carried out by robots. The 5th IR will deploy smart sensors, Cyber-Physical Systems (CPS) Internet of Things (IoT), Internet of Service (IoS), big data and analytics, Augmented Reality (AR), autonomous robots additive manufacturing 3 dimensional printing (3D printing) and cloud computing for optimum purposes (Ansheri, et al 2022).

Besides, the 5th industrial revolution challenges societies to rethink and adapt existing systems and structures to ensure that the benefits are inclusive and accessible (Pujihastuti, 2023). This is primarily because it underscores the importance of preparing a workforce with the skills and adaptability necessary to thrive in this evolving landscape. Skills such as adaptability, digital literacy and a deep understanding of ethical considerations in technology became invaluable in this context (Nwobu, et al 2024). For effective knowledge management in the 5th industrial revolution, library professionals are expected to possess diverse skills and relevant knowledge required to excel in this revolution. According to Oseji (2021), the era of 5th IR is characterized by swift technological advancements and digital metamorphosis and as such, the role of libraries is undergoing transformation. Librarians should have the ability to critically assess information for its accuracy, reliability and relevance before disseminating such information.

Library professionals should be possessing adequate technological proficiency in order to excel in the 5th IR. This is necessary because according to Tella, et al (2023), librarians must be comfortable with wide range of technologies like library management systems, digital assets management platforms as well as on-line research tools. Librarians should therefore prepare themselves adequately through training and re-training particularly, in the use of information and communication technology facilities to still remain relevant in the 5th IR. This will put librarians in a strategic position to embrace knowledge management in the 5th industrial revolution. This paper is aimed at reviewing knowledge management in the 5th industrial revolution.

Origin of knowledge management

The idea of knowledge management is not new as people think. This is because human beings have always been interested in acquiring and sharing knowledge. According to Spender (2015), knowledge management came into wider use in the 1990s. Knowledge management was popularized as tools and techniques for finding and managing firm's under-managed intangible knowledge assets. Knowledge management as a discipline is tied to the information age and the technological tools that have increased the ability to share and spread knowledge at a rapid pace (Dalkir, 2005). According to Mclnerney (2002), knowledge management emerged as a scientific discipline in the early 1990s, supported by individual practitioners and management theorists.

Thus, by mid 1990s, knowledge management was recognized by many of the world leading companies as a required asset for success. Some world leading companies in the world including the World Bank were visibly transformed through their understanding of the power of knowledge management. By 1919, the term Personal Knowledge Management (PKM) which means the management of knowledge at the individual level was introduced (Wright, 2005).

In the field of library and information science, Koenig and Neverosky (2008) stated that KM is a recent phenomenon which came into librarianship parlance in 1990s. The authors further stated that the earliest closely related print reference about KM appears to have been used in the context of library and information work. Similarly, Towe, et al (1997) also noted that knowledge management has only recently emerged as an explicit area of pursuit for managing organizations and equally became a topic of serious study or academic knowledge transfer.

Today, there are three components of knowledge management namely: people/culture, process and technology (Liebowitz, 2009). The author further stated that 80 percent of knowledge management is the people/culture, while technology enables processes of knowledge management to a large extent as acquisition of knowledge is also made easier; knowledge/information can be accessed quickly from any location. Ruggles as cited by Masic, et al (2017) classified knowledge management technology as tools that enhance and enable knowledge generation, codification and transfer; generate knowledge; code knowledge and transfer knowledge. Hansen, Nohira, et al (1999) observed that codification strategy is focused on the computer and people-to-documents approach, while personalization strategy focuses on people-to-people communication and not on stored knowledge objects in data bases. The authors equally stated that knowledge is shared directly and the role of information technology is to help the process of communication.

Modern KM involves systematic and intentional management of knowledge resources. This will enable workers in organizations like libraries to ask questions anonymously, contribute expertly and create a living knowledge base. According to Insider (2025), as we approach 2025, the landscape of KM is undergoing a significant transformation driven by technological advancements evolving organizational cultures and relentless pace of innovation. Information and communications technology is contributing tremendously to knowledge management in the 21st century.

Knowledge management in Nigerian libraries in the 5th industrial revolution

The 5th industrial revolution is characterized by fusion of physical, digital and biological processes with focus on human-electricity, sustainability and collaboration between human and machines to achieve greater success. The 5th IR made strong emphasis on personalization and craftsmanship. It introduced Artificial Intelligence (AI), robotics and Internet of Things (IoT). The 5th IR created a world where technology supports and enhances experiences and equitable access to digital benefits as well as brings solution to climate change and resources depletion. According to Noble, et al (2022), the 5th IR encompasses the notion of harmonious human-machine collaborations with specific focus on the well-being of the multiple stake-holders such as the society, companies, libraries, employees, library users, customers, etc. The authors further stated that 5th IR paved the way for evolution in thinking about leveraging human-machine collaboration for greater societal well-being. The 5th IR created higher value jobs which afforded greater personalization for customer improved design and freedom for workers.

The 5th industrial revolution is already gaining momentum in Nigerian libraries and information centres. It came with lots of transformation in library structure through the use of Artificial Intelligence (AI), big data, Internet of Things (IoT), etc. To cope with these changes, the roles of libraries and librarians are also undergoing significant transformation (Nwobu et al, 2024). According to Awoyemi (2022), the shift from traditional to digital libraries marks a significant paradigm change in how information is accessed, organized and disseminated.

The technological advancements in the 5th industrial revolution have tremendous impact on library management practices and this has enabled libraries to operate more efficiently. According to Karneli (2023), automation technologies particularly, the Radio Frequency Identification (RFID), tagging and self-checkout systems have modified and streamlined most routine tasks in the libraries and this gives librarians the opportunity to concentrate on more professional activities in their libraries. With the adoption of these sophisticated technology facilities in library operations, knowledge management in the 5th IR is taking a different level. This is primarily because these technological facilities have taken up most of the routine jobs in libraries. Knowledge transfer and knowledge in the 5IR involves knowledge creation, knowledge, knowledge storage, knowledge transfer and knowledge application. The 5th IR accommodates full the application of mechanical and digital machines and communication devices for information transfer over the networks (Ibinaiye & Jiyane, 2022). These improved mechanical and technological facilities have helped library and information science professionals to provide effective services to library patrons.

Library professionals in Nigeria are of the view that 5th IR technologies are going to improve data/information extraction, processing and effective service delivery. According to Ekwueme, et al (2024), the 5th IR has revolutionized library operations and services from traditional automation to advanced technologies, thus enhancing easy connectivity, speed and innovative solutions as well as boosting productivity and creating new library opportunities. Librarians should embrace the use of advanced technologies like AI robotics, IoT, cloud computing and three dimensional (3D) printing to enhance access, sharing of information and improve user experience (Ibinaiye & Jiyane, 2022). The 5th IR requires library professionals to develop common transferable skills as well as intangible skills useful in different work situations such as inter-personal communication skills, co-habitation ability to be open minded with the world and understanding of information and communication (Iiham & Apriliyanti, 2022).

Reasons for knowledge management in Nigerian libraries in the 5th industrial revolution

A lot of reasons have been adduced to provoking knowledge management by librarians and other related professionals in 5th industrial revolution. According to Andrew (2025), the major reasons for KM are; reduced time to find information; reduced time for new staff to become competent; reduced operational cost; improved customer satisfaction and improved bid win/loss ratio. Similarly, Insider (2024) asserts that the main reasons for knowledge management include; enhanced decision-making, increased efficiency and productivity, fostering innovations and competitive advantage.

Knowledge management is very important in every organization including libraries and information centres. Knowledge management practice in libraries enables library staff to be focused towards the achievement of the library goals. Different organizations including libraries and information centres are of the opinion that the reasons for knowledge management in libraries and other organizations include:

1. **Identification of skill gap:** Any library that embraces KM usually creates relevant documentation around implicit or tacit knowledge or consolidation knowledge. It highlights gaps in core competencies across the staff. This will provide valuable information to the library management and help them to restructure or even hire additional resources be it staff, information resources or equipment for optimum productivity.
2. **Make better informed decision:** Knowledge management system arm individuals and departments or units in the library with relevant knowledge about the system. It will help them to create the accessibility to current and historical enterprise knowledge. It will help the department or unit to up-skill and make more information-driven decisions that support library goals.
3. **Maintain enterprise knowledge:** Adopting KM strategies will enable the library to create an organizational memory.
4. **Operational efficiency:** Knowledge management practices create a-go-to-place that enables knowledge management workers to access the searchable time for such information and eventually lead to faster decision-making and cost-saving through operational efficiency.

5. **Increased collaboration:** Knowledge management strategy helps librarians to build trust among colleagues. It brings in transparency among colleagues and this creates understanding among them and enables them to collaborate and work harmoniously to achieve the goals of the library.
6. **Reduces knowledge loss:** It is very understandable that when employees leave their jobs either through resignation, retirement, death, or dismissed from job, their knowledge go them. A well-implemented KM system ensures that critical expertise is retained and transferred to new employees seamlessly.
7. **Data/information security:** Knowledge management strategy enables libraries to customize permission control, viewership control and the level of documentation security to ensure that information is shared only in the correct or target audience or even with selected individuals.

Stages of knowledge management process in libraries

There are many stages in knowledge management process in different organizations which libraries and information centres can leverage to build reliable KM process. According to Olmstead (2022), these KM stages create a structured framework to ensure that knowledge management is accessible, accurate and impactful. The stages in KM process include:

a). **Documentation:** This stage captures knowledge from diverse sources like employers, colleagues employees or expertise and process and provide feedback to the system. Documentation converts tacit and implicit knowledge to explicit knowledge format in the form of written guides, videos, tutorials or structured process work-flow.

b). **Organising and storing:** When knowledge is documented, it will be systematically organized for easy access. At this stage, the information is categorized, applying metadata tags and stored in centralized repositories.

c). **Sharing:** At this stage in KM process, the organized and stored information is shared to reach the right users at the right time. This can be done through collaborative tools, intranet or centralized knowledge repositories to disseminate information and facilitate knowledge exchange. These tools streamline access to critical resources, supporting collaboration and improving operational efficiency.

d). **Analysing:** Analysing knowledge simply refers to evaluating its relevance, accuracy and effectiveness. Organizations like libraries and information centres can use analytics tools to identify gaps, track usage patterns and refine their knowledge management strategies.

e). **Optimising and updating:** Knowledge must remain current and valuable as organization evolves or grows. At this stage, knowledge is continuously reviewed and the contents updated to reflect new insights, process and technologies.

Different libraries can adopt these KM stages to establish dynamic knowledge management framework to ensure that information is shared effectively and put to use to achieve the goals of the library.

Creating knowledge management strategies in Nigerian libraries.

To effectively practice knowledge management in the 5th industrial revolution, librarians working in libraries in Nigeria should create effective KM strategy. A robust KM strategy will help librarians to capture, organize and share information effectively among colleagues. A well structured strategy will identify the right knowledge that libraries and librarians need to manage and provide the blue print to keep the initiative going to align with the library goals. For effective KM in libraries and information centres in the 5th IR, Olmstead (2022) suggests that library professionals should adopt the following strategies:

1. **Build knowledge management team:** Heads of libraries should assemble a team of staff who understand the importance of managing organizational knowledge and who can champion the adoption and implementation of KM in their offices. This team of professionals will serve as the champions for the KM initiative and ensure that their suggestions are in harmony with the library goals.
2. **Identify knowledge goals:** Every library should define specific measurable goals for the knowledge management strategy of the library. The specific measurable goals must align with the general library objectives. This approach will provide a clear road map for the implementation of KM strategy in the library.
3. **Conduct a knowledge management audit:** A knowledge management audit assesses the resources assets of the library to identify the gaps that exist in the information resources stock. Knowledge management audit reviews where the information resources are in the library and who should have access to it and how effectively it will support the library goals.
4. **Adopt a good knowledge management technology:** It is very necessary that librarians should adopt appropriate technology tools which will help the library to achieve its KM goals. The use of appropriate technology for KM in the library will enhance seamless storage, retrieval, collaboration and sharing of appropriate information/knowledge among colleagues.
5. **Create a communication plan:** An effective communication plan with colleagues ensures that librarians and other colleagues understand the purposes and benefits of KM process. This will make them to put in their best to ensure that the library's KM goal is realized

Knowledge management tools for libraries

The success of any knowledge management largely depends on the selection of the right or appropriate tools to capture, store and share information effectively. Librarians should adopt various technologies to centralize the resources, encourage collaboration and enhance productivity. According to Olmstead (2022), the following KM tools can be adopted in libraries.

a). **Knowledge management-base software:** Knowledge management-base software like On-line Public Access Catalogue (OPAC), social media platforms, etc. are repositories for critical information such as policies, users guideline, etc. and ensures that librarians and library users have on demand access to accurate and up to date resources, enjoy reduced repetitive inquiries and expedite issues resolution. Knowledge management based software provides organizations like libraries with tools to create manage and organize their knowledge base.

b). **Frequently Asked Questions (FAQs):** This refers to a list of questions that library users often ask about in the library or through library website on the internet and immediate provisions of the answers to the questions. This is another simple way to answer client's queries in libraries. The library can create a website, intranets or even user portals to provide quick and prompt answers to users' queries. This helps them to maximize the need for direct support.

c). **Internal wiki platform:** Internal wiki platform as KM tool in libraries is a centralized repository where employees like librarians can access, create, share and manage library specific information in real time. Internal wiki will enable library staff to create, edit and share information collaboratively. This type of platform is user-friendly and adaptable, thus making them appropriate for documenting evolving processes, team workflow and organizational best practices.

d). **Library drive:** This refers to files or platforms for library file storage. Such file drive include Google drive and one drive which provides a centralized space for storing and sharing documents securely. The drives simplify version control and ensure team-wide access to the latest document.

e). **Artificial Intelligence (AI) chatbots:** A chatbot is a computer program designed to stimulate conversation with human users, especially over the internet. Artificial Intelligence chatbots as KM tool enhances access to information by delivering instant responses to queries using natural language processing tools. It provides accurate content-aware answers by retrieving data from integrated knowledge.

Challenges of knowledge management in Nigerian libraries in the 5th industrial revolution

The 5th industrial revolution is experiencing unstoppable proliferation of information resource in libraries and information centres which will likely pose problems for library professional to manage them. Knowledge management is an on-going, persistent and purposeful process that enables organizations like libraries to create, select, organize, conserve, disseminate and share knowledge to achieve strategic objectives in the system (Biygautane & Al-Yahaya, 2011). According to Ou and Davidson as cited by Edom and Edom (2015), organizations like libraries and information centres are usually confronted by a variety of knowledge management problems which include;

1. **Capturing tacit knowledge:** One of the most complex KM challenges which libraries struggle with in this 5th IR is how to capture tacit knowledge. It is often hard to articulate and even much difficult to document. If tacit knowledge is not captured or documented, there is every tendency that it may be lost when the particular employee/librarian who has the knowledge leaves the library or even when he/she changes roles in the library.
2. **Resistance to change:** Most library professionals are engulfed in doctrinal belief that can prevent them from adopting new knowledge management approaches in the 5th IR. Most librarians feel more comfortable sticking to familiar or already existing methods even when current systems are inefficient. Librarians may see knowledge management as extra work load to them.
3. **Information over load:** Disconnected system and unstructured data/information make it difficult for librarians to find the necessary information needed to serve library patrons and this leads to inefficiencies and frustration. Knowledge management systems tend to clutter overtime with outdated or redundant information piling up in the library. When users can't find the information resources they need within the shortest possible period, it can lead to frustration and lack of trust in that particular unit or the library generally.
4. **Maintaining up to date knowledge:** Some types of information resources particularly, medical and law books become outdated in a very short time because of increased scientific researches and changes in the legal system. In most libraries, keeping current information resources in these areas of study is very difficult because of paucity of funds and this may likely pose serious challenges to libraries and librarians in the 5th IR. Without regular update of current information resources, librarians might rely on outdated KM practices which distort efficiency.
5. **Breaking down silos:** This simply means sharing information among librarians in a particular library. When information is left with a particular librarian in the library, to collaborate with other

colleagues in the office may not be seen as important to him again. In such a situation, collaboration or team work among colleagues is discouraged. Silos prevent librarians from leveraging collective knowledge leading to redundant efforts and slower innovation. This as it were, will pose serious challenge for knowledge management in libraries in the 5th IR.

6. **Technology limitations:** It is obvious that even the best knowledge management strategy by any library or librarian can be frustrated when using poor or outdated technology facilities to perform some tasks in the library. Outdated technology facilities will likely discourage librarians from using them to perform their functions and provide effective services to library patrons. This may pose a serious challenge for KM by librarians in the 5th industrial revolution.
7. **Lack of clear guidelines:** Lack of clear guidelines on how knowledge should be captured, organized and shared by librarians will likely pose serious challenge to librarians in the 5th IR. Most librarians in notable libraries may not know what important documents are or even know how to manage them. This could lead to inconsistent practices and inefficiencies on how to manage important documents in such libraries and this will be a serious problem in the 5th IR.
8. **Lack of librarians' engagement:** Librarians may resist participating in KM initiatives in their libraries particularly when they see it as extra job or workload to them. If they don't see the value or feel that it is not relevant to their daily work schedule, they are unlikely to contribute to this laudable goal. This will definitely be a serious challenge for librarians in the 5th IR.
9. **Lack of knowledge sharing culture:** Most librarians in Nigeria are opposed to knowledge sharing culture and this has its impact on KM in the 5th IR. Librarians who know the importance of KM usually feel reluctant to share it with their colleagues through mentorship, guidance, collaboration or other viable methods. Without a sharing culture that values collaboration, team work and transparency, librarians may hoard or hesitate to share professional knowledge with colleagues. This attitude kills innovativeness and efficiency in libraries and this is a serious setback for KM in the 5th industrial revolution.
10. **Lack of leadership support:** This is also another challenge which KM in libraries has in Nigeria in the 5th IR. If experienced librarians do not champion KM initiatives in their libraries, the less experienced librarians may view KM as unimportant or even optional in their workflow. This attitude may frustrate KM in libraries in the 5th IR.

The way forward

To solve the KM problems in libraries in the 5th industrial revolution, it is suggested that the following steps should be adopted:

1. Build a knowledge management sharing culture in libraries.
2. Use the right and current technology facilities for knowledge management in libraries.
3. Set clear guidelines for library staff to follow in the knowledge management process.
4. Reduce information overload through regular audit to sieve the system of unnecessary information.
5. The use of appropriate library knowledge software is recommended for effective knowledge management in libraries.
6. Library managers should motivate their staff to contribute their own quota in the knowledge management process.

Conclusion

The 5th industrial revolution has introduced the use of different technological devices which is the cause of tremendous transformation in different libraries around the globe and this calls for effective knowledge management practices to sustain the tempo. To meet up with these changes and other demands of the 5th industrial revolution on libraries, libraries in Nigeria like their counter parts around the globe, should also engage in effective knowledge management practices which are what other libraries in developed countries leverage to sustain their services. Implementation of effective knowledge management practices requires good KM tool and strategies and the cooperation of every stake holder in the library sector. Organisations that own and fund libraries should provide good working environment for effective KM practices. Libraries in Nigeria should therefore adopt the 5th industrial revolution technologically friendly KM tools and strategies to enable it cope with the changes that came with the revolution in the area of library functions and services.

References

Andrew, I. (2025). Knowledge management. Retrieved from: https://www.valamis.com/hub/knowledge-management on 23/4/25

Ansheri,M.,Syafraudin,M. &Fitriyani, N.L.(2022). Fourth industrial revolution between knowledge management and digital humanies. Retrieved from: https://doi.org/10.3390/infor/13060292 on 18/3/25

Awoyemi, R. R. (2023). *Library Management Engagement with Emerging Technologies in Research and Learning: Handbook of Research on Facilitating Collaborative Learning through Digital Content and Learning Technologies.* Ibadan: ABC Press.

Biygautane, M. & Al-Yahaya, K. (2011). Eneblers and barriers to effective knowledge management: The case of Dubai Public Sector. Retrieved from: www.academa/edu/104937/eneblers-and-barriers-to-

effective-knowledge-management-the-case-of-Dubai-public-sector on 23/4/25
Dalkir, N. (2005). Knowledge management in theory and practice. Boston: Elsevier/Puttle Worth-Heinemann
Edom, B.O. & Edom E.U. (2015). Challenges of knowledge management in organizations in the knowledge economy. In K. N. Igwe, C. O. Nnadozie, A. O.Unagha, C.P.Uzuegbu and M. M. Naga (eds.) Fundamentals of Knowledge Management for the Knowledge Economy. Lagos: Zeh Communications
Gatobu, K.(2025). Definition of knowledge management. Retrieved from: https://www.academia.edu/6182533/definition_knowledge_management on 22/4/25
Gilanie, G. (2022). Knowledge and its types. Retrieved from: https://www.researchgate,com on 22/4/25
Ibinaiye, I. D. & Jiyane, G. V. (2021). The prospects of 5th industrial revolution and academic library services: Exploring the role of data science in the post pandemic period. Retrieved from: https://events.academicinformation-technology.org/proceedings/14.pdf on 28/3/25.
Igwe, K.N., Nnadozie, C.O. Unagha, A.O. (2015). Nature of knowledge and the knowledge economy. In K.N.Igwe, C.O. Nnadozie, A.O.Unagha and M.M. Naga (eds.) *Fundamentals of knowledge management for the knowledge economy.* Lagos: Zeh Communications.
Iiham, M. & Apriliyanti, M. (2022). Challenges of the industrial revolution era: 1.0-5.0. U niversity Digital library in Indonesia. Retrieved from: https://digitalcommons.uni.edu/libphilprac/6994 on 28/3/25.
Insider, K.M.(2025). The new era of knowledge management in 2025: Innovations and trends shaping the future. Retrieved from: https://kminsider.com/blog/the-new=era-of-knowledge-management-2025/ on 4/4/25
Jennex, M.E.(2007). What is knowledge management? *International Journal of Knowledge Management.* 1(4);i-iv. Retrieve from:https://www.researchgate/publication/314500732_what_is_knowledge_management. On 17/2/25
Lai, H. & Chu, T. (2001). Knowledgement management: a review of industrial cases. Retrieved from:https://diwqtxts1xzle.cloudfront.net/7274239/knowledge-management on 12/4/25
Karneli, O. (2023). The role of autocratic leadership facing the changing business environment. Journal of Contemporary Administration and Management. 1 (2): 77-83
Koenig, M. &Nerveroski,K. (2008).The origins and development of knowledge Management. *Journal of Information and Knowledge Management* 7(4):243-254.
Lai, H. & Chu, T. (2001). Knowledge management: A review of industrial cases. Retrieved from: https://diwqtxts1xzle.cloudfront.net/7274239/knowledge-management on 12/4/25.
Liebowitz, J. (2009). The quick bases of knowledge management in public health. Retrieved from: doi.10.1201/978/439806012.chl on 16/4/25
Lin, X. (2019). Review of knowledge and knowledge management research. American *Journal of Industrial and Business Management*. 9:1753-1760. Retrieved from: https://doi.org/10.4236/ajibm.2019.99114. on 13/3/25
Masic. B.,Nesic, S., Nikolie, D. & Dezeletovic, M (2017). Evolution of knowledge management. Retrieved from: doi.10.5937/industrija on 12/3/2025.
Mclnerney, C. (2002). Knowledge Management and the dynamic nature of knowledge. *Journal of American Society of Information Science and Technology.* 53(12): 1009-1018
Noble, S.M., Mende, m., Grewal, D. & Parasuraman, A. (2022). How harmonious human-machine collaboration is triggering retail and service revolution. *Journal of Retailing* 98(2): 199-208
Nohria, N.,Terney, T. & Hasen, M.T. (1999).What's your strategy for managing knowledge? *Harvard Business Review* 77(20): 106-116
Nwobu, B.K., Dumbiri, R. Ibia, M.J. & Oladokun, B.D. (2024). Libraries in the 5th industrial revolution: skills and knowledge required in preparing librarians for an uncertain future. In U.C. Udof et al (eds.) Digital Technology and Libraray Management in Higher Institutions of Learning in Nigeria. Port Harcourt: Chadick Printng Press.
Olmstead, L. (2022). What is knowledge management? Use cases challenges. Retrieved from: https://whstfix.com/blog/knowledge-management on 18/4/25
Oseji,N.A.(2020). Training of librarians for service delivery in the digital age in Federal university libraries in North-Central, Nigeria. *Niger Delta Journal of Libray and Information Science.* 1(1):59-69.
Pujihastuti, I. (2023). Disruptive finance: Facing challenges and finding opportunities in a new era. *Central European Journal* 31(2): 1126-1133.
Spender, J.C.(2015). Knowledge Management: origin, history and development. Retrieved from: https://www.researcgate.net/publication/312773414 on 30/3/25 Knowledge Management
Tella, H.T., Mai, N.H. & Duyan, H.N.(2023). Librarians professional development needs in the digital age: a case study of the learning resource centre, Can-Tho University, Vietnam. *Journal of Social Science and Humanities.* 65(3):82-88.
Towe, B.C, Pizziconi, V. & Wiig, K.M.(1997). Knowledge Management: Where did it come from and where it go. Journal of Expert System with Application 13(1):1-14. Retrieved from: Doi.10.106/s0957417(97)00018-3 on 15/4/25
Wright, K.(2005). Personal knowledge management : supporting individual knowledge workers performance. Knowledge Management Research and Practice 3(3):156-165

Knowledge Sharing Strategies for Information Service Provision among Librarians in Military University Libraries in Northern Nigeria

By

Abdulwasiu Ahmad Ismail
Nigerian Defence Academy, Kaduna
iaabdulwasiu@nda.edu.ng
07064759601

&
Lawal Umar, PhD
Department of Library and Information Science
Umaru Musa Yar'adua University, Katsina

Abstract

Knowledge sharing is a viable means of improving the provision of library and information services among various stakeholders in every user community. This paper attempted to investigate knowledge sharing strategies adopted for information services provision among librarians in military university libraries in Northern Nigeria. The study adopted survey research design to guide the study. The population of the study comprised of all the librarians in the military university libraries, which stood at a total of 124. Total enumeration technique was adopted due to the size of the population for the study. Questionnaire was used as the instrument for data collection. Out of the 124 questionnaires administered, only 118 librarians responded appropriately to the survey (95% response rate). The collected data was analyzed using SPSS version 25. The research hypothesis was tested using Pearson Product Moment Correlation at level of significance of 0.05. In order for libraries to notice a change in performance through the application of knowledge sharing practice, the study suggested that the library management should develop and maintain a written policy, which will help to set up a proper reward system in order to motivate staff to share knowledge among colleagues for improved information service provision in the library. The library management, through properly written policies and laid down plans, should build and maintain trust and a culture of knowledge sharing among librarians in the library in order to enhance their knowledge sharing, innovation and creativity. This can uplift the capabilities of the employees, which in turn will extend career opportunities and organizational success.

Keywords: *Knowledge Sharing, Information Service Provision, Librarians, Military University Libraries*

Introduction

Knowledge sharing strategies are steps and plans adopted to facilitate and sustain knowledge sharing. These strategies are categorized as either personalization or codification, in line with tacit and explicit knowledge. Personalization strategies deal with sharing tacit knowledge through direct person-to-person platforms such as mentorship, apprenticeship, communities of practice, meetings, seminars, job rotation, coaching, storytelling, and job shadowing. Codification strategies entail facilitating explicit knowledge sharing through technologies (Ali and Khan, 2017). Knowledge sharing has become an important tool in the hands of academic librarians to improve information service provision in the library. Institutions who realize the importance of knowledge sharing and its subsequent implementation are more likely to function better compared to those who do not. As a part of knowledge management, knowledge sharing is key to the creation of knowledge, and is also an essential practice to upsurge innovation, improve productivity and strengthen understanding among information professionals such as the academic library staff. To this end, Ajegbomogun and Diyaolu (2018) suggested that practicing knowledge sharing in academic libraries so that the creation and reuse of knowledge, for the provision of improved library products and information services to users, are enhanced. They also add that academic library employees, as the knowledge assets of the library, can share knowledge among themselves in order to reform library products and services. Academic library service providers, engaged in the practice of knowledge sharing, can boost the productivity of library services through the exploitation of their collective intellectual resources.

Academic libraries are service-oriented organisations established within higher institutions of learning. They, by virtue of their roles, provide significant resources and quality services in order to meet the teaching, learning, and research needs of their parent institutions. These libraries are also supportive of their parent institutions' mission in generating knowledge and equipping clients with the required knowledge to serve and function better in the society. Academic libraries have been referred to as both the nerve centres or hubs of academic activities in higher learning institutions, and the hearts of the universities. They are expected to be leaders in providing information services to their user communities. The academic library

user community is made up of students, faculty members, lecturers, researchers, administrative staff, and other staff of the parent institution. Library employees in academic libraries in Nigeria, have been reported as often unenthusiastic to engage in knowledge sharing among colleagues to share their expertise and so when they leave the profession or workplace, they oftentimes leave with their knowledge which is highly useful for service provision. Loss of knowledge due to employees quitting or retiring may pose a threat to mentoring of new staff and results to inefficiency lost. The consequences of this knowledge loss are the inability of the library to learn from past mistakes, duplication of tasks, and also lost of potential mentorship for training and retraining of library personnel which eventually negatively affect service provision (Tahleho, 2016).

Statement of the Problem

The efficiency and relevance of academic libraries is measured largely by the library services rendered through the availability of library material and skilled human resources. The relevance of knowledge sharing towards the provision of these library services cannot be overstated. The goals of knowledge sharing in academic libraries are to share top library practices, library policies, and lessons learned while performing library services. Librarians also share their knowledge about daily tasks, how to solve problems and ideas for library development. This unarguably leads to improved service provision in academic libraries. Study has revealed that knowledge sharing practices are not fully integrated in most libraries and knowledge sharing brings about innovation and creativity in organizations. On the other hand, there seems to be low provision of a technology-enhanced library services in military university libraries in Northern Nigeria which could improve service delivery to the users in this challenging digital environment.

The service provision in the library is ineffective in meeting the goals of the library and, by extension, the mission of the parent institutions. This is as a result of some librarians being unskilled, inexperienced, or poorly trained and knowledge loss, resulting from staff retirement and resignation. Librarians at Military university libraries in Northern Nigeria have different sets of skills which, if combined, could improve service delivery. By not sharing and retaining this existing wealth of knowledge, it means when librarians retire or resign from work, they will certainly take the knowledge they possess (especially tacit one) with them. The result of this knowledge loss is that the library may be plagued with inability to learn from past experiences, which leads to reinvented wheels, unlearned lessons and the pattern of repeated mistakes. Losing knowledge through retirements or resignations could reduce the availability of potential mentors for new employees. When people leave, efficiency is lost, which in turn leads to cost-cutting strategies, and simply adding more human resources is not a viable solution. When senior and knowledgeable people leave an organization, they could take with them knowledge that afforded the organization a competitive advantage. It is in view of the above shortcomings that knowledge sharing strategies for information service provision among librarians in Military University libraries in Northern Nigeria was investigated.

Objectives of the Study

The general objective of this study is to investigate the knowledge sharing strategies for information service provision among librarians in Military University Libraries in Northern Nigeria. The specific objectives are to:

1. Find out the types of knowledge sharing strategies adopted among librarians in Military University Libraries in Northern Nigeria
2. Ascertain the types of information services provided among librarians in Military University Libraries in Northern Nigeria

Research Questions

This study provided answer to the folowing research questions:

1. What types of knowledge sharing strategies for information services provision are adopted among librarians in Military University Libraries in Northern Nigeria?
2. What are the types of information services being provided among librarians in Military University Libraries in Northern Nigeria?

Research Hypothesis

The following hypothesis was formulated for the study:

$H1_1$: There is statistically significant relationship between knowledge sharing strategies and information service provision among librarians in Military University Libraries in Northern Nigeria

Knowledge Sharing Strategies among Librarians in Academic Library

Knowledge sharing strategies are categorized as either personalization or codification, in line with tacit and explicit knowledge. Personalization strategies deal with sharing tacit knowledge through direct person-to-person platforms such as mentorship, apprenticeship, communities of practice, meetings, seminars, job rotation, coaching, storytelling, and job shadowing (Ali & Khan, 2017). However, these knowledge sharing strategies for information service provision in academic libraries include:

Community of Practice (CoP)

CoP refers to a group of individuals or team members who have maintained a work relationship over a period of time, and through extensive interaction, have established a common interest and desire to share their tacit knowledge (Maestro, 2020). Communities of practice (Cops), as a communication channel of knowledge sharing are formal and informal groupings of people who voluntarily share similar interests and goals. It consists of a group of people, in an organization, who forms an interactive group in order to share their expertise, learn from each other, with regard to certain aspects of their tasks, and provide a social framework for those tasks (Maestro, 2020).

Social Networks

This refers to a more formal and structured institutional capacity of knowledge sharing especially those in spheres that are critical to the organization. Social networks are one of the most common tools of Web 3.0 technologies that support collaboration, knowledge sharing, interaction and communication among users in different places who come together with a common interest or goal (Maestro, 2020).The literature revealed that the use of social networks has gained impetus in many organizations, particularly university libraries. ICTs like Web 3.0 are playing an important role in dissemination of knowledge and in communication. Examples of social networks that can enhance or support knowledge sharing in university libraries are: video-conferencing/telephone, groupware such as lotus notes, intranets/internet, portals, expertise location, electronic bulletin boards, knowledge directories, databases, electronic mails, intelligent search engines and weblogs, Facebook and Twitter (David-West and Nmecha, 2019).

Storytelling

This refers to a storytelling session, whereby the person who attends an event or training session is given the opportunity to disseminate the knowledge gained to others within the organization. Storytelling is an in-depth discussion that happens during and after completion of a project, workshop or an activity, to capture what lessons were learnt during the entire activity. Stories are used to impact tacit knowledge from one person to another. Sharing stories enables people to learn through other peoples' experiences (Ajegbomogun and Diyaolu, 2018).

2.3.4 Knowledge Repositories

Knowledge repositories as a strategy for knowledge sharing facilitate the documentation of relevant operational knowledge in order to mitigate attrition challenges and aid in the learning period for new employees (Tahleho, 2016). Bawack (2019) defines knowledge repositories as "organizational knowledge that consists of large databases, data warehouses, internet and intranet". Documenting operational knowledge could assist individuals to internalize their experiences, thus enriching their tacit knowledge. Integrated systems such as databases, internet and knowledge management systems (KMS) facilitate the sharing and transferring of explicit knowledge to other people, thus transferring experiences of others indirectly.

Staff training/Human Resources Development

Staff training enables employees to update their skills and to promote knowledge sharing through the exchange of experiences and new ideas (Schonfeld, 2019). The use of extensive training and development programmes could help library staff to gain skills and build confidence to interact and share tacit knowledge with others. By increasing interaction it helps to increase interpersonal ties, shared norms and trust with each other. Training is very useful in retaining organizational knowledge and intellectual intelligence. A report compiled by the Association of Commonwealth Universities on the state of Commonwealth libraries on the development of new skills of librarians indicated that 90% of libraries surveyed cited a need for staff training and development on the use information and communication technologies (ICTs) as knowledge sharing tools (Ifeoma, 2019).

Mentorship Programmes

Mentorship is one way in which knowledge in an organization can be shared or transferred. In mentoring, the mentor demonstrates how an activity is to be performed and can enhance the learning experience. Mentorship programmes as a knowledge sharing strategy enable senior employees to share their knowledge, specific insights and skills with their juniors within a short space of time, such that when the experienced employees leave the organization the knowledge is retained within the organization (David-West & Angrey, 2018). Ihekwoaba & Okwor (2019), studying mentoring circles in higher education in Australia revealed that mentoring groups worked for those who felt comfortable working in a group.

Job Shadowing

Job shadowing is a great mechanism to share knowledge from one individual to another. It provides an employee with the prospect of learning how other colleagues work and what tasks they execute. It develops a greater knowledge and understanding of the roles and functions of others within the organization.

Knowledge is shared in dealing with day-to-day challenges in the process of job shadowing, which is very useful in situations where experienced employees are leaving the organization. According to Heathfield (2020) job shadowing is a process of pairing an inexperienced employee with one who is already experienced, and who is capable of sharing such experience. Similar to mentoring, job shadowing requires the personnel requiring knowledge to shadow those personnel who possess the required knowledge.

Job rotation

Job rotation can be defined as working at different tasks or in different positions for set periods of time in a planned way using lateral transfers aiming to allow employees to gain a range of knowledge, skills and competencies and is also seen as an on-the-job training technique. Ali and Khan (2017) argued that many organizations are now concerned about their employees being so called "multi-taskers". Their concern is based on the premise that multitasking is good for organizational development. The name multi-tasking is given to an employee who is able to handle many jobs outside his or her job scope. Such person is able to do any job that is assigned to him and this gives the management more confidence that the person can be depended on even when other employees are not around.

Service Provision in Academic Libraries

Today's academic library has witnessed a significant change in its operationality due to technological advancements, a change in the higher education model, and a rapid change in user needs and demands during the digital era (Xiao,2020). Although the mission of academic libraries remains the same, the means of sustaining and fulfilling it has changed during the digital era. The services of academic libraries have expanded as well as witnessed tremendous changes in the model of provision from the 20th century (Chawner and Oliver 2013; Reid, 2019). However, the traditional services have remained relevant with changes only in their provision. Circulation services are central to, and a traditional part of, the academic library. This is because these services ensure the easy circulation of library resources. Circulation services is the blanket term used to refer to several services, such as SDI, current awareness, user education, borrowing services, renewal services and library cooperation (inter-library loan), borrower and renewal service, user education, referral service, document delivery service. The issuing, record keeping procedures and weeding of library resources are all part of the circulation services provided by academic libraries (Idakwo, Shehu, Saba and Dankwalba, 2018).

The reference services of the academic library play an essential role in bridging the gap between the library patrons and library resources. Basically, the reference services encompass a process where a reference librarian provides responses and assistance to library patrons in person, through mails (including electronic mails), or over the phone (Okoroma, 2018). The digital age changed the way in which the academic library's reference services are provided. This change birthed, among others, the library's Virtual Reference (VR) services, also known as the Digital Reference services (DRS). The Virtual Reference (VR) services are provided through the Internet, usually with the use of chat software, but alternatively through email, or other virtual means. The origin of email, chat, and instant messaging (IM) engendered the virtual reference services, just like the origin of telephones/mobile phones stimulated telephone reference services. VR services allow alliances to occur between two or more individual librarians and the library users. The multiple face-to-face reference desks can become a single online virtual reference point. Referral and other services are delivered instantly since queries are sent directly to a specialized reference librarian by sifting software or forms (Schonfeld, 2019).

Organisational Knowledge Creation Theory (Seci Model)

The knowledge creation theory explains knowledge sharing as a continuous process. In this theory, tacit knowledge is converted into explicit knowledge, and vice versa (Mbugua 2018; Dikotla 2016). The theory enables a continuous process of creation, conversion, and reuse as individuals perform tasks and acquire new knowledge. The knowledge creation theory was first proposed by Nonaka in 1991 and expanded on by Nonaka and Takeuchi in 1995. Nonaka and Takeuchi based their theory on the two major types of knowledge, namely tacit and explicit knowledge. They proposed four models by which the two types of knowledge can be created and shared in an organization. These four modes are socialization, externalization, combination, and internalization (SECI).

Socialization

Socialization processes involve transferring tacit knowledge, and converting tacit knowledge into tacit knowledge, through observations, when working with more skilled and knowledgeable people. It is the conversion of one's tacit knowledge into that of another, which occurs from the sharing of experiences between people (Menolli, 2015). In this study, socialization explores how the tacit knowledge of one staff member is converted and transferred into new tacit knowledge for another staff member at the Military university libraries. It is indicated in the reviewed literature that the socialization mode ensures the flow of tacit knowledge within the library. This can be achieved through observations, formal meetings, job rotation, and training programmes, especially for new staff members.

Externalization

Externalization is the process of converting tacit knowledge into explicit (documented) knowledge. It is the process of documenting and verbalizing tacit knowledge for easy access. This process is important to any organization, but a difficult knowledge conversion process. Externalization in this study clarifies how the Military university libraries in Northern Nigeria, converts and codifies its staff members' tacit knowledge into explicit knowledge, for easy access and use by all staff. This tacit knowledge can be converted or codified into documents, such as reports, manuals, minutes, memos, authority files or policy papers, for future reference, which could aid the provision of services. An example of this is a common practice often found in the reference and cataloguing and classification sections of the academic library, where staff members document specific knowledge related to daily tasks and procedures, by formulating a document often referred to as the authority file for future reference. This authority files can then be consulted by any staff who find them relevant, to carry out tasks when needed.

Combination

In the combination mode explicit knowledge is converted into explicit knowledge, that is, explicit knowledge is created using a different existing coded knowledge. The combination mode, which is considered the simplest form of knowledge conversion, allows for several documents and databases to be reconfigured and developed into organizational knowledge, leading to knowledge sharing within and outside the organization. Employees and individuals exchange and combine knowledge via meetings, groupware, the exchange of documents, and phone conversations (Othman, 2014). Combination is the simplest form of knowledge sharing, where explicit knowledge is converted into a more complex and systematic explicit knowledge, using different forms of explicit knowledge. This basically explains how explicit knowledge is categorized and reconfigured in order to form a more valuable and defined explicit knowledge. An example of this is the formulation of annual reports, where the university librarian, who is the head of the library, collects reports from the various section heads in order to form an annual report. This annual report is then disseminated to the entire staff as new knowledge. For this study, combination helps to examine how the Military university libraries in Northern Nigeria categorizes and reconfigures the different captured explicit knowledge into a more valuable, explicit knowledge, which can be used by all the library's staff.

Internalization

The last mode, which is internalization, involves the conversion of explicit knowledge into tacit knowledge, to the traditional concept of learning. This is when individuals acquire tacit knowledge by internalizing explicit knowledge, which means 'learning by doing' (on the job) or 'trial and error' using explicit sources (Farnese et al. 2019). Here, employees and individuals make use of explicit knowledge through listening to and reading manuals or documents about their tasks and organization, and reacting to them in order to create valuable tacit knowledge and enrich their knowledge base. Internalization in this study will help to examine how the staff at the Military university libraries in Northern Nigeria, incorporate or utilize explicit knowledge in their daily tasks, thereby creating new tacit knowledge in the process. According to Nonaka (1994), internalization is the conversion of explicit knowledge into tacit knowledge, to the traditional concept of learning. The implication of internalization in the MUL is that when the staff members are exposed to explicit knowledge on library practices or operations, they incorporate this in their daily tasks, and form new individual tacit knowledge in the process, which will eventually become a valuable asset to the entire library. For example, in job orientation programs, new staff members can assume new roles by ordinarily studying documents or task manuals, and reflect upon them, in order to form their own new knowledge, or boost their existing knowledge.

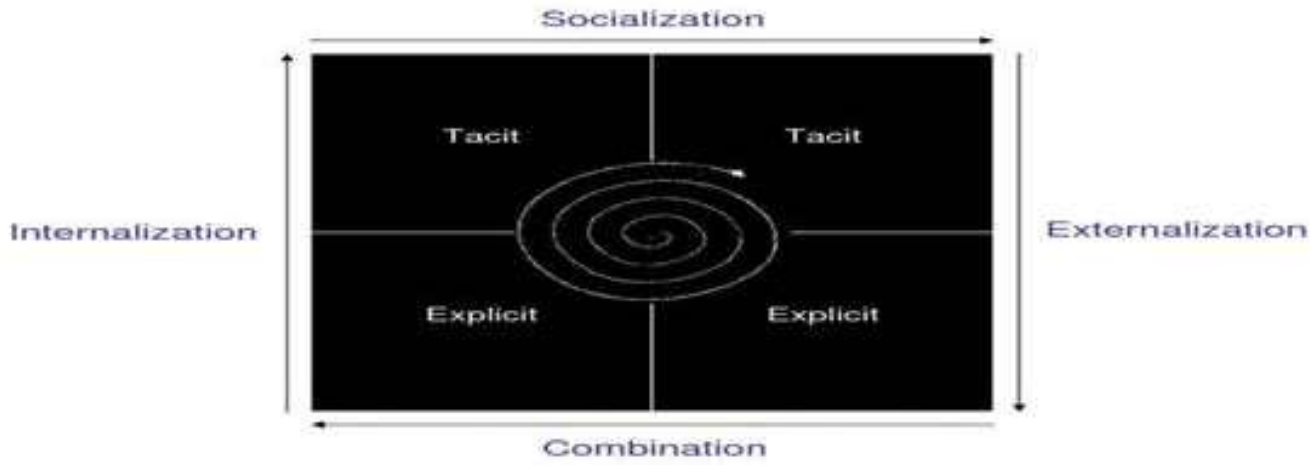


Figure 1.1 the knowledge spirals as illustrated by Nonaka and Takeuchi (1995)

The SECI theory guides this study in order to understand the knowledge sharing practice, encouragements, and sustainability among librarians at the Military university libraries in Northern Nigeria for improved information service provision. Based on the reviewed literature, this theory is considered useful for this study in examine how knowledge is created, documented, and shared among librarians in Military university libraries in Northern Nigeria. The SECI is also relevant in examining the knowledge sharing strategies, knowledge sharing tools and factors that facilitate knowledge sharing at the Military university libraries in Northern Nigeria. According to the reviewed literature, the SECI theory enables a continuous process of creation, conversion, and reuse. This is because it appreciates the dynamics surrounding knowledge and knowledge sharing, and elucidates how knowledge can be generated and shared through the four modes of socialization, externalization, combination, and internalization.

Methodology

The survey research design was adopted for this study. Survey design is considered appropriate because it would give the opportunity to gather responses from a large number of respondents in Military University libraries in Northern Nigeria. The population of this study consisted of all librarians in Military University libraries in Northern Nigeria. There are 124 librarians in Military University libraries in Northern Nigeria (Library Secretary Office 2025). The sample size for this study was 124 respondents, considering the manageable population size, all members of the population were used. Therefore, total enumeration was used for the study. Self-structured questionnaire was designed by the researcher in order to obtain responses from the librarians. The questionnaire was closed-ended questions. A total number of 124 copies of the questionnaire were administered to librarians while 118 questionnare were dully completd and returned. The data for this study was analyzed using descriptive and inferential statistics. The research questions were analyzed carefully using frequency distribution, simple percentage scores, mean, and standard deviation.

Result and Discussion

Research Question One: What are the knowledge sharing strategies of librarians in Military University Libraries in Northern Nigeria

Table 1. Presents information on the knowledge sharing strategies of librarians.

SN	knowledge sharing Strategies/Methods	SA (F%)	A(F%)	N(F%)	D(F%)	SD(F%)
1	Staff training	68(57.6%)	50(42.4%)	0(0%)	0(0%)	0(0%)
2	Communities of practice	36(30.5%)	73(61.9%)	6(5.1%)	3(2.5%)	0(0%)
3	social Network site	71(60.2%)	46(39.0%)	1(0.8%)	0(0%)	0(0%)
4	Storytelling	3(2.5%)	2(1.7%)	1(0.8%)	56(47.5%)	55(46.6%)
5	knowledge repository	63(53.4%)	53(44.9%	0(0%)	1(0.8%)	1(0.8%)
6	Mentorship and Peer Learning	62(52.5%)	52(44.1%)	1(0.8%)	3(2.5%)	0(0%)
7	Job shadowing	60(50.8%)	51(43.2%)	4(3.4%)	2(1.7%)	1(0.8%)
8	Job rotation	29(24.6%)	70(59.3%)	19(8.5%)	6(5.1%)	3(2.5%)

Respondents were asked to indicate the knowledge sharing strategies or methods they use to enhance information service provision in the library. From the findings, it was observed that 68 (57.6%) strongly agree and 50 (42.4%) agree that they use staff training/human resource development to enhance information service provision in the library. When asked about communities of practice, 36 (30.5%) strongly agree and 73 (61.9%) agree that they used communities of practice to enhance information service provision in the library. Whereas 71(60.2%) strongly agreed and 46 (39.0%) agree that they used social network sites to enhance information service provision in the library. also, 3(2.5%) were in strong

agreement and 2(1.7%) agreed that they use storytelling to enhance information service provision in the library. Similarly, majority 50(42.4%) strongly agree and 53 (44.9%) agreed that they used knowledge repository to enhance information service provision in the library. Another 50 (42.4%) strongly agree and 63 (53.4%) agree that they used performance evaluation to enhance information service provision in the library. When asked about the use of mentorship and peer learning to enhance information service provision in the library, 62 (52.5%) strongly agreed whereas 52 (44.1%) agreed. In the same vein, 60 (50.8%) strongly agreed and 51 (43.2%) agreed that they used job shadowing to enhance information service provision in the library. A majority of respondents 34 (28.8%) strongly agreed and 70 (59.3%) agreed that they used interactive learning experience to enhance information service provision in the library. Finally, 29 (24.6%) strongly agreed and 70 (59.3%) agreed that they used job rotation to enhance information service provision in the library.

What are the types of librarians' service provision in Military University Libraries in Northern Nigeria?

Table 2. presents information on the types of Information Service Provision available in Military University libraries in Northern Nigeria.

SN	Services	Yes		No	
		Frequency	Percentage	Frequency	Percentage
1	Reference services	118	100%	0	0%
2	Lending services	118	100%	0	0%
3	Research support service	113	95.8%	5	4.2%
4	Reprographic service	115	97.5%	3	2.5%
5	User Orientation service	104	88.1%	14	11.9%
6	Current awareness services	87	73.7%	31	26.3%
7	Inter-library loan services	52	44.1%	66	55.9%
8	Referral Services	61	51.7%	57	48.3%
9	Document delivery services	64	54.2%	54	45.8%
10	Information Technology (IT) Related Services	92	78.0%	26	22.0%

The results in table above shows that all the services listed were offered at the military university libraries with the degree of services offered defer according to the libraries and librarians. The services which received the highest affirmative responses of 118 (100%) were the reference service and lending or circulation service. This is follow by reprographic service with 115 (97.5%) while only 3 (2.5%) with negative response. The next service that received the highest response was E-service with 113 (95.8%) affirmed the provision of E-service with only 5 (4.2%) negative response. Also, user orientation service received a positive response of 104 (88.1%) with only 14 (11.9%) negative response. On the other hands, information technology related service receive a positive response of 92 (78.0%) abut library service provision while 26 (22.0%) respondents gave a negative response. Meanwhile, current awareness services received an affirmative response of 87 (73.7%) abut library service provision while 31 (26.3%) respondents gave a negative response. Document delivery service and referral services receive a positive response about library services provision with 64 (54.2%) and 61 (51.7%) respectively, while 54 (45.8%) and 57 (48.3%) gave negative affirmative response about library services provision. Inter-library loan services in the library received an affirmative response of 52 (44.1%) whereas 66 (55.9%) respondents gave a negative affirmative about library service in the military university libraries in Northern Nigeria.

Test of Hypothesis

$H1_1$: There is significant relationship between knowledge sharing strategies and information serviceprovision

Table 4.11 Knowledge Sharing Strategies and Information Service Provision

Correlations			
		knowledge sharing strategies	information service provision
knowledge sharing strategies	Pearson Correlation	1	.214*
	Sig. (2-tailed)		.020
	N	118	118
User Orientation service	Pearson Correlation	.214*	1
	Sig. (2-tailed)	.020	
	N	118	118
*. Correlation is significant at the 0.05 level (2-tailed).			

The data above revealed that there was a strong positive correlation between the knowledge sharing strategies and information service provision of librarians in military university under investigation which was statistically significant (r=.214; n= 118; p= .020) i.e less than 0.05 therefore, the study reject the null hypothesis and accept the alternative hypothesis since $p < 0.05$ this implies that there is positive statistically significant relationship between knowledge sharing strategies and information service provision of librarians in military university libraries in Northern Nigeria.

Discussion of Findings

The findings on knowledge sharing strategies of librarians in Military University libraries in Northern Nigeria indicated that the respondents strongly agreed that librarians use staff traning, social network site, knowledge repository, mentorship and peer learning, community of practices, job shadowing and job rotation to enhance and facilitate knowledge sharing in the Miitary university libraries in Northern Nigeria. The result showed that there is a limitation in the use of knowledge sharing strategies such as storryteing. The Library as an organization, through knowledge sharing can accelerate the process of knowledge creation and reuse of knowledge through more than the knowledge sharing methods indicated by the sampled librarians so as to move its services forward in this technology advanced age.

O the contrary, Chipeta (2018) and Muchaonyerwa (2015) emphasized the insignificant use of web 2.0 tools such as blogs, wikis and twitter for knowledge sharing among academic library staff members. They further argued that even though these staff members are acquainted with, and make use of, blogs and wikis, they do so only for social networking, and not for sharing knowledge which would benefit the library's operation or improve on its service provision. In the same vein, Onifade (2015) in a study on knowledge sharing in Nigeria showed that Nigerian librarians in Federal Universities have a positive perception on knowledge sharing. The study also revealed that regardless of Nigerian libraries having a positive perception on knowledge sharing, knowledge sharing strategies is still very low among the staff of most university libraries in Nigeria.

The result on the types of service provision revealed that libraries in Military University libraries in Northern Nigeria provide reference services, current awareness services, lendng service, research support service, user orientation services, document delivery service and information technology related service, while provision of interlibrary loan service was very low and need to improve. Similarly, Ikolo (2018) further concluded that the provision of interlibrary loan services in the library is inadequate and often not available. Hence, the researcher recommendation that, the academic libraries should increase their provision of interlibrary loan services to users. The findings of the study on the types of library services revealed that the online service delivery is moderately low in tertiary institutions in Lagos State because the respondents only agreed to the provision of a few online library services when there are other online services such as selective dissemination of information, instant messaging services, online interlibrary loans and distance learning services that can be provided online to the library community. This is similar to the findings of Hamad,Tbaishat and Al-Fadel (2016) on the role of social networks in enhancing the library profession and promotion of library services revealed that librarians in Jordan and Al-Balqaa' Applied University use social media tools extensively for professional development but in terms of using social media for the promotion of library services, the result indicated to be low. Similarly, Akpoiroro and Okon (2015) in a study on students'satisfaction with service delivery in federal universities in South-South, Nigeria, revealed that students satisfaction with library services were low due to inadequate information technology facilities in the institution.

Conclusion

The main focus of the study was to examine knowledge sharing strategies for information service provision

among librarians in military university libraries in Northern Nigeria. The particular interest of the study was the knowledge sharing strategies towards information service provision among librarians. The research findings made it obvious that librarians in the military university libraries engage in different kinds of knowledge sharing strategies which enhance information service provision in the libraries investigated. The research hypothesis tested indicated that the independent variables (knowledge sharing strategies) have a significant relationship with as dependent variable (information service provision). The established fact from the study is that there is a good level of knowledge sharing that enhance information service provision in the three military university libraries investigated.

Recommendations

In line with the findings of this study, the following recommendations were made;

1. Knowledge sharing strategies such as storytelling and appraisal evaluation which were not fully used to share knowledge by librarians should be encourage in the library
2. Librarians should be encouraged to promote library services such as; e-current awareness services, selective dissemination of information, instant messaging services and distance learning services which were moderately promoted in the library.
3. Librarians should be given adequate exposure and training to be equipped with the knowledge and skills on the use of social media tools in order to share knowledge that will improve service delivery in the library.

References

Ajegbomogun & Diyaolu (2018). The relationship between knowledge sharing, employee performance and service delivery in public sector organizations: a theoretical framework. *Public Sector ICT Management Review* 3(1):37-45.

Akporhonor, BA & Olise, FN. (2015). Librarians' use of social media for promoting library and information resources and services in university libraries in south-south Nigeria. *Information and Knowledge Management* 5(6):1-8.

Ali, PMN & Khan, D. (2017). Investigating knowledge management strategies in central university libraries in India. *DESIDOC Journal of Library & Information Technology* 37(2):73-78.

Bawack & Patel UA. (2019). Planning and implications of social media tools to provide quality library services in academic libraries. *Journal of Advanced Research in Library and Information Science* 6(1):23-26.

Chawner, B & Oliver, G. (2013). A survey of New Zealand academic reference librarians: current and future skills and competencies. Australian Academic & Research Libraries. *Taylor & Francis Online* 44(1):29-39.

Chipta T., Muchaonyerwa, N & Mutula, S. (2017). Knowledge sharing strategies among library staff at selected university libraries. *Mousaion* 35(3):1-24.

David-West, BT & Nmecha, JA. (2019). Mentoring: a tool for career development in academic libraries. *Library Philosophy and Practice (e-journal)*. 2631.

Dikotla, MA. (2016). An exploration of knowledge sharing as a means of improving municipal governance in selected Limpopo municipalities. PhD Thesis. University of Fort Hare.

Farnese ML, BarbieriB, & Patriotta, G. (2019). Managing knowledge in organizations: ANonaka's SECI Model Operationalization.*Frontiers in Psychology* 10(2730):1- 15.

Hamad, F., Tbaishat, D. & Al-Fadel, M. (2016). The role of social networks in enhancing the library profession and promoting academic library services: A comparative study of the University of Jordan and Al- Balqaa' Applied University. *Journal of Librarianship and Information Science.* Retrieved from http://journals.sagep ub.com/doi/abs/10.1177/0961000616656043

Heathfield, SM. (2020). Job shadowing is effective on-the-job training: job shadowing lets employees learn about different jobs, in *The balance,* edited by SM Heathfield. New York: Dotdash.

Idakwo I S, Shehu A B & Dankwalba I A. (2018). Application of Information and Communication Technology in circulation operations in selected federal university libraries in North Central Nigeria. Information Impact: *Journal of Information and Knowledge Management* 9(4):35-47.

Ifeoma, N. (2019). Knowledge sharing strategies, in *Organisational Knowledge Sharing Practices*. edited by A Montcalm. Ontario: ETEC 510.

Ihekwaba K. & Okwor J. (2019). What factors influence knowledge sharing in organizations? A social dilemma perspective of social media communication. *Journal of Knowledge Management* 20(6):1-31

Ikolo, U. (2017). Knowledge Management in Academic libraries in Africa. *The Electronic Library* 35(1):137- 151

Maestro R.G. (2020). The role of organisational factors in combating tacit knowledge loss in organizations. *Southern African Business Review* 15(1):49-69

Mbugua, N. (2018). Information and communication technologies for knowledge management processes in the public sector in Kenya: a case study of the state department of infrastructure. Masters

Dissertation, University of South Africa, Pretoria.

Menolli,A, & Malucelli, A. (2015). "Old" theories, "new" technologies: understanding knowledge sharing and learning in Brazilian software development companies. *Information and Software Technology* 58(1):289-303.

Muchaonyerwa, N & Mutula, S. (2015). Knowledge sharing strategies among library staff at selected university libraries. *Mousaion* 35(3):1-24.

Nonaka & Takeuchi (1995). From information processing to knowledge creation: a paradigm shift in business management. *Technology in Society* 18(2):203-218.

Nonaka, I. Takeuchi & Voelpel, S. (1996). Organizational knowledge creation theory: evolutionary paths and future advances. *Organization Studies* 27(8):1179- 1208.

Okoroma N.B. (2018). Knowledge and information management using ICT: A remedy for today's library. *International Journal of Physical and Social Sciences*, 2(8):307-316.

Onifade, F. N. (2015). Knowledge sharing among librarians in federal university libraries in Nigeria. *Information and Knowledge Management,* 5 (2). from iiste.org/Journals/index.php/IKM/article/view/20587

Othman Ramadan (2014). Intellectual capital, knowledge management and social capital within the ICT sector in Jordan. *Journal of Intellectual Capital* 18(2):437-462.

Reid, HF. (2019). Learning on the job: librarians keeping up to date with emerging technologies. PhD Thesis. Charles Sturt University.

Schonfeld, RC. (2019). Restructuring library collaboration: strategy, membership, governance. New York: Ithaka:1- 17.

Tahleho R.A. (2016). Knowledge-sharing practices by legal information professionals at Hogan Lovells: law firm in South Africa and England. Masters Dissertation. University of South Africa, Pretoria.

Xiao, Lang (2020). Innovative Application of Knowledge Management in Organizational Restructuring of Academic Libraries: A case study of Peking University Library. *International Federation of Library Association and Institutions Journal*, 46(1), 15-24.

Leveraging 5th Industrial Revolution for Sustainable Library Tasks in Academic Libraries in Nigeria: The Place of Digital Inclusion

Stanley Omondiale Unuabor, Ph.D
Ag. College Librarian,
Edo State College of Education Library, Igueben, Edo State
s.unuabor@nict.edu.ng
Tel., +2348053010454

Adekunjo Olalekan Abraham, CLN
Principal Librarian, Kenneth Dike Library, University of Ibadan, Oyo State olalekanadekunjo@gmail.com
Tel.: +2348054063921

Adedoyin Oluwatosin Esan, Ph.D
Emily Aig-Imoukhuede Library
Wellspring University Benin City, Edo State
sayrald@yahoo.com
+2348069600248

Abstract

Digitally included environment where access, ability and affordability of digital technologies are practicable, plays key role in leveraging on the potentials the 5th industrial revolution provides for librarians and information and knowledge managers towards addressing communication challenges facing the systems using wireless devices and internet connectivity. Merging digital and human technologies could enhance well-being of staff and library users. This paper therefore draws attention to digital inclusions' place in the leveraging Fifth Industrial Revolution (5IR) for sustainable library tasks in academic libraries. It also highlights its potential for addressing a host of issues where 5IR is dominant in academic library services. The implications of the leveraging the 5IR for sustainable academic libraries tasks were established. The literature reviewed examines studies focusing on leveraging the 5th industrial revolution for sustainable library tasks in academic libraries: the place of digital inclusion. The methodology adopted for the study was the qualitative approach using related literature. Consequently, the review analyses leveraging the 5th industrial revolution for sustainable library tasks in academic libraries: the place of digital inclusion. After a careful literature analyses based on the objectives set for the study. It was therefore found that, academic libraries in developing countries could benefit from the interdependent connection with digital inclusion and 5IR in the field of library and information science by means of digital technologies vs human technologies. In conclusion, it is expected that digital inclusion's role of librarians in academic libraries can bridge the knowledge gap towards the performance of library tasks leveraging the 5IR for sustainable library tasks.

Keywords: 5th Industrial Revolution (5IR), Academic Libraries, Digital Inclusion, library tasks.

Introduction

Over the years, digital inclusion has impacted positively on academic libraries service delivery in Nigeria as against the over reliance of the conventional operation method of delivery information research activities which suffered severe setback as compared to the developed nations. It has become evident in the 5th industrial revolution era that conventional methods of performing library tasks can no longer hold in the education eco system in Nigeria. Therefore, academic libraries are adopting digital platforms alongside human efforts for sustainable library tasks. Digital inclusion serves as powerful tool for enhancing hands on tasks and application of online platforms in academic libraries for innovative information services. It has enabled library users have access to information and communication technologies in libraries, including helping librarians and information professionals to reach the furthest in their profession. Also, well planned technological solutions access point is required to be created with digital technology such as artificial intelligence tools and other online platforms which could help librarians perform better in the 5IR era.

Industrial revolutions are times of swift changes achieved through innovations. Globally, there is growing focus on combining innovations from all the revolution stages (first, second, third, fourth) to the present fifth industrial revolution (5IR) era into various aspects of academic library operations. The innovations occasioned by this revolutions brought transformations in the employment circles, workplace, and collaboration with the surrounding ecosphere with the advent of significant elements such as, computers, online platforms, AI, cognitive systems, data mining, and the Internet of Things. Academic libraries are already leveraging on these innovation due to their level of access, ability and affordability (digital Inclusion). Digital inclusion occurs when we have both the ability and the opportunity to use online technologies effectively (Barraket & Wilson, 2020). Digital inclusion is the concept that individual and

communities should be afforded access to and use of emerging technologies. In addition to access, the underlying values of digital inclusion is that librarians and the library communities acquire the knowledge and skills, background content, and technological supports services necessary to use technology (Institute of Museum and Library services, 2018). According to Reddick, et al, (2020), digital inclusion is all about access through the internet which is fundamental to bridging the digital divide. Also, digital divide has become a social issue in the developing countries considering the extent to which the internet access is provided in academic libraries for innovative services. Furthermore, the development of digital inclusion posed new challenges for library and information science professionals in information services delivery. It will be safe to say that digital inclusion has brought a new platform for innovative ideas where users have to be given access to digital information that is borne out of innovative ideas.

The Fifth Industrial Revolution (5IR) represents the latest phase of technological advancement that is reshaping industries, economies, and societies. Building upon the foundation of the 4th Industrial Revolution (4IR), which encompassed technologies like automation, AI, and IoT, the 5IR takes these innovations further, incorporating breakthrough in areas such as biotechnology, nanotechnology, quantum computing, and more (Enakrire, et al., 2024).

This study became imperative considering the changes that have evolved in the performance of library tasks in academic libraries holding strong to the 5th law of library science (library, a growing organism), as it has become evident in the 5IR era, where librarians can now interact with technologies/machines for problem solving in course of performing library tasks. Hence this study is set out to examine leveraging the 5th industrial revolution for sustainable library tasks in academic libraries in Nigeria with emphasis on digital inclusion.

Digital Inclusions' Place in Leveraging Fifth Industrial Revolution (5IR) for Sustainable Library Tasks in Academic Libraries

The 5IR is manifest with advance improvement in activities such as digital technologies artificial intelligence (AI), robotics, Internet of Things (IoT) cloud computing, big data, 3D printing. As against the need for sophisticated flexibility to support new information communication devices such as moving robots or drones (Satparthy, et al., 2020). 5IR has emerged to take dominance which includes applications of mechanical and digital machines to communication devices for information service delivery over the network. This include the IoT (Prajapati, et al., 2019). The applications of wireless technologies such as 5G has helped to improve the flexibility and use of 4G robots to perform library tasks. To a very high extent, the 4G technologies are used to guide 5G mobile networks (5G), to gain flexibility, efficiency, QoS- and energy-aware solutions, for a sustainable economy (Hatzivasilis, et al., 2018). This provides opportunities for librarians/ information professional and researchers to address the challenges facing communication systems using wireless devices, including education challenges. The present-day 5IR information communication technologies rely on wire-line technologies to connect sensors and which informs the reason why the present technological connections need to be replaced with wireless technologies to support the emergence of 5IR. In the library and information science sector, information managers can use 5IR wireless communications to enhance service provisions for their clients which in turn requires the need for further training in the specific areas where they seek information.

According to Ibinaiye (2021), the 5th industrial revolution provides many opportunities for the industrial and commercial sectors, researchers, educationists, information specialists, librarians and health managers to address communication challenges facing the systems using wireless devices through 5G. The Link between 5IR and digital inclusion librarians in academic libraries must understand is the acquisition of digital skills and techniques could be jointly utilised by man and machines to improve library tasks in academic libraries. According to Chiware (2020), academic and research libraries in Africa remains an important aspect of higher education and the national systems of research and innovation. As such, leveraging of 5IR for performance of library tasks is one of the important roles.

Enakrire, et al (2024) study revealed that technological advancements have enabled paperless libraries such that on-screen reading is increasingly prevalent, rapid development support through mobile computing, software, and internet/connections/Wi-Fi, multifarious electronic information retrieval among others. Also, other findings were anchored on the relevance of paperless libraries in the 5IR and the functionality of paperless library systems, which enhanced accessibility, and inclusivity, collaboration and connectivity, and environmental impact. These can be made possible in academic libraries in developing nation like Nigeria through digital inclusion. Furthermore, one aspect that should be considered within the context of digital inclusion in 5IR era is the enhancement of accessibility, ability and affordability. It is important to explore all approaches and actions that implement digital technologies to dismantle obstacles in sustaining library tasks and establish a fair and inclusive atmosphere that welcomes a broad spectrum of users. According to ALA (2022), creating a future where every citizen is seamlessly connected and actively engaged in the online realm is imperative, with libraries playing a central role in this endeavor. By deploying digital technologies of 5IR and using them in academic libraries can help overcome barriers and establish a more equitable and welcoming environment for diverse users. Frank et al. (2021) investigated the undertakings of librarians from academic library, the emphasis of the study was on fostering digital equity and inclusivity, a wide-ranging scrutiny of insights and strategies shared by librarians involved in diverse library tasks and further illustrated their collective commitment to advancing digital equity and

inclusion which will help sustain the gains they have made in the 5IR era. Also, the importance of utilizing assistive technologies and inclusive design principles to make digital resources accessible to individuals with disabilities were highlighted. Also, curating digital collections in multiple languages aims to cater to a global audience and enhance cross-cultural learning a collaborative initiative between UNESCO and the Norwegian Agency for Development Cooperation (Norad), is another area digital inclusion in academic libraries can help sustain library tasks in 5IR era such as online platform that offers well-crafted reading materials for early-grade learners, where opportunity is provided for digital reading or print usage (Aboelmaged et al., 2024).

Digital inclusion in academic libraries has help broaden the horizon of e-learning which seems to be more promising than before, presenting limitless prospects for acquiring knowledge on digitals skills and engaging in lifelong learning in workplace towards sustainable library tasks. All these issues underscored how academic libraries can flourish thereby serving as catalysts for positive societal change, contributing to inclusivity, accessibility, and engagement for users, thereby leveraging the advantages of the 5th Industrial Revolution to provide a more versatile and equitable learning environment, by bridging the gaps, facilitate interdisciplinary consideration, and play key role in shaping a more inter connected and knowledgeable society within the context of the 5IR. The above emphasized the study of Noack (2023) which stated that the 5IR is poised to forge an even tighter and smoother connection, evoking a sense of directness and immediacy. The intelligent device people interact with through touch and voice will fade into the background, as brain-computer interfaces step in to take their place. The obstacles and complexities of shifting towards digital environment in academic libraries provides a thorough collection of tactics to tackle and reduce these difficulties, placing emphasis on the proactive measures needed to ensure the effective adoption of digital tool of 5IR generation and enduring functionality of digital academic library systems within the context of the 5th Industrial Revolution for the sustainable library tasks. Moreover, in Reddy's (2020) study, where emphasis was placed on the emerging role of digital literacy in advancing sustainable development objectives and the role of ICT in fostering various sectors, notably education with particular reference to academic libraries. Accordingly, strategies such as digital literacy initiatives, inclusive user support, and collaboration with libraries empower users with the skills to navigate and maximize digital resources effectively.

5IR Dominance in Academic Library Tasks

Changes in information needs of library users

In the modern day library services, the users need information as soon as possible or now as the case may be. Thus, the provisions of free access to information resources in academic libraries require wireless technologies to enhance it usage. This is achievable when academic libraries are digitally included through the use of wireless technologies promoted in 5IR to better improve the role of librarians in information service delivery. Many libraries in developed countries have embraced the opportunities provided by new technologies to improve their library services, although in some countries such as in United State, data librarians still value the role of traditional librarians such as reference services, collection management, literature searching more than the emerging role of expertise such as data science skills, grant experience, and research impact assessment" (Reed, et al., 2020). While the under-developed countries are not maximizing the potentials of leveraging on 5IR in library operations. Successful integration of digital tools into library services no doubt requires new skills and collaboration among library staff to work with both researchers and end-users as they manage information resources going forward.

Technological advancement

Fifth Industrial Revolution has ushered in a profound era of technological advancement and societal transformation, prompting a critical examination of the evolving role of libraries in this digital landscape. Traditionally regarded as the custodians of knowledge, libraries must adapt to these changing dynamics of the digital world while preserving their core principles (Adigun, et al., 2024). Also, it encompasses a convergence of diverse technologies, including the Internet of Things (IoT), cloud computing, biotechnology, nanotechnology, and quantum computing, all underpinned by the currency of data. Artificial intelligence (AI) is a focal point, promising enhancements in user experiences and operational efficiency, however, it also raises critical ethical and privacy concerns that challenge fundamental library principles. The study of Green (2023) noted that librarians are recognizing the importance of aligning library services with the lifestyles and preferences of their user communities, a principle which has led to multiple changes in librarianship in recent years. The chief drivers of these changes are the rapid advancements in technology and the increasing demand for closer partnership between librarians and library users in academic libraries. It is widely acknowledged that academic libraries leveraging emerging digital technologies is likely to establish stronger connections with their communities on a global scale (Ajani et al. 2023). Accordingly, academic libraries worldwide are adopting various emerging digital technologies and methods to tailor library tasks to the specific information needs the communities they serve.

Adigun, et al., (2024) carried out a study on "the intelligent libraries: innovation for a sustainable knowledge system in the fifth (5th) industrial revolution", the study looked into the strategic integration of advanced technologies, which aimed to redefine the mission of libraries in the face of complex challenges, the study further employed an interpretive content/document analysis approach to examine the evolving

roles of libraries, considering their pivotal function in bridging the digital divide, providing equitable access to technology and digital resources, advancing research and innovation, and fostering community engagement. Virtually almost all operations that exist in the academic libraries in the 5IR era now happen in the digital space with the support from applications (Apps). Apps add fun to mobile phones through the provision of information services in electronic form. They offer numerous benefits that contribute to improved reading, research, user experience, accessibility, and overall library services. Mobile technology holds great promise for enabling libraries to provide enhanced services. Igwela and Nsirim (2018) opined that for library users who were in possession of high-end internet-enabled mobile devices, there is a smooth and speedy information search. Therefore, mobile apps could facilitate e-reading and research because if apps when created enhance reading and research, that makes it easier for researchers to access information resources through the app perhaps encouraging its adoption and discouraging the use of print information resources.

The study of Ibinaiye (2021), examined the prospect of the 5th industrial revolution and academic library services by exploring the role of data science in the post-pandemic period. The review analysis focused on data science, academic library services and post-pandemic recovery in the 5th industrial revolution. The study found that academic libraries in developing countries could benefit from the interdependent connection with data science and the field of information science using digital technologies. Also, research by Hatzivasilis, et al., (2018) found out that "Smart interconnected devices, including Cyber-Physical Systems (CPS), permeate our lives and are now as an integral part of our daily activities, paving the way towards the Internet of Things (IoT)". In the academic library domain, these devices interact with their surroundings and system operators, while often also integrating cloud applications. According to Hammad (2020), the internet of thing (IoT) enable machines to be connected and communicate, whereas the Internet of Everything (IoE) makes the connection more relevant between all smart devices, machines and also people with huge data, high speed and high security. The new wireless communication technologies were proposed to solve communication problems, to meet the increasingly high demand as well as improve the performances of bandwidth connectivity (Satpathy, et. al.: Hassan, et. al & Hammad, et al). Tella and Kadri (2021) examined an aspect of data science such as big data and the importance to users in academic libraries but found out that "big data is indeed very big in academic libraries given the pieces of evidence of its adoption and best practices and use in academic libraries across the world".

Tzanova (2020) examined some changes in academic libraries in the era of Open Science, but found out that "academic libraries face challenges regarding accommodating and providing support for open big data, the expansion of library services, and adoption of new roles and responsibilities" which includes the "development of the supporting models for research data management, providing data management plan assistance, expanding the qualifications of library personnel toward data science literacy, integration of the library services into research and educational process and among others. Given the emerging prospects that 5IR presents in the aspects of technologies, wireless communication technologies, increase in bandwidth connectivity, artificial intelligence (AI), robotics, Internet of Things (IoT) cloud computing, big data, 3D printing, Digital inclusion plays a key role for full dominance of academic libraries in the 5IR.

Implications of Leveraging 5IR for Sustaining Library Tasks in Academic Libraries

Envision of Human-Machine Interactions

Certain challenges and mitigation strategies abound when librarians navigate this transformative state called 5IR era, the emergence of paperless academic libraries stands as a demonstration to the harmonious integration of technological skill and human aspirations. Consequently, the envision human-machine interactions has pose a threat to information professionals who are not willing to upgrade their digital skill considering the significance of AI and human-centric innovation occasioned by 5IR. Schwab (2017) stated that the 5th Industrial Revolution is a dynamic force that transcends boundaries and catalyzes innovations across multiple domains. Its transformative power has the potential to reshape industries, address global challenges, and redefine the way we live and work. The 5IR involves a scenario where humans interact with technology or machines, such that individual and organizational problems in society are solved from a broader perspective (Noble et al., 2022). The interaction process helps the individual to recognize the strengths which the technologies or machine is capable of when as an entity (Huang and Rust, 2018). The cultivation practices are the synergistic relationship between technology and humans (Huang et al., 2019), which helps in addressing certain support for tasks in the organization (Kopalle et al., 2022). The paradigm shift that serves as an enabler is in formation, communication, and AI creating a sustainable and human-centric innovation, and services (Broo et al., 2022).

Paradigm Shift in Academic Library's Tasks

Alex-Nmecha and Nsirim (2022) noted that the information needs and seeking behaviour of society have been influenced by the rapid development and proliferation of digital tools. In view of the foregoing, libraries' mode of service delivery has improved in the provision of access to electronic resources such as e-books, CD-ROM, and publication of digital contents, therefore, facilitating scholarly publications. Consequently, this has reduced the use of printed books, journals, and other information resources thereby promoting paperless initiatives and upholding paperless libraries. Therefore, the changes in academic libraries tasks have affected the switch from traditional paper storage operations to cloud-based storage,

which offers various advantages for the environment, including sustainability and a smaller carbon footprint. Multiple users now share information resources on the same infrastructure with cloud storage. This decreases the need for redundant facilities and hardware, resulting in better resource management and reduced electronic waste. The reduction in the use of print publications decreases the associated carbon emissions and resource consumption (Yousufi, 2023). While cloud-based storage offers environmental benefits, it is essential therefore to consider the overall impact of digital inclusion on academic library services. This includes provision of access to electronic information resources and services as well as efficient resource utilization which are critical factors in ensuring that cloud storage remains a sustainable option for data storage and processing. It is, therefore, imperative to note that digital inclusion could promote cloud-based storage and accessibility which is vital in upholding environmental sustainability.

More so, in the present 5IR era, information dissemination occurs swiftly and extensively, necessitating the discernment of accurate and inaccurate information (Correa and Limos-Galay, 2024). Therefore, the issues of digital divide that have been experienced overtime due to unequal access to technology and internet connectivity has been a fundamental issue that needs to be addressed in the developing Country such as Nigeria. As the world academic activities becomes increasingly centered around digital technologies, it behooves on the under developed countries to double their efforts in eliminating the disparity between individuals with access to emerging digital technologies with connectivity and those with equal access in order to enthrone vast transformation in sustaining quality service delivery through the support of cutting-edge technologies in the 5IR. The study of Adigun, et al., (2024) underscored the imperative to address challenges related to data privacy, digital inclusion, resource allocation, intellectual property, and sustainability. Yet, despite these challenges, libraries are poised to remain indispensable pillars of education, research, and community interaction. To do so, they must embrace technology strategically to redefine their roles and expand their influence within evolving knowledge systems (Adigun, et al., 2024).

Approaches for enhancing digital inclusion towards leveraging 5IR for sustainable library tasks

Significant progress has been made through digital inclusion and the use of artificial intelligence with Internet of Things, and has impacted so well in performing library tasks. Librarians need to blend the conventional library skills with digital skills to be able to adapt to the new normal in workplace to be able to navigate the landscapes of the information profession with wide range of digital knowledge. To effectively leverage 5IR, librarians should focus on lifelong learning, networking and digital integration. Also, librarians should upscale their skills by continuously engaging in professional development activities such as seminars, webinars, conferences etc. This can help librarians keep up to date and in pace with their global counterparts. In addition, the importance of staff training and retraining cannot be over emphasize, as the study of Eiriemiokhale and Sulyman (2023) posited that librarians are participating in conferences and workshops to raise awareness of the tools of the 5IR, thereby improving their professional development, partnership formation and collaboration skill. Also, the study of Sikadinov, et. al (2024) enumerated the importance of continuous training in the digital literacy and technology. Therefore, librarians must shift to originality, creativity and innovative driven library tasks to meet the information needs of the user's leveraging 5IR.

Similarly, Ekwueme, et al (2024), carried out a study on "empowering librarians in the fifth industrial revolution: navigating skills, challenges, and strategies for effective library services in open and distance learning" and found that, librarians exhibit collaborative and digital skills essential for working with both people and machine in delivery services to leaners (users). The study further revealed that respondents acknowledge that there are challenges associated with the implementation but agreed that improved power supply, continues training to acquire the requisite skills could be a strategic factors for libraries to effectively leverage 5IR toward sustainable library tasks in academic libraries.

Discussion

Based on the literature reviewed in this paper, it could be judged that librarians need to upscale their skills to improve their performances of library tasks in order to thrive in the 5IR era, bearing in mind the paradigm shift in performing library tasks that has altered conventional library practice. The above judgement corroborates the study of Eiriemiokhale and Sulyman (2023) which posited that librarians are participating in conferences and workshops to raise awareness of the tools of the 5IR, thereby improving their professional development, partnership formation and collaboration skill. Also, it supports the study of Sikadinov, et. al (2024) which enumerated the importance of continuous training in the digital literacy and technology. Therefore, librarians must shift to originality, creativity and innovative driven library tasks to meet the information needs of the user's leveraging the 5IR.

Furthermore, it was revealed through literature reviewed that the integration of technological prowess and human aspirations envisioned through 5IR (human-machine interactions) has taken a center stage of the modern academic library functions coupled with the journey from old-style repositories of knowledge to digital harbors of information which has captured the crux of evolution made by the 5IR should not be seen as a threat. The hope for librarians in 5IR has been confirmed in the study of Adigun, et al., (2024) which underscored the imperative to address challenges related to digital inclusion and sustainability. Hitherto, x-rayed that, despite these challenges, libraries are poised to remain indispensable

pillars of education, research, and community interaction. To do so, they must embrace technology strategically to redefine their roles and expand their influence within evolving knowledge systems (Adigun, et al., 2024). Also, the above assertions confirm the place of digital inclusion in the sustainability of academic library tasks in the 5IR era.

Conclusion

The digital inclusion's role of librarians in academic libraries can bridge the knowledge gap towards the performance of library tasks leveraging the 5IR for sustainable library tasks. This is a testament to the importance of leveraging the 5IR is evident in librarian's capacity to seamlessly blend the past with the future global competiveness in performance of library tasks. Therefore, it is pertinent to state that the 5IR's commitment to digital inclusiveness cannot be over emphasized in the equitable access to information resources with human ingenuity and environmental conscience of the 5IR which symbolizes a guarantee towards a sustainable library practices. This approach could save the time of the users, make queries to be served digitally or through AI, without having to visit any physical library space or building to access information resources. This is believed to bring a cost benefit exploration through digital inclusion in the era of 5IR.

Finally, librarians can connect through adaptive technologies to overcome barriers and establish a more equitable and welcoming digital/internet environment for diverse users. Also, promotes initiatives in digital space from a software application viewpoint, primarily to speedy information search through high-end internet-enabled mobile devices to be able to function optimally in the 5IR era.

Recommendations

The study recommend the following.

1) Digital inclusion by academic libraries and its level of access, affordability and ability would fully propel librarians to face work place realities in the 5IR era.
2) The potentials of 5IR should be harnessed in academic libraries for sustainable library tasks.
3) The perceived implications amongst librarians in academic libraries if attentions is given to consolidating on 5IR for sustainable library tasks should not be seen as a threat rather an opportunity to improve the patterns of service delivery to better serve the changing needs of diverse patrons.
4) AI tools should be deployed and applied in academic libraries for improved service efficiency and effectiveness in performance of library tasks.
5) Institutions should provide infrastructural supports to academic libraries to seamlessly perform library tasks to remote users in the 5IR era.
6) Librarians should advocate for revise in the TETFund percentage distribution ratio of academic library intervention from 70% books and 30% facilities/equipment to 70% facilities/equipment and 30% books to enable beneficiary libraries bridge the digital gap for digital inclusion in their libraries for sustainable library tasks in the 5IR era.

References

Adigun, G. O., Yusuf, A., Ajani, Y. A. & Enakrire, R. T. (2024). The Intelligent Libraries: Innovation for a Sustainable Knowledge System in the Fifth (5th) Industrial Revolution. *LIBRI, 74*(3): 211–223. https://doi.org/10.1515/libri-2023-0111

Ajani, Y. A., R. T. Enakrire, B. D. Oladokun, M. T. (2023). Reincarnation of Libraries via Metaverse: a path way for a Sustainable Knowledge System in the Digital Age." *Business Information Review 40* (4): 191–7. https://doi.org/10.1177/02663821231208044.

Alex-Nmecha J, Nsirim O. (2022). Integration of information and communication technology to the library and information science curriculum: the practicum in library schools in Rivers State. *Global Science Research Journal: Global Educational Journal of Library and Information Science 9*(2): 1–7.

Barraket, J. & Wilson, C. (2021*).* Digital inclusion and covid-19: *CSI response centre for Social Impact.* https://www.csi.edu.au/media/uploads/csi-covid.

Broo, D. G, Kaynak O. & Sait S. M (2022). Rethinking engineering education at the age of industry 5.0. *Journal of Industrial Information Integration*, 25, 100311.

Chiware, E. R. (2020). Open research data in African academic and research libraries: a literature analysis. *Library Management*, 41(6-7), pp. 383-399. DOI: 10.1108/LM-02-2020-0027

Correa, K. A. O. & Limos-Galay J. A (2024). Effects of digital literacy on the digitalization of business name registration for micro business owners in Magsaysay, Occidental Mindoro. *International Journal of Research 12*(3): 17–24.

Enakrire, R.T., Oladokun, B. D., Nsirim, O. & Gaitanou, P. (2024). Paperless libraries: The trending way to go in the fifth industrial revolution. *Business Information Review*, 41(4) 164–173. doi: 10.1177/02663821241289793

Eiremiokhale, K. A. & Sulyman, A. S. (2023). Awareness and perception of artificial intelligence among libarians in university libraries in Kwara State, Nigeria. *Indonesian Journal of Librarianship*, 4(2),

107-118. doi: https://doi.org/10.33701/ijolib.v4i2.3364
Frank J., Salsbury, M., McKelvey H, et al. (2021). Digital equity & inclusion strategies for libraries: promoting student success for all learners. *The International Journal of Information, Diversity, & Inclusion 5*(3). DOI: 10.33137/ijidi.v5i3.36190.
Green, A. (2023). Academic Library Employees and Their Work Modality Options and Preferences." *The Journal of Academic Librarianship 49* (5): 102764. https://doi.org/10.1016/j.acalib.2023.102764.
Hamad, F., Fakhuri, H., & Abdel Jabbar, S. (2020). Big data opportunities and challenges for analytics strategies in Jordanian Academic Libraries. *New Review of Academic Librarianship, 1*-24. doi: 10.1080/13614533.2020.1764071.
Hatzivasilis, G., Fysarakis, K., Soultatos, O., Askoxylakis, I., Papaefstathiou, I., & Demetriou, G. (2018). The industrial internet of things as an enabler for a circular economy Hy-LP: a Novel IoT protocol, evaluated on a wind park's SDN/NFV-enabled 5G industrial network. *Computer Communications*, 119, 127-137. https://www.sciencedirect.com/science/article/pii/S0140366417309404
Huang M. H., Rust R. & Maksimovic, V. (2019). The feeling economy: Managing in the next generation of artificial intelligence (AI). *California Management Review, 61*(4): 43–65.
Ibinaiye, D. I. & Jiyane, G. V. (2021). The Prospect of 5th Industrial Revolution and Academic Library Services: Exploring the role of Data Science in the Post Pandemic Period 4th International Conference on Information Technology in Education and Development 2021
Igwela J. N. B., & Nsirim O. (2018). Mobile social media as a facilitator of library services delivery in Nigeria: a case study of Rivers State. *International Journal of Information Processing and Communication*, 6(2): 346–355.
Kopalle, P. K, Gangwar M., Kaplan, A. et al. (2022) Examining artificial intelligence (AI) technologies in marketing via a global lens: Current trends and future research opportunities. *International Journal of Research in Marketing 39*(2): 522–540.
Noack, P (2023). The Fifth Industrial Revolution: Where the Mind Meets Machine. Abu Dhabi: National News. https://www.thenationalnews.com/opinion/comment/the_f_ifth-industrial-revolution-where-mind-meets-machine-1. 1061280.
Noble, S. M., Mende, M., Grewal D, et al. (2022). The fifth industrial revolution: How harmonious human–machine collaboration is triggering a retail and service revolution. *Journal of Retailing 98*(2): 199–208.
Reddick, C., Harrise, R., Enriquez, R., & Sharma, B. (2020). Digital inclusion survey and assessment UTSA policy studies center. https://hcap.utsa.edu/wp-content/uploads/2020.
Reddy, P., Sharma, B. & Chaudhary, K. (2020) Digital literacy: a review of literature. *International Journal of Technoethics 11*(2): 65–94. DOI: 10.4018/IJT.20200701.oa1.
Reed, J. B., & Carroll, A. J. (2020). Roles for Health Sciences Librarians at College and University Libraries. *Issues in Science and Technology Librarianship*, (94), 1-19. doi: 10.29173/istl42
Satpathy, S., Dash, K. K., & Mohapatra, M. (2020). A Study on the New Design Thinking for Industrial Revolution 4.0, Requirements and Graduate Readiness. *Rupkatha Journal on Interdisciplinary Studies in Humanities, 12*(4).
Schwab, K. (2017). The fourth industrial revolution. Crown Business. London: Penguin UK.
Tella, A., & Kadri, K. K. (2021). Big data and academic libraries: is it big for something or big for nothing? *Library Hi Tech News*. DOI: 10.1108/LHTN-07-2020-0069.
Tella, A., Y., Ajani, A. & Ailaku, U. V. (2023). Libraries in the Metaverse: The Need for Metaliteracy for Digital Librarians and Digital Age Library Users. *Library Hi Tech News*, *40* (8): 14–8. https://doi.org/10.1108/ LHTN-06-2023-0094.
Yousufi, M. K. (2023). Exploring paperless working: a step towards low carbon footprint. *European Journal of Sustainable De velopment Research 7*(4): 1–8. DOI: 10.29333/ejosdr/13410.

Leveraging Chatbot for Service Delivery in the age of 5th Industrial Revolution: Awareness and Perspectives of Academic Librarians in Kwara State, Nigeria

[1]Dr. Abdulmumin Isah, College Librarian, FCE Ilawe-Ekiti & Associate Professor of Library and Information Science, University of Ilorin, isah.a@unilorin.edu.ng, abdulmumin.isah@yahoo.com +2348132471622

[2]Dr. Mulikat Yetunde Abdulkareem, Faculty of CIS, Department of library and information science, University of Ilorin, Ilorin, Kwara state, mulikatadisa@yahoo.com +2349050401662

Abstract

Chatbots are increasingly finding their way into libraries, as their implementation opens up promising opportunities to improve service delivery in the present age of 5th Industrial revolution. However, our understanding of how librarians perceive chatbots, and how this perception may influence chatbot integration for service delivery in academic libraries, remain quite unclear, are librarians prepared and aware of the potential benefits of chatbot for service delivery and challenges brought by the integration of the modern technology? Therefore, this research sought to: examine the level of awareness about chatbots; examine the perception of librarians on the integration of chatbots; determine the extent to which chatbot integration will improve service delivery in age of 5th industrial revolution; and identify the factors hindering the integration of chatbots for service delivery in academic libraries. The study adopted descriptive survey design. Total enumeration technique was adopted with total population of 162 librarians in six selected universities in Kwara State, Nigeria. Findings of the study revealed that librarians in Kwara State Universities are aware of chatbots and have good perception of chatbots for service delivery in academic libraries and they agreed that chatbots can be used as conversational agents for users to reduce physical interaction with the librarians. However, lack of sufficient infrastructure to adopt chatbot was identified as the major constraint to the integration of chatbot for service delivery in academic libraries. The study recommends comprehensive training programs for librarians to familiarize them with chatbot technology, implementation of robust privacy and data security measures to alleviate librarians' concerns regarding successful implementation and integration of chatbots into existing library systems.

Keywords: *Artificial intelligent, Chatbot, 5IR, service delivery, Academic librarians, Kwara State*

Introduction

Chatbots are increasingly finding their ways into libraries, as their implementation opens up promising opportunities to improve service delivery in the present age of 5th Industrial revolution. The trajectory of evolutionary inventions has over the years transformed libraries from mere custodians of information to dynamic spaces that anticipate and adapt to the complex and evolving needs of diverse user groups. Chatbots stand out as one of the primary applications of artificial intelligence, aiming to foster an interactive dialogue environment between humans and machines to address inquiries through textual or voice interfaces that simulate human cognition (Fatouh and Hamam, 2024). According to Chiara (2022), chatbot is a conversational software program that may mimic human communication abilities in order to communicate with a user via chat. Many businesses and organizations, including those in the banking and tourism sectors, have effectively used conversational agents, often known as chatbots, to address their particular problem and improve their operating capabilities.

The integration of chatbots in libraries holds a huge advantage over the traditional human to human transactions. Several important differences exist between traditional service interactions involving direct human-to-human contact, and those that are facilitated by chatbots, while human agents may provide different levels of information accuracy and service quality, depending on their level of expertise, as well as the employee's current emotional state, chatbots, on the other hand, can provide unbiased information and consistent experience that is free from fatigue (Huang & Rust, 2018). In addition, chatbots can provide responses to consumers' enquiries almost instantly and any time of day, in comparison to human agents who are bound by limited capacity. In an era where convenience and speed are highly valued (Collier & Kimes, 2013). Hence, service interactions involving chatbots could be more consistent than traditional human-mediated interactions.

By leveraging chatbots' capabilities, librarians can create more personalized services that equip patrons with the skills needed to navigate the diverse huge digital resources that are not restricted to the four walls of the library. Therefore, library that want to meet the needs of technology savvy users must embrace the pervasive and changing technological innovations of the 5th industrial revolution.

There is no denying the fact that librarians and information professionals are presently working in a technological driven environment, where artificial intelligent tools are revolutionizing how libraries manage and develop their collection, facilitating efficient processing and analysis of vast amounts of data to maintain up-to date metadata, user data, and resource statistics (Jantz, 2017). As noted by Grant and Camp (2018), many academic libraries, mostly in developed nations, have adopted chatbots to meet the many services demands of their customers, including reference and circulation services. Despite the potential of chatbots for effective and efficient information service delivery, there is little or no research to the knowledge of the researchers on their application in developing countries like Nigeria. It is against this background that the present study sought to understand how librarians perceive chatbots, and how this perception may influence chatbot integration for service delivery in academic libraries.

Objectives of the Study

The main objective of this research was to investigate the perception of chatbots for service delivery in selected academic libraries in Kwara state, Nigeria.

The specific objectives of the study were to:

1. examine the level of awareness about chatbots
2. examine the perception of librarians on the integration of chatbots

3. determine the extent to which chatbot integration will improve service delivery in age of 5th industrial revolution
4. identify the factors hindering the integration of chatbots for service delivery in academic libraries

Literature Review

Chatbots are software programs that have been created to engage with customers through online platforms using written or aural means (Bock, Wolter, & Ferrell, 2020). As viewed by Chiara (2022), chatbots are conversational software programs that may mimic human communication abilities in order to communicate with a user via chat. Cragg (2016) posited that chatbot is a rudimentary form of artificial intelligence software that can relate with humans to answer questions. Chatbots employ natural language processing and AI algorithms to communicate with users, comprehend their inquiries, and provide relevant information and support (Russell and Norvig, 2022). Shelmerdine (2018) posited that most users are already familiar with chatbots in other contexts in their everyday life, using them for example to find items on their phone with Apple's Siri, search their computer with Window's Cortana, or navigate the internet with Ok Google or Amazon's Alexa. Hence, awareness is something that impact on adoption of technologies.

Awareness and perception are important components that determine consumers' willingness to adopt a technology. Winkler and Söllner (2018) writes in their study that it is crucial that the user beforehand has knowledge about chatbots and what the chatbot's aims and goals are. If not, the user might think that the chatbot appears too complex and would not transition towards using it. Chatbot technology can be considered an important innovation for e-learning: in fact they are turned out to be the most innovative solution in filling the gap between technology and education. The implication of chatbots create an interactive learning experiences for the student, like the one-one interaction with the teacher. (Colace *et al.* 2018)

Chatbots have also been deployed as simulated teaching assistants within college courses. The first of these, the "Jill Watson" AI, was created at the Georgia Tech College of Computing in 2015 (Peterson, 2020). Dubbed "the world's first artificial intelligent teaching assistant," Jill Watson was deployed in each course in that school's online Master of Computer Science degree program. Jill Watson was integrated with each class via the learning management system (Goel & Polepeddi, 2018). This setup allowed students to ask questions to the Jill Watson AI and access its knowledge base as answers to "basic student questions" 24 hours a day (Peterson, 2020).

In the case of libraries, chatbots are not something new. They have existed for more than ten years in US libraries – "Emma the Catbot", Mentor Public Library, Ohio and "Pixel", University of Nebraska–Lincoln Libraries are a couple of prominent chatbots in libraries (McNeal & Newyear, 2013). Their developments were influenced by the use of a programming language specifically for AI called Artificial Intelligence Mark-up Language (AIML) which uses pattern recognition to process inputs and pre-defined templates to generate outputs (Pandorabots, 2019). The first public library chatbot, Kornelia, was implemented in Bern, Switzerland in 2010 (McNeal & Newyear, 2013). According to Allison, the first academic library installation in Europe was the Stella experiment at the Bibliotheks system Universität Hamburg (2012). This was followed shortly after by Chatbot Charlie at the Delft University of Technology (Akbayrak, 2012). The Mentor Public Library (MPL) and the Akron-Summit County Public Library (ASCPL) in United States were among the first to deploy chatbots, with each being listed as being in operation as of 2012 (Allison, 2012).

In the same vein, U.S. academic libraries also developed chatbots, including the University of Nebraska-Lincoln Libraries, which released its Pixel project in February 2011 (Allison, 2012; McNeal & Newyear, 2013).

Librarians are the ones that best know their users, and hence the right people to collaborate with technologists on its development. The amount of information the chatbot can store and the strength of its natural language program is key to their success, as 'there is a complicated development platform behind any chatbot which will only be as good as its knowledge base which maps a user's words into the most appropriate response' (Abdul-Kader & Woods, 2015).

Specifically, the librarians felt a chatbot could assist patrons looking for specific or general information on the library's website by providing it for them. Furthermore, they speculated that it might help users find content that they would not have otherwise discovered without mediation from a librarian. A chatbot's assistance was presumed to be especially helpful because students go to library websites specifically to find information or learn about library news and events (Chao, 2019).

The early research on Chatbot suggests a range of potential benefits and drawbacks across various fields such as healthcare, business, psychology, and computer science, among others. Like the beginnings of the internet or the creation of digital assets (Lawuobahsumo, 2022), Chatbot and its underlying technology have the opportunity for both positive and negative disruption. While many scholars have raised concerns about the impact of Chatbot on employment opportunities in different industries, there are also significant ethical considerations to be addressed before widespread implementation can occur.

Despite these existing studies, which are predominantly carried out in developed countries, there remains a need for further research on librarians and how they perceive chatbots as a form of service interaction. It is against this background that this study seeks to examine the perception of chatbot for service delivery in academic libraries in Kwara State, Nigeria.

Methodology

A descriptive survey design was adopted for the study. Total enumeration technique was adopted with total population of 162 librarians in six selected universities in Kwara State, Nigeria. Questionnaire was used to collect data for the study and the collected data was analysed using frequency count, percentage for variables such as age and rank.

Table 1. Population of librarians (professionals and para-professionals) in the six (6) selected universities.

S/N	Name of Universities	Number of Librarians
1.	Al-Hikmah University, Ilorin	17
2.	Crown Hill University, Ilorin	8
3.	Kwara State University, Malete	17
4.	Landmark University, Omu-Aran	22
5.	Summit University, Offa	4
6.	University of Ilorin	94
Total		**162**

Source: Registrar Departments, 2024.

The sample size for this study covered all the population from the selected universities which was 162. Thus, total enumeration sampling techniques was used in this study because the population size of this study was relatively small. However, out of 162 copies of the research Questionnaire successfully administered, 110 were returned, resulting in a response rate of 69%.

Table 2 Demographic Characteristics of the Respondents

	Demographic Variables	Frequency	Percentage
Gender	Male	84	76.4%
	Female	26	23.6%
	Total	**110**	**100**
Age	26-35 Years	71	64.5%
	36-45 Years	34	30.9%
	46-above	5	4.5%
	Total	**110**	**100**
Academic Level	Diploma	13	11.8%
	Bachelor Degree	72	65.5%
	Masters Degree	20	18.2%
	Doctorate Degree	5	4.5%
	Total	**110**	**100**
Job Position	Senior Librarian	14	12.7%
	Librarian I	45	40.9%
	Librarian II	31	28.2%
	Assistant Librarian	18	16.4%
	Information Specialist	2	1.8%
	Total	**110**	**100**
Years of Experience	1-5 Years	39	35.5%
	6-10 Years	61	55.5%
	11-20 Years	7	6.4%
	21- above	3	2.7%
	Total	**110**	**100**

Table 3 Librarians' Awareness level of the existence of Chatbots technology

S/N	Statement	SA (%)	A (%)	D (%)	SD (%)	Mean	Standard Deviation
1.	I am aware of the edistence of chatbot technology	36 (32.7)	70 (63.6)	4 (3.6)	0	3.29	.531
2.	I am aware chatbots are used for serƀice deliƀery in libraries	19 (17.3)	83 (75.5)	7 (6.4)	1 (.9)	3.09	.517
3.	I am aware chatbots are used for reference serƀices in libraries	27 (24.5)	74 (67.3)	9 (8.2)	0	3.16	.551
4.	I am aware chatbots are used for answering freƙuently asked ƙuestions in libraries	39 (35.5)	63 (57.3)	8 (7.3)	0	3.28	.592

5.	I am aware chatbot are used by different applications on mobile phones that reply to freƙuently asked ƙuestions e.g siri, biɗby.	61 (55.5)	41 (37.3)	6 (5.5)	2 (1.8)	3.46	.686
6.	I am aware chatbots are on different websites that pose to answer ƙuestions	69 (62.7)	37 (33.6)	3 (2.7)	1 (.9)	3.58	.596
7.	I am aware chatbots are used by network proɓiders for serɓice deliɓery	59 (53.6)	48 (43.6)	3 (2.7)	0	3.51	.554

Source: *Field Survey, (2024)*
Note: SA = Strongly Agree, A = Agree, D= Disagree, SD= Strongly Disagree.

Table 3 shows that majority of the respondents stated that they were aware chatbot are used by different applications on mobile phones that reply to frequently asked questions e.g siri, bixby (ẍ3.46), they stated that they are aware chatbots are on different websites that pose to answer questions (ẍ3.58), quite a number stated that they are aware that chatbots are used by network providers for service delivery (ẍ3.51).

Table 4 Perception of Librarians on the Integration of Chatbots for Service Delivery in Academic Libraries.

S/N	Statement	SA (%)	A (%)	D (%)	SD (%)	Mean	Standard Deviation
1.	The concept of employing a chatbot as a library resource is ƙuite interesting to me	49 (44.5)	57 (51.8)	4 (3.6)	0	3.41	.563
2.	I posit that the integration of a library chatbot can afford fast, prompt and conɓenient accessibility to library information	35 (31.8)	70 (63.6	4 (3.6)	1 (.9)	3.26	.570
3.	Library chatbot can efficaciously aid in self-serɓice of minor reference issues	27 (24.5)	78 (70.9)	5 (4.5)	0	3.20	.503
4.	Chatbot holds potential in the facilitation of managing minor ƙuery concerns, hence obɓiating the need for an in-person consultation with a librarian	30 (27.3)	74 (67.3)	5 (4.5)	1 (.9)	3.21	.560
5.	Chatbot possesses the capability to proɓide precise and dependable suggestions pertaining to freƙuently asked ƙuestions	28 (25.5)	77 (70.0)	5 (4.5)	0	3.21	.509
6.	Chatbots can be used as conɓersational agents for users to reduce physical interaction with the librarians.	29 (26.4)	77 (70.0)	4 (3.6)	0	3.23	.501

Source: *Field Survey, (2024)*
Note: SA = Strongly Agree, A = Agree, D= Disagree, SD= Strongly Disagree.

Table 4 shows that majority of the respondents perceived that chatbots can be used as conversational agents for users to reduce physical interaction with the librarians (ẍ3.23) also, they felt that library chatbot can efficaciously aid in self-service of minor reference issues (ẍ3.20) and the capability to provide precise and dependable suggestions pertaining to frequently asked questions (ẍ3.21).

Table 5 Extent to which chatbot integration will improve service delivery in age of 5th industrial revolution

S/N	Statement	SA (%)	A (%)	D (%)	SD (%)	Mean	Standard Deviation
1.	Chatbots will reduce workload of librarians as chatbots neɓer get tired to answer users in their ƙueries	11 (10.0)	94 (85.5)	5 (4.5)	0	3.05	.379
2.	Chatbots will saɓe time of both the librarians in performing their duties and the library users in getting their needs	15 (13.6)	88 (80.0)	6 (5.5)	1 (.9)	3.06	.475

3. Chatbots can assist librarians in answering compleď and diɓerse ƙueries, using natural language processing and semantic analysis	10 (9.1)	74 (67.3)	26 (23.6)	0	2.85	.556
4. Chatbots can handle simple inƙuires and tasks automatically, can free up librarians' time to focus on proɓiding more in-depth assistance to patrons who reƙuire it	27 (24.5)	74 (67.3)	8 (7.3)	1 (.9)	3.15	.578
5. Chatbot can be used for language translation for better library serɓice to all tribes	16 (14.5)	75 (68.2)	19 (17.3)	0	2.97	.566
6. The integration of chatbot has the potential to optimize time management and mitigate the necessity for face-to-face consultations with librarian	19 (17.3)	84 (76.4)	7 (6.4)	0	3.11	.476
7. Chatbots can reduce manual and repetitiɓe tasks for librarians, minimize errors and inconsistencies in data.	15 (13.6)	86 (78.2)	9 (8.2)		3.05	.466

Note: SA = Strongly Agree, A = Agree, D= Disagree, SD= Strongly Disagree.

Table 5 shows that majority of the respondents perceived that chatbots will save time of both the librarians in performing their duties and the library users in getting their needs (ẍ3.06), most of them agreed that chatbots assist librarians in answering complex and diverse queries, using natural language processing and semantic analysis (ẍ2.85), they also stated that chatbot can be used for language translation for better library service to all tribes (ẍ2.97).

Table 6 Factors hindering the integration of chatbots for service delivery in academic libraries

S/N	Statement	SA (%)	A (%)	D (%)	SD (%)	Mean	Standard Deviation
1	The lack of skills and the need for training before the integration of chatbots in uniɓersity libraries.	5 (4.5)	81 (73.6)	24 (21.8)	0	2.83	.486
2	Low awareness leɓel among librarians on the eďistence of chatbots	2 (1.8)	46 (41.8)	62 (56.4)	0	2.45	.536
3	Lack of technical know-how to deɓelop chatbot app for library serɓice.	4 (3.6)	59 (53.6)	46 (41.8)	1 (.9)	2.60	.578
4	Chatbot is perceiɓed as a threat to the job of librarians in uniɓersity libraries	2 (1.8)	38 (34.5)	67 (60.9)	3 (2.7)	2.35	.568
5	Lack of sufficient infrastructure to adopt chatbot in uniɓersity libraries.	10 (9.1)	92 (83.6)	8 (7.3)	0	3.02	.406
6	Inadeƙuate funding to deɓelop chatbot technology systems in libraries.	25 (22.7)	82 (74.5)	2 (1.8)	1 (.9)	3.19	.498
7	High system deɓelopment and maintenance cost of chatbot in libraries.	20 (18.2)	87 (79.1)	3 (2.7)	0	3.15	.432
8	The issue of high priɓacy intrusion by chatbots.	8 (7.3)	80 (72.7)	21 (19.1)	1 (.9)	2.86	.533

Source: *Field Survey, (2024)*
Note: SA = Strongly Agree, A = Agree, D= Disagree, SD= Strongly Disagree.

Table 6 shows that majority of the respondents identified lack of sufficient infrastructure to adopt chatbot in university libraries (ẍ3.02), inadequate funding to develop chatbot technology systems in libraries (ẍ3.19), high system development and maintenance cost of chatbot in libraries (ẍ3.15), issue of high privacy intrusion by chatbots and the lack of skills and the need for training before the integration of chatbots in university libraries (ẍ2.83) as the factors militating against the integration of chatbot in academic libraries. On the other hand, majority of the respondents stated that low awareness level among librarians on the existence of chatbots (ẍ2.45), lack of technical know-how to

develop chatbot app for library service (ẍ2.60), and chatbot been perceived as a threat to the job of librarians in university libraries (ẍ2.35) are the factors militating against the integration of chatbot in academic libraries.

Discussion of Findings

The finding of this study revealed that majority of librarians are aware of chatbots for service delivery in libraries, and also aware that chatbots are on different websites that pose to answer questions. This is in line with Shelmerdine (2018) who found out that most users are already familiar with chatbots in other contexts in their everyday life, using chatbots for example to find items on their phone with Apple's Siri, search their computer with Window's Cortana, or navigate the internet with Ok Google or Amazon's Alexa.

Similarly, the study shows that librarians considered integration of chatbots as potential for fast, prompt and convenient accessibility of library information services; and facilitation of managing minor query concerns, hence obviating the need for an in-person consultation with a librarian; and chatbot possesses the capability to provide precise and dependable suggestions pertaining to frequently asked questions. This agrees with Sherrie-Anne and Oscar (2022), who noted that chatbots will reduce costs for companies by decreasing human input and will increases user value by engaging in intelligent conversation that reduce the time it takes a human to achieve a task and improve their performance. Panda and Chakravarty (2023) also viewed chatbots as tool that have potential to provide satisfaction to users, initiate virtual assistance, overcoming time and location barriers.

The study equally suggests that chatbot will reduce workload of librarians as chatbots never get tired to answer users in their queries, and save time of both the librarians in performing their duties and users in getting their needs. This is consistent with Huang and Rust (2018) whose study revealed that chatbots can provide unbiased information and consistent experience, as unlike humans, chatbots are free from fatigue. Hence, service interactions involving chatbots could be more consistent than traditional human-mediated interactions.

However, the study identified lack of skills and the need for training before the integration of chatbots in university libraries, and lack of sufficient infrastructure to adopt chatbot in university libraries as major constraints to integration of chatbots for service delivery. These findings agree with Sjöström (2018) who posited that chatbot's usage may be rejected by the target audience, who may not feel comfortable with an impersonal method of communication and that chatbots rely on technology infrastructure and integration with library systems. Technical issues such as system downtime, connectivity problems, or compatibility issues with different platforms as factors that can hinder the smooth functioning of chatbots.

Recommendation

Based on the findings of this study, the following recommendations were made:

- Academic libraries should develop and provide comprehensive training programs for librarians to familiarize them with chatbot technology and its potential applications in academic libraries. These programs should cover not only the technical aspects but also address any concerns or misconceptions associated with chatbots.
- Librarians should collaborate with technology experts to ensure successful implementation and integration of chatbots into existing library systems. This collaboration will help address technical challenges and enable librarians to leverage the full potential of chatbot technology which are the goals of 5th industrial revolution.
- Academic libraries should implement robust privacy and data security measures to alleviate librarians' concerns regarding user information and data collected by chatbots.
- Librarians should work alongside chatbots to handle more complex queries and provide personalized assistance when needed.
- Librarians should regularly solicit feedback from library users to identify areas for improvement and make necessary updates on the chatbots to enhance user experience and overall service delivery.

References

Abdul-Kader, S. 8. (2015). Survey on chatbot design techniques in speech conversation systems. International Journal of Advanced Computer Science and Applications, 6 (7), 72-80.

Akbayrak, E. H. (2012). Chatbot Charlie (TU Delft library's virtual assistant). Bluesyemre.Retrieved from https://bluesyemre.com/2012/06/04/chatbot-charlie-tu-delft-librarys- virtualassistant

Allison, D. (2011). Chatbots in the Library: is it time? Library Hi Tech, 95-107.

Bock, D. E. (2020). Artificial intelligence: Disrupting what we know about services. The Journalof Services Marketing., 34 (3), 317-334.

Chao, Z. (2019). Rethinking user experience studies in libraries: The story of UX Cafe.

Chiara, V. M. (2022.). Chatbots in customer service: Their relevance and impact on service quality.The 13th International Conference on Ambient Systems, Networks and Technologies (ANT)., (pp. 22-25). Portugal

Collier, J. E. (2013). Only if it is convienient: Understanding how convenience influences self-service technology evaluation. Journal of Service Research., 16 (1), 39-51.

Cordero, J. T.-G. (2020). Use of chatbots for user service in higher education institutions. 15thIberian Conference on Information Systems and Technologies (CISTI).

Cragg, O. (2016). Chatbot: What can they do and whay is everyone talking about them. Retrievedfrom www.ibtimes.co.uk

Fatouh, A. H. & Hamam, A. A. (2024). Investing of Chatbots to Enhance the Library Services. American Journal of Information Science and Technology, 8(1)15-21. https://doi.org/10:11648/j.ajist.20240801.12

Goel, A. K. (2018). Jill Watson: A virtual teaching assistant for online education. In Learning Engineering for Online Education., (1),21.

Grant, C. &. (2018). Scaling artifial intelligence in libraries via a national project registy. Retrieved from https://www.cni.org/wp-content/uploads/2019/01/CNI_Scaling_Grant.pdf

Lawuobahsumo, K. K. (2022). Exploring dependence relationships between bitcoin and commodity returns: an assessment using the gerber cross-correlation. 1, 34-49.

Ma, Z. D. (2021). One Chatbot Per Person: Creating Personalized Chatbots based on Implicit User Profiles. Proceedings of the 44th International ACM S/GIR Conference on Research and Development in Information. Retrieved from https://doi.org/10.1145/3404835.3462828

McNeal, M. L. (2013). Chapter 1: Introducing chatbots in libraries. Library Technology Reports, 49(8), 5-10.

McPherson, M. A. (2015). Library anxiety among university students: a survey. International Federation of Library Associations and Institutions., 41 (4), 317-325.

Palasundrum, K. M. (2019). Sequence to sequence Model Performance for Education Chatbot. International Journal of Emerging Technologies in Learning.

Panda, S. and R. Chakravarty (2023). Adapting intelligent infor mation services in libraries: A case of smart Al chatbots. Li brary Hi Tech News, 39(1), 12-15.

Perez, J. Q. (2020). Rediscovering the use of chatbots in education: A systematic literature review. Computer Application in Engineering Education., 28(6), 1549-1565.

Peterson, T. (n.d.). Improve online learning and more with artificial intelligence. EdTech - Classroom. Retrieved from https://edtechmagazine.com/higher/article/2020/08/improve-onlinelearning-and-more-artificial-intelligence.

Pregalinska, A. C. (2019). In bot we trust: A new methodology of chatbot performance measures. Business Horizons., 62 (6). 785-797.

Ramchandani, N. (2018). The rise and rise of chatbots, technology -THE BUSINESS TIMES. Retrieved from https://www.businesstimes.com.sg/technology/the-rise-and-rise-of-chatbots

Shelmerdine, A. J. (2018). Library anxiety: stories, theories and possible solutions. Journal of the Australian Library and Information Association., 67 (4), 342-352.

Sherrie-Anne, K. &. (2022). A Muli-Industry Analysis of the Future Use of AI Chatbots.

Singh, R. (2020). AI and chatbots in education: What does the future hold? Retrieved from https://chatbotsmagazine.com/ai-and-chatbots-in-education-what-does-thefuturehold-9772f5c13960

Sjostrom, J. A. (2018). Designing Chatbots for Higher Education Practice. International Conference on Information Systems Education and Research. Retrieved from https://www.researchgate.net/publication/328245964_Designing_Chatbots_for Higher Education_ Practice.

Smestad, T. (2018). Personality matters! Improving the user experience of chatbot interfaces. Norwegian University of Science and Technology.

Tubachi, P. S. (2017). Application of Chatbots Technology in LIS. Third International Conference on Current Trends in Enginering Science and Technology, 1135-1138.

Wilson, J. D. (2018). Collaborative Intelligence: Human and Al are joining forces. Harvard Business Review, 114-123.

Wirtz, J. P. (2018). Brave new world service robots in the frontline. Journal of Service Management., 29 (5), 907-931.

Woods, H. (2018). Asking more of Siri and Alexa: feminine persona in service of surveillance capitalism. Critical Studies in Media Communication., 35 (4), 334-349.

Xu, Y. S. (2020). Al customer service: Task complexity, problem-solving ability, and usage intention. Australasian Marketing Journal., 28 (4), 189-199.

Leveraging Open Educational Resources for Inclusive Education in the 5th Industrial Revolution

Mrs. Nwabunkeonye Nkechi Joy, CLN
Archbishop Charles Heerey Memorial College of Nursing Sciences,
Ogbor Hill, Aba, Abia State.
Email: nkechinwabunkeonye@gmail.com
&
Promise Chinyere Awa, CLN
Michael Okpara University of Agriculture, Umudike
Email: awapromise@gmail.com

Abstract

The 5th Industrial Revolution (5IR) has brought unparalleled opportunities for transformative and inclusive education globally. Leveraging Open Educational Resources (OER) is vital in harnessing this potential. This paper explores the evolving role of OER in addressing the challenges of the 5IR, focusing on enhancing digital literacy, creativity, and adaptability. Through an analytical review of existing literature and case studies, the findings show that OER supports equitable access to education, fosters collaboration, and bridges skill gaps. However, barriers such as the digital divide, lack of infrastructure, and insufficient policy support limit its widespread adoption. The paper recommends developing inclusive digital frameworks, promoting OER awareness, and integrating OER into formal education to prepare a workforce aligned with the human-centric goals of the 5IR.

Keywords: *Open Educational Resources, 5th Industrial Revolution, Digital Literacy, Inclusivity, Educational Technology*.

Introduction

The 5th Industrial Revolution (5IR) builds upon the digital and automation advancements of the 4IR, prioritizing human-machine collaboration, ethical AI and inclusive growth. This metamorphosis in the world landscape has transcended to the field of education and required educational institutions to find ways to adapt to these changes by removing barriers to knowledge access and produce graduates that will thrive in an innovation-driven and knowledge-based society. However, bridging the gap between what the industry requires and what the academe produces remains elusive (Volzer et al., 2021; World Economic Forum, 2020).

Open Educational Resources (OER) refer to educational resources that are publicly sharable through multimodal data (e.g., text, audio, and visual stimuli). OER include various types of learning environments, as well as sharable and electronic materials that are publicly accessible. The variety of OER platforms range from Web-based learning materials to stand-alone computing applications across different learning contexts. Many countries have failed to catch up with the industry developments and struggled to adopt a curriculum that is ahead of its time, particularly the developing countries (Barrot, 2021). In fact, it was estimated that 65% of children entering primary school today would land in jobs that do not yet exist (World Economic Forum, 2020). These challenges have led to a social crisis known as the skills gap. The skills gap refers to the competencies that the industry needs but do not match with the competencies that graduates possess.

One means to address this educational challenge is through an innovative-driven and future-ready curriculum. As we approach the fifth industrial revolution (5IR), our curriculum needs to catch up with this development.

This paper examines:

- The intersection of OER and Inclusive education in 5IR.
- Key benefits and challenges of OER adoption.
- Policy and technological strategies for scaling OER globally.

Statement of problem

The global education divide that is the recurrent gap in access to quality education between high income and low income regions remains one of the most pressing challenges of the 21st century. Despite global commitments like SDG 4 (Global Education for All), systematic inequalities continue to exclude millions of children and adults from learning opportunites. Systematic inequalities like; lack of internet, lack of electricity, computers, or broadband, overcrowded classrooms, outdated materials, untrained staff etc.

Education inequality fuels poverty cycles, unemployment, and social instability. Without urgent intervention, half of the world's youth will lack basic skills for future jobs (Wee,2023).

Methodology:

This study adopts a mixed-methods approach combining quantitative data analysis, qualitative case studies and policy review to evaluate how Open Educational Resources and digital innovations can reduce education inequality.

2. The 5th Industrial Revolution and its Educational Demands

The 5IR as a construct originated from Japan's Society 5.0, which refers to "a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space" (Cabinet Office, n.d.). It is a forward-looking society where people show mutual respect and live an enjoyable and active life within an information society. 5IR also promotes a super-smart society that converges cyberspace and physical space to resolve various social challenges and humanizes the use of technologies by combining human creativity and craftsmanship with cyber-physical systems (European Economic and Social Committee, 2018; UNESCO, 2019). As Salgues (2018) and Nakanishi (2019) posited, 5IR harmonizes humans, nature, and technology in creating a society that allows people to practice their diverse skills, feel safe and secure, go back to their values, and experience ample opportunities. It is, therefore, expected that efforts are geared toward creating advanced human–machine interfaces where the power and creativity of human brains are complemented by automation to achieve the highest level of efficiency and productivity. Key characteristics include:

- **Human-AI Collaboration;** In the case of education, the transition to 5IR requires educational reforms that would address the demands of this "utopic" society. One such reform is through an innovative-driven and future-ready curriculum, which I term as Curriculum 5.0 . Curriculum 5.0 is a state-of-the-art curriculum that matches the demand of future jobs and 5IR environment and guides the teachers, learning materials developers, school leaders, education agencies and organizations, policymakers, and other key stakeholders in achieving the educational goals of a country or territory. Unlike the conventional curriculum, this innovative curriculum is ahead of its time. It is able to see the job roles that are likely to decline and increase in the next several years, consequently calibrating its goals and desired competencies. According to Volzer et al., 2021; World Economic Forum, 2020 the gap between the competencies that fresh graduates possess and the skills that the industry demands remain wide, more particularly in developing regions. One factor that contributed to this problem is the use of an overly academic and cognitive curriculum that fails to help students bring their learnings in the classroom to the real world. To address this problem, many countries have adopted outcomes-based pedagogy (OBP), which argues that any curriculum should clarify the intended learning outcomes (ILO) that they want to see from the students. Of course, these learning outcomes are expected to be aligned with the demands of the industry. One principle behind OBP is constructive alignment, which emphasizes alignment among teaching-learning activities, content, assessment, and ILOs, the latter being the core (Biggs, 1996; Spady, 1994). OBP also requires alignment among the ILOs at the institutional, program, and course levels.

  Industries and communities are becoming more complex, so are the needed skills. To be truly responsive to the community and industry, Curriculum 5.0 utilizes a systematic approach to ensuring this alignment. First, it is the product of collaboration between the higher education institutions (HEIs) [some countries have Skills Councils or their equivalent for vocational education and Training, e.g., Australian, England, not just IHLs. Apprenticeships are more the domain of VET] and the employers to better understand what the needed skills are and the job roles associated with them.

- **Lifelong Learning;** A curriculum may be classified as process-based (highlights teaching and learning process), content-based (emphasizes subject-matter topics), or product-based (emphasizes output or outcomes) [there are other ways of classifying a curriculum – perhaps you could say something like, a common way of classifying curriculum is...]. In the case of Curriculum 5.0, it is primarily a layered curriculum that fuses the features of the different curricula. In short, it equally emphasizes the use of content knowledge and processes to achieve the desired learning outcomes or competencies (Barrot, 2015, 2019). To do this, the curriculum substantially integrates learning strategies as a vital component of the learning plan. On the part of the teachers who are expected to exhibit mastery of related knowledge and skills, they are expected to demonstrate the processes and model the product/performance that students are expected to perform. A wide range of studies have provided empirical evidence on the positive impact of modeling on students' academic achievement and competencies (e.g., Bassanezi, 1994; Casey & MacPhail, 2018; Gilbert & Justi, 2016). Because dealing with the process during the teaching-learning activities takes time, curriculum developers need to be selective of the key topics and competencies to be included in the curriculum.

- **Inclusivity:** Education must be accessible to marginalized communities. According to the National Center for Education Statistics at Institute of Educational Sciences (IES; NCES, 2020) in the United States, the percentage of learners aged 3–21 years who are served under the Individuals with Disabilities Education Act (IDEA) is quite large (13% of all learners, 7.1 million in total). Furthermore, more than 10% of learners with disabilities spend less than 40% of their time taking general classes. This statistic shows that OER can be particularly beneficial for learners with disabilities, who are more likely to face challenges in accessing learning opportunities than typically developing learners. Research on open learning is essential to understand how OER can be designed and implemented to guide the meaningful learning experiences of individuals with disabilities.

OER supports these demands by providing:

- **Affordable learning materials (** reducing cost barriers)
- **Customizable content (** adaptable for diverse learners)
- **Global knowledge sharing (** facilitating cross-cultural collaboration)

3. OER as a tool for Inclusive Education

3.1. Accessibility for all

Digital equity denotes a learner's right to access educational resources without barriers. Prior research has explored how to embrace learners with disabilities through OER as a practice of digital equity (Park et al., 2019; Treviranus, 2018). Research on OER for learners with disabilities have been rooted in two concepts: accessibility and universal design for learning (UDL; Spencer, 2011; Spooner et al., 2007). According to the IMS Global Learning Consortium (2012), accessibility refers to the ability of a learning environment to adjust to individual learners. A major goal of accessibility design is to consider the visibility of information to allow learners with disabilities greater understanding in OER. Specifically, accessibility considers information presentation that enables individuals to better access and comprehend information without interruption by physical body constraints.

In terms of Web accessibility, previous research has focused on building more accessible Web resources that consider learners with disabilities. Similarly, the international World Wide Web Consortium (W3C, 2020) has offered the Web content accessibility guidelines (WCAG) since 2008. Following these guidelines, two examples demonstrate how accessibility in OER has been considered: 1. The FLOE Project is an online learning resource that incorporates user-interface options and inclusive-technology resources (Treviranus et al., 2014). The project aims to offer personalized and "one-size-fits-one" learning materials for learners with disabilities. 2. Hashey and Stahl (2014) suggest a voluntary product accessibility template, which demonstrates how educational devices are tailored to learners' contexts, involving modality preferences. This template also helps designers to conceptualize multimodal interactions in a Web-based platform. In addition to accessibility, research has considered UDL as a major framework to envision instructional strategies to promote learners' engagement in a digital learning environment (Meyer et al., 2014). UDL refers to instructional products or practices that are optimized for all learners, including individuals with disabilities. While accessibility refers to enhanced information visibility that is tailored to learners with disabilities, UDL seeks to provide a set of learning strategies with digital tools that inclusively support learners' engagement (Spencer, 2011). In this sense, UDL demonstrates three principles regarding learners' improved participation in learning (Spooner et al., 2007): a. representation, which refers to providing multiple formats of representation (e.g., visual and auditory) to allow learners to choose the optimal channel of information; b. action and expression, which denote using methods that enable learners to demonstrate their behaviors and thoughts in various ways; and c. engagement, which refers to choosing a variety of sources that are personally meaningful to an individual learner to enhance their motivation. Although both accessibility and UDL have been pivotal to understanding OER design and development for learners with disabilities, few studies have attempted to bridge the two perspectives and explain how each framework has been incorporated in current OER (Navarro et al., 2016; Ngubane-Mokiwa, 2016).

3.2. Supports Diverse Learning Needs

Engagement is a key indicator of the success of OER. Learner interaction determines an individual's engagement levels in an educational setting. Thus, researchers have been interested in boosting learners' engagement through OER (Panke & Seufert, 2013). Since OER depend on learners' self-regulation (Kocdar et al., 2018), such as time management and strategic planning, research has underscored the promotion of learners' interactions to maintain their engagement. In particular, an emerging concern for learners' handson practices in OER-enabled pedagogy (Wiley & Hilton III, 2018) emphasizes ways to promote learner interaction. Multiple lines of OER research provide clues on how to better facilitate learners' interactions. In terms of accessibility, research has investigated how to improve perception, navigation, and interaction in Web environments that serve as OER. Such research has focused on designing and developing graphical user interfaces (GUIs), which allow learners to control multimodal inputs and navigation paths in a Web system (Bittencourt et al., 2016; Navarrete & Luján-Mora, 2018). In addition, the field of human-computer interaction suggests an ability-based design, which intends to optimize learners' existing capabilities in their interactions (Wobbrock et al., 2011). Such research aims to provide a system interface that corresponds to an individual's characteristics. Research on UDL considers the external design factors of a learning environment, such as peer- or instructor-interaction settings. UDL research aims at designing multiple modes of instruction that enable learners with disabilities to choose their preferred learning materials to assist in their learning. UDL focuses on optimizing individuals' learning experiences (Spooner et al., 2007) across different instructional settings.

3.3. Bridging the Global Education Divide:

The global education divide refers to the vast disparities in access to quality education between high income and low income regions, exacerbated by economic, technological and infrastructural inequalities. Addressing this divide is critical for achieving Sustainable Development Goal 4 ensuring inclusive and equitable quality education for all by 2030.

4. Challenges in OER Adoption

Despite its potential, OER faces challenges:

- **Quality Assurance** – Ensuring accuracy and relevance
- **Digital Divide** – Limited internet access in rural areas
- **Sustainability** – Funding for OER development and maintenance
- **Faculty Resistance** – Lack of awareness or incentives for adoption.

5. Strategies for Effective OER Integration

5.1. Policy Intervention

- Government should mandate OER use in public education
- Funding for OER initiatives (e.g EU'S **Open Education Europa)**

5.2. Institutional Adoption

- Universities should incentivize faculty to use OER
- Integration with Learning Management Systems (LMS)

5.3. Technological Innovation

- AI – drIven OER personalization (adaptive learning paths)
- Blockchain for credentializing OER based learning

6. Conclusion

OER is a catalyst for inclusive education in the 5IR breaking down economic and geographical barriers. To maximize its impact, stakeholders must collaborate on policy, infrastructure and pedagogical innovation. By embracing OER, we can build an equitable future-ready education system.

References

Barrot, J. S. (2021). K to 12 curriculum reform in the Philippines: Towards making students future ready. *Asia Pacific Journal of Education, 1–15.*

Bassanezi, R. C. (1994). Modelling as a teaching-learning strategy. For the Learning of Mathematics, 14(2), 31–35.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education, 32(3), 347–364.*

Bittencourt, I. I., Baranauskas, M. C., Pereira, R., Dermeval, D., Isotani, S., & Jaques, P. (2016). A systematic review on multi-device inclusive environments. *Universal Access in the Information Society, 15(4), 737–772. https://doi.org/10.1007/s10209-015-0422-3*

Cabinet Office. (n.d.). Society 5.0. https://www8.cao.go.jp/cstp/english/society5_0/index.html

Casey, A., & MacPhail, A. (2018). Adopting a models-based approach to teaching physical education. *Physical Education and Sport Pedagogy, 23(3), 294–310.*

Gilbert, J. K., & Justi, R. (2016). *Modelling-based teaching in science education (Vol. 9). Springer.*

Hashey, A. I., & Stahl, S. (2014). Making online learning accessible for students with disabilities. *Teaching Exceptional Children, 46(5), 70–78.* https://doi.org/10.1177%2F0040059914528329

IMS Global Learning Consortium. (2012). IMS GlobalAccessForAll® (AfA) Primer: Version 3.0 specification. Public draft 1.0. https://www.imsglobal.org/accessibility/afav3p0pd/AfAv3p0_SpecPrimer_v1p0pd.html

Kocdar, S., Karadeniz, A., Bozkurt, A., & Buyuk, K. (2018). Measuring self-regulation in self-paced open and distance learning environments. *The International Review of Research in Open and Distributed Learning,*

Navarrete, R., & Luján-Mora, S. (2018). Bridging the accessibility gap in open educational resources.*Universal Access in the Information Society, 17, 755–774.* https://doi.org/10.1007/s10209-017- 0529-99*(1).* https://doi.org/10.19173/irrodl.v19i1.3255

Navarro, S., Zervas, P., Gesa, R., & Sampson, D. G. (2016). Developing teachers' competences for designing inclusive learning experiences. *Educational Technology and Society, 19(1), 17–27.* https://www.j-ets.net/collection/published-issues/19_

Ngubane-Mokiwa, S. A. (2016). Accessibility strategies for making MOOCs for people with visual impairments: A universal design for learning (UDL) perspective [Working paper]. *PanCommonwealth Forum 8. Commonwealth of Learning and Open University Malaysia. http://hdl.handle.net/11599/2561*

Meyer, A., & Fourie, I. (2016, June 6–11). *Make the makers' voices count: Combining universal design and participatory ergonomics to create accessible maker spaces for individuals with (physical) disabilities [Paper presentation].* 15th European Association for Health Information and Libraries Conference: Knowledge, Research, Innovation, Seville, Spain.

Nahavandi, S. (2019). *Industry 5.0 – A human-centric solution. Sustainability, 11(16), 4371.*

Park, K., So, H.-J., & Cha, H. (2019). Digital equity and accessible MOOCs: Accessibility evaluations of mobile MOOCs for learners with visual impairments. *Australasian Journal of Educational Technology, 35(6),* 48–63. https://doi.org/10.14742/ajet.5521

Salgues, B. (2018). *Society 5.0: Industry of the future, technologies, methods and tools*. Wiley.

Spady, W. G. (1994). *Outcome-based education: Critical issues and answers.* American Association of School Administrators.

Spooner, F., Baker, J. N., Harris, A. A., Ahlgrim-Delzell, L., & Browder, D. M. (2007). Effects of training in universal design for learning on lesson plan development. *Remedial and Special Education, 28(2), 108–116.* https://doi.org/10.1177%2F07419325070280020101

Treviranus, J., Mitchell, J., Clark, C., & Roberts, V. (2014). An introduction to the FLOE project. In C. Stephanidis & M. Antona (Eds.), Universal Access in Human-Computer Interaction. Universal Access to Information and Knowledge. UAHCI 2014. *Lecture Notes in Computer Science (Vol. 8514)*. Springer. https://doi.org/10.1007/978-3-319-07440-5_42

Volzer, D., Burgess, J., & Magda, A. (2021). *Reimagining the workforce 2021: Closing the skills gap through education.* Wiley.

Wiley, D., & Hilton III, J. L. (2018). Defining OER-enabled pedagogy. *The International Review of Research in Open and Distributed Learning, 19(4)*. https://doi.org/10.19173/irrodl.v19i4.3601

World Economic Forum. (2020). *The future of jobs report 2020*. World Economic Forum.

W3C.(2020). *W3C Accessibility Guidelines*. https://www.w3.org/WAI/standards-guidelines/#guidelines

Leveraging the 5th Industrial Revolution for Sustainable Library Services Delivery

[1]KAJANG, Victor S. (CLN), [2]EGWUIBE, Martina O., (CLN)
[3]ZAKI, Suzanah D. (CLN), [4]IKEGWUIRO, Patience U. (CLN)
[1]Department of Library and Information Sciences,
National Research Institute for Chemical Technology, Basawa – Zaria.
Email: kajhvictor73@gmail.com / 08167248379
[2]National Library of Nigeria, Kaduna Branch,
Kaduna-Nigeria.
+2347034973996
[3]University Library, Kaduna State University,
Kaduna State, Nigeria.
Email: mumycube@gmail.com +2348032986381
[4]Research and Technical Service Department,
National Water Resources Institute, Mancto Road, Kaduna, Nigeria.
Email: bankike2@gmail.com +2348032294537

Abstract

Leveraging Library Services Delivery refers to the strategies and methods libraries use to effectively provide resources and services to their users. It involves utilizing various tools, technologies, and organizational structures to enhance accessibility, convenience, and efficiency on how library services are delivered. The 5th Industrial Revolution, Characterised by the fusion of advanced digital technologies, Artificial Intelligence (AI), Robotics, and human-centric innovation, presents new opportunities for transforming library information services. This paper explored how libraries can leverage the capabilities of the 5th Industrial Revolution to deliver sustainable, efficient, and user-centered information services, focusing on enhanced resource accessibility, personalised users experience, operational efficiency, and environmental sustainability. This approach aligns with the growing emphasis on sustainability, ensuring library services can maintained over the long term while reducing operational costs and environmental impact. By critically evaluating the intersection of the 5th Industrial Revolution technologies with library functions, the paper aims to provide insights into how libraries can evolve in the digital age while maintaining a commitment to sustainability.

Keywords:*Leveraging, 5th Industrial Revolution, Library Services, Sustainability.*

Introduction

The 5th Industrial Revolution (5IR) marks a new era where the synergy between advanced technologies and human intelligence becomes the cornerstone for transforming industries, including the field of library services. Unlike its predecessors, the 5IR is characterized by the integration of artificial intelligence (AI), robotics, the Internet of Things (IoT), and sustainable technologies in ways that emphasize human-centered innovation, inclusivity, and environmental consciousness (Pereira et al., 2021). As the library sector grapples with the pressures of adapting to this rapidly evolving technological landscape, it finds itself at a pivotal juncture to leverage these advancements for sustainable service delivery.Libraries have always been pillars of knowledge dissemination, community engagement, and information accessibility. With the 5IR, libraries can not only continue these roles but also enhance them by adopting smart technologies that foster personalized services, enhance operational efficiency, and contribute to sustainability goals (Rowley, 2020). The application of technologies such as Artificial Intelligence (AI) in cataloging, data management, and user experience, alongside IoT systems for real-time resource monitoring and automation, presents new opportunities to reduce operational costs and minimize the environmental footprint of libraries (Hilton et al., 2022). Furthermore, embracing digital and renewable energy technologies allows libraries to provide services that are both environmentally responsible and economically viable, making sustainability a key feature of their mission.

Sustainability in library services encompasses environmental, economics, and social dimensions. Libraries contribute to sustainability goals by reducing the environmental impact of operations (e.g., through green building), promoting resource sharing (e.g., open access initiatives), and supporting the UN sustainable Development Goals (SDGs) (UNESCO, 2020). Therefore, sustainable library services go beyond just offering eco-friendly buildings and reducing energy consumption. They encapsulate the integration of cutting-edge technologies that improve access to resources, preserve collections, and foster social inclusion. This dynamic combination of technological innovation and sustainability holds the potential to reshape library services in the 5IR, empowering libraries to contribute meaningfully to the broader objectives of the global community, such as the United Nations' Sustainable Development Goals (SDGs) (United Nations, 2015). By focusing on enhanced resource accessibility and operational efficiency, libraries can become more resilient, responsive, and inclusive in meeting the diverse needs of their users

(Squires & Wilkinson, 2022). This paper highlights the critical elements of how libraries can leverage 5IR technologies to redefine their service models to ensure the sustainable delivery of services in a world where digital transformation and environmental responsibility go hand in hand.

The Role of Libraries in Community Engagement and Sustainable Library Services Delivery

Libraries have long been anchors of community engagement and educational development. The integration of 5IR technologies presents an opportunity for libraries to lead in fostering digital literacy and bridging the digital divide. By incorporating emerging technologies into educational programs, libraries can equip users with the skills needed to thrive in an increasingly tech-driven world (Berg, 2021). Additionally, libraries can serve as hubs for innovation, where community members collaborate on technological projects and explore the potential applications of 5IR technologies in local contexts. The 5IR builds upon the technological advancements of the Fourth Industrial Revolution (4IR), emphasizing collaboration between humans and intelligent machines (Schwab, 2016). In libraries, this shift is marked by a transition from manual, labor-intensive cataloguing methods to AI-driven systems capable of automating metadata generation, classification, and subject indexing (Yayavaram & Basole, 2021). The 5IR fosters a human-centric approach, ensuring that AI applications in libraries align with ethical standards, inclusivity, and user-centric service delivery. The 5th Industrial Revolution Technologies improve search precision and relevance, enhancing user satisfaction and promoting inclusive access to information (Tammaro, 2021).

Elements of How Libraries can Leverage the 5thIndustrial Revolution Technologies to Attain Sustainable Library Services Delivery:

1. Integration of Artificial Intelligence for Personalized Services

AI can be used to enhance the user experience within libraries. By incorporating AI-based systems like chatbots, recommendation engines, and smart search algorithms, libraries can offer highly personalized services to users. Artificial Intelligence (AI) in cataloguing involves the application of machine learning (ML), natural language processing (NLP), and computer vision technologies to automate and enhance bibliographic control processes. Automated cataloguing reduces human error and accelerates workflow, allowing libraries to allocate resources more effectively (IFLA, 2023). This technology can also assist in improving information retrieval systems, making it easier for library users to find exactly what they need, efficiently and effectively (Liu et al., 2020).

AI can also help with administrative tasks such as cataloging, automating repetitive processes like sorting and shelving, and enhancing user interaction through virtual assistants (Jain, 2021). These innovations allow libraries to operate more efficiently, thus contributing to sustainability by optimizing resources and reducing operational costs.

2. Blockchain Technology for Enhanced Data Security and Resource Sharing

Blockchain technology has the potential to transform the way libraries manage resources, ensuring data security and integrity. For example, libraries can utilize blockchain for secure digital transactions, such as verifying the authenticity of borrowed materials and tracking digital lending (Sweeney, 2022). Furthermore, blockchain can facilitate decentralized data sharing, allowing libraries to collaborate more effectively with other institutions while maintaining control over their data and resources. This secure exchange of information ensures greater transparency and trust, which is essential for fostering collaborative, sustainable library networks.

3. Robotic Process Automation for Efficient Resource Management

Robotic process automation (RPA) can improve the efficiency of library operations, such as cataloging, inventory management, and circulation. With the integration of robots and automated systems, libraries can manage their physical collections more effectively, while minimizing human error and reducing the need for manual labor. In the long run, such automation helps reduce costs and resource consumption, contributing to sustainability goals. RPA can also enable libraries to offer more interactive and engaging services, like robotic storytimes for children or assisting patrons with disabilities (Patel & Gohil, 2020).

4. Sustainable Infrastructure with Green Technologies

Libraries can also align with the 5IR by adopting sustainable infrastructure practices. This includes using renewable energy sources, energy-efficient systems, and environmentally friendly materials for building construction and maintenance. Smart building technologies, such as IoT sensors for energy management, can help libraries optimize their usage of electricity, heating, and cooling, thus reducing their carbon footprint (Bawden & Robinson, 2020). Furthermore, digital libraries and e-books can reduce the need for physical storage, printing, and paper usage, further contributing to sustainability.

5. Collaboration and Open Access through Digital Platforms

The rise of open-access platforms is a key feature of the 5IR. Libraries can leverage these platforms to make educational resources freely accessible to the public, fostering equitable access to information. By collaborating with universities, research organizations, and global information networks, libraries can

create open repositories and digital archives, making academic and scientific research available to wider audiences (Abbott et al., 2022). This shift towards digital accessibility helps libraries serve as catalysts for knowledge sharing and global collaboration, thereby contributing to global sustainability.

6. Human-Centric Services and Community Engagement

The 5IR places a significant emphasis on human-centric values, which align with the core mission of libraries: serving people. Libraries can utilize technology to enhance engagement with their communities, offering inclusive and accessible services that cater to diverse needs. For instance, by using AI tools to analyze community needs, libraries can offer tailored programs for specific groups, such as digital literacy workshops for seniors or job training for unemployed individuals. This emphasis on personalized, community-driven services ensures that libraries remain relevant and responsive to local needs in the 5IR (O'Connor, 2021).

7. User-Centered Information Services

The key to the 5IR's potential lies in its ability to enhance user experience through personalized and interactive services. Libraries are increasingly embracing AI-driven chatbots and virtual assistants that provide users with real-time information and support, improving access to services and answering questions more efficiently than traditional methods (Sundaram, 2023). These tools can be integrated with machine learning algorithms to learn from users' behaviors, making interactions more intuitive and dynamic over time.The user-centered approach can also extend to resource discovery. AI-enabled systems can recommend books, articles, and multimedia based on users' search histories, preferences, and research trends, offering highly curated and contextually relevant suggestions. In this way, libraries can better cater to the evolving needs of their diverse clientele while minimizing the time spent searching for relevant materials.

8. Promoting Digital Literacy and Sustainability Education

Libraries play an essential role in promoting digital literacy, and in the context of the 5IR, they can foster knowledge and skills necessary for sustainable living. Libraries can organize workshops and events that teach people how to use emerging technologies like AI, IoT, and blockchain. They can also offer sustainability-focused educational materials, such as content on climate change, energy conservation, and responsible technology use. By becoming hubs for sustainability education, libraries can empower individuals to make informed decisions about technology and its environmental impacts (Seale & Roberts, 2023).

Challenges of Leveraging the 5th Industrial Revolution in Libraries

Digital Divide and Inequality

While 5IR emphasizes human-centric technologies like AI, IoT, and robotics, many libraries, especially in developing regions, still face infrastructure gaps such as unreliable internet, limited digital tools, and low digital literacy (Chukwuemeka et al., 2022).

Resistance to Change

Library staff may resist adopting new technologies due to fear of redundancy or unfamiliarity with emerging tools like AI or robotic process automation (RPA) (Nwalo & Okiki, 2021).

Funding Constraints

The integration of 5IR technologies often requires significant investment. Public libraries, in particular, rely on limited government funding, making it difficult to invest in advanced technologies (IFLA, 2020).

Data Privacy and Ethical Concerns

AI and IoT-based services raise questions about the ethical use of patron data, requiring strong privacy protocols which many libraries are not yet equipped to handle (Floridi et al., 2018).

Skill Gaps among Library Professionals

The workforce in many libraries lacks training in emerging technologies like machine learning, data analytics, and robotics, which are central to 5IR (Aina, 2021).

Conclusion

The integration of 5IR technologies into library services offers a pathway to enhanced operational efficiency, more inclusive access to information, and a more sustainable approach to resource management. By aligning library services with values and capabilities of the 5th industrial revolutions, institutions can transform from traditional models to dynamic knowledge ecosystems that are resilient, sustainable, and responsive to the evolving needs of their users and the global community and also drive social progress.

Ultimately, leveraging the full potential of the 5th Industrial Revolution requires libraries to adopt a forward-thinking, innovative approach to service delivery, focusing on continuous adaptation to technological advances while maintaining a strong commitment to the communities they serve.

Recommendations

Strategic Investment in Infrastructure

Governments and stakeholders should prioritize investment in high-speed internet, smart devices, and renewable energy to enable smart, green libraries.

Capacity Building and Continuous Training

Librarians must be equipped with 5IR-relevant skills through workshops, certification programs, and collaborations with tech firms.

Adoption of Inclusive Technology Policies

Policies should ensure that the integration of 5IR tools doesn't marginalize vulnerable groups. Libraries should adopt technologies that are accessible to people with disabilities and underserved populations.

Public-Private Partnerships (PPPs)

Collaborations with tech companies can help libraries access cutting-edge tools and expertise without bearing the full cost.

Embracing Sustainable Technologies

Libraries should implement eco-friendly technologies such as solar-powered devices and digital lending systems to reduce their carbon footprint.

Ethical AI Implementation

Libraries should adopt transparent AI systems with strong data protection policies to build trust with patrons and avoid misuse of personal data.

References

Abbott, C., et al. (2022). "The Role of Libraries in Open Access and Global Knowledge Sharing." *Library Management Journal*, 41(2), 84-98.

Aina, L. O. (2021). "Information and Knowledge Management in the 5th Industrial Revolution." *African Journal of Library, Archives and Information Science,* 31(2), 155-171

Bawden, D., & Robinson, L. (2020). "Green Technologies in Library Management." *Environmental Information Science*, 26(3), 123-135.

Berg, J. (2021). "AI and Automation in Library Operations: Efficiency and Future Trends." *Library Journal*. 38(10), 1-4.

Chukwuemeka, E. O., et al. (2022). "Digital Divide and the Challenges of the 5th Industrial Revolution in African Libraries." *Journal of Information Science & Technology*. 10(2), 18-32

Floridi, L., et al. (2018). "AI4People - An Ethical Framework for a Good AI Society." *Minds and Machines*, 28(4), 689–707.

Ghosh, M. (2022). "Automation of Library Cataloguing Using Artificial Intelligence: A Study." *Library Philosophy and Practice*, 1–15.

Hilton, L., Stewart, L., & Vincent, J. (2022). "Innovative Library Services in the Age of the 5th Industrial Revolution." *Journal of Library Technology*, 58(3), 101-115.

https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

IFLA. (2020). Libraries, Development and the United Nations 2030 Agenda. Retrieved from: https://www.ifla.org

IFLA. (2023). Artificial Intelligence and Libraries: The Role of Library Professionals in the AI Age. Retrieved from https://www.ifla.org/ March, 2025

Jain, P. (2021). "AI in Libraries: Challenges and Opportunities." *Journal of Library Innovation,* 12(4), 1-15.

Liu, L., et al. (2020). "Personalized Library Services Using AI: A Case Study." *Library Technology Reports*, 56(8), 34-47.

Moyo, L., & Ngulube, P. (2021). "Greening Library Services in the Context of the Fifth Industrial Revolution." *Information Development*, 21(8), 36-47

Nwalo, K. I. N., & Okiki, O. C. (2021). "The Role of Library Professionals in the Age of the 5th Industrial Revolution." *Library Philosophy and Practice*, 66(12), 88-97

O'Connor, P. (2021). "The Impact of Human-Centric Technologies on Library Services." *InformationTechnology and People*, 34(1), 75-89.

Patel, S., & Gohil, A. (2020). "Robotic Process Automation in Libraries: Current Trends and Future Prospects." *Journal of Library Automation*, 47(5), 106-120.

Pereira, L., Silva, A., & Costa, M. (2021). "The Role of Digitalization and the 5th Industrial Revolution in Transforming Education and Knowledge Management." *Journal of Knowledge Management*, 25(4), 786-805.

Rowley, J. (2020). "Library Services in the Digital Age: Strategies for Sustainable Delivery." *Information Management Journal*, 29(2), 233-245.

Schwab, K. (2016). The Fourth Industrial Revolution. World Economic Forum.

Seale, C., & Roberts, S. (2023). "Libraries and Sustainability: Promoting Digital Literacy for a Green Future." *Sustainability Education Review*, 15(2), 49-61.

Squires, T., & Wilkinson, J. (2022). "Sustainability Practices in Modern Libraries: Integrating 5IR Technologies." *Library Sustainability Review*, 11(1), 55-66.

Sundaram, M. (2023). "Enhancing User Experience through Artificial Intelligence in Libraries." *Journal of Digital Libraries*, 17(4), 203-215.

Sweeney, K. (2022). "Blockchain for Libraries: Ensuring Data Security and Transparency." *Journal of Digital Preservation*, 13(4), 58-72.

UNESCO. (2021). Human-Centered AI for Libraries. Retrieved from: https://www.unesco.org

UNESCO. (2022). AI and the Future of Libraries: Bridging the Digital Divide. Paris: UNESCO Publishing.

United Nations. (2015). Transforming our World: The 2030 Agenda for Sustainable Development. United Nations.

Yayavaram, S., & Basole, R. C. (2021). "The Fifth Industrial Revolution: An Agenda for Strategic Research." *Strategic Management Review*, 2(1), 1–19.

Librarians' Perception in Leveraging on the 5th Industrial Revolution Technologies for Sustainable Rural Library Development

Vincent C. Opara
University Library
David Umahi Federal University of Health Sciences, Ebonyi State, Nigeria
oparachima77@gmail.com 08104274615
Gift Ihunanya Nwosu
The College Library
Rivers State College of Health Science and Management Technology, Port Harcourt, Nigeria
gingift1@gmail.com
And
Promise Chinyere Awa
Michael Okpara University of Agriculture, Abia State, Nigeria
awapromise@gmail.com

Abstract

In today's reality, the introduction of the 5th Industrial Revolution (5IR) characterized by advancements in technologies such as artificial intelligence (AI), the Internet of Things (IoT), and automation among others, is penetrating the field of librarianship. Hence, this study investigates librarian's perception in leveraging on the 5th industrial revolution technologies for sustainable rural library development. The population includes librarians in Nigeria. Data were gathered via Google form questionnaire that was distributed to respondents through Nigerian Library Association State chapter whatsapp groups. 117 responses were received and used for the analysis. Mean scores was used to analyze the data. Results of the analysis show that artificial intelligent technology, augmented reality, blockchain technology, internet of things and big data analytics are 5IR technologies that can promote rural library development. Librarians perceived that the 5IR technologies will improve and promote sustainable rural library development and can bridge the gap between rural dwellers and urban dwellers amongst others. This study revealed that Proper knowledge and understanding of emerging technologies, The ability to evaluate and select appropriate 5th IR technologies, Collaborative skill and Communication skill are the skills require by librarians to navigate 5IR technologies, While the challenges discovered were inadequate infrastructure, poor funding, poor networks and Limited technical expertise. This study therefore recommends a coordinated effort from libraries, librarians, administrators, governments and community leaders to ensure that 5IR technologies are implemented and used in rural libraries for sustainable development in rural settings.

Keywords: *librarians, perception, 5IR Technologies, rural library, sustainable development*

Introduction

Libraries are considered to be one of the tools for social integration between knowledge, people and the society. As a social institute, libraries are responsible to serve both the rich and the poor, literate and illiterate, urban and rural dwellers through its facilities, resources and services. It can be a measure to determine grassroots development. Rural libraries are libraries established to cater for the information, education, recreational, technological and social needs of rural dwellers. According to Library and Information Research for Research (2020), rural library is a library that serves communities with a population of 10,000 residents or less. It provides for physical access, research, outreach services, exhibition and display, ICT services while catering for the various information need of a community or population. Rural libraries can be classified as a direct extension of public library. However, Rural library development has always being a very peculiar aspect of library services in that it helps to ensure that library services reach the unreachable and meet the needs of various users irrespective of their background, age, skills, technological literacy etc. Rural libraries are considered to be one of the recommendable institution for social, economic, political and technological integration of local communities to promote sustainable development. Ezeala, (2023) noted that libraries are meant to be keenly involved in the social, economic, cultural and lifelong learning of the people. It is the only institutions that offer free access to knowledge to both high and lowly citizens. Yet it is not accorded high priority in planning and development by governing institutions. Libraries have always had to justify their existence to sponsors as they are not considered 'essential' as compared to sectors like health, education, roads and many others. Librarians' voices must become audible in convincing everyone including the grassroots, legislators and leaders at all levels on the need to let libraries spread in all areas of the country. While libraries are highly entrusted institutions rooted in the communities that they serve, their budgets and relevance are continually questioned in this 21st Century as it is characterised with ready information available online to anyone, anywhere, with access to the internet and other technological innovations. This era marks a significant shift characterized by the convergence of cutting-edge technologies such as artificial intelligence, the Internet of Things, blockchain, biotechnology, and advanced robotics, among others (Alojaiman, 2023). Pandin (2021) stated that the

industrial revolution represents a pivotal transformation in human history, marketing a shift from primary source of information to generative sources. This transformation brought major changes such as urbanization, altered labored practices, and new technologies that can transform library work force and the services they offer to humanity, especially to rural dwellers. The era of the Fifth Industrial Revolution (5IR) signifies the current and forthcoming phase of industrial and technological evolution, building upon the legacies of its predecessors known as 4.0. This convergence ushers in a transformative period in human advancement, fundamentally reshaping the very fabric of our existence, forcing for a change of work, services, facilities and skills.

However, the increasing interest around library services in the wake of 5IR is becoming significant while, minimal attention has also been given to the concept or understanding of the rural library development and how it can leverage on 5IR technologies for sustainable development. Although, this line of study plays a major role in actual and potential speculation of rural library's future in service provision yet limited research has been conducted that can provides real insights for rural libraries to play their roles in a technological developing era such as the 5IR. Given the shortage of rural library studies in the wake of 5IR technologies, this paper draws it objective.

Objective of the study

1. To identify 5IRS technologies that can promote sustainable rural library development.
2. To investigate librarian's perception in leveraging on the 5th industrial revolution technologies for sustainable rural library development.
3. To determine the perceived skills required by librarians to navigate 5IR technologies for sustainable rural library development.
4. To identify the possible challenges in leveraging on the 5th industrial revolution technologies for sustainable rural library development.

Literature review

Rural library in modern age

The aim of rural library development is to promote and support learning and literacy activities in local communities by providing current and usable technologies while training communities on digital skills for sustainable development. Rural libraries are strong governmental agencies. This can be expressed in the nature of services it offers such as; educational and social institution to common people in remote or local areas. Besides promoting the education wellbeing of communities it foster technological training and bridge the gap between rural and urban development. More so, it is positioned to introduce children, youths, adult and old citizen to new and acceptable way of creating, retrieving and communicating information in modern age (Smsuddin & Shaffril, 2019). In today dynamic world of technology rural libraries are been recognized a critical facilitators of inclusive education and function as promoters of sustainable development, particularly to technological underserved and under-represented areas. Rahman and Lim (2023), noted that the modern age as a result of technological advancement can promote equal educational opportunities and life-long learning center for people in remote places. The term modern age is a concept that describes the introduction and development of information communication technologies (ICT) (Chaudhari, 2018). ICT is the building block of a modern society. The benefit of the modern age is the transition of traditional libraries to digital and virtual library, printed documents into electronic documents, card catalogues to OPAC, register system to barcode system, closed access to open access, manuscripts into digitized documents, and reduced efforts of handling volumes and workforce utilization for check in and out. The emphasis of modern age is on technology but lay more importance on effective and efficient services. Aziz and Jalaludin (2023), highlights how libraries can empower communities by offering programs that teach digital skills, from basic computer to more advanced technological training. This service not only help rural dwellers gain technical expertise but enhance their abilities to access information, such as government policies, healthcare, educational and socio-economic resources, thereby improving the overall quality of life of people. The success of these programs heavily relies on the availability of adequate resources, facilities and policies. Rahman and Lim (2024) stated that rural libraries must continuously innovate to stay relevant and provide sustainable modern solutions for people in rural places.

Rural library and the fifth Industrial revolution

In this age, libraries are expanding their roles by offering essential digital services such as advance technological facilities, digital literacy programs among others. Nevertheless, rural areas often face a technological gap compared to urban centres, which can limit the impact of their services. Despite these challenges, rural libraries can show resilient by adopting emerging technologies in the 5IR era to meet the needs of communities they serve. More so, as new technologies become increasingly integrated into everyday life, rural libraries are positioned as critical hubs for bridging the digital divide (Hassan & Ismail, 2023).

The Industrial revolution began as a result of the introduction of machines instead of human slavery labour. The introduction of machines announced the industrial revolution. The invention of computers in production is the product of the advancement of the industrial revolution from 1.0 to 5.0. these technologies are continuously been reinvented to reduce the volume of manual work and replace the human hand with automatic physical and software tools like robots, AI, Blockchain technology and other advanced technologies. It therefore means that industrial revolution is a process of rapid change witnessed as a result of the adoption of scientific projects, which led to the move from the era of agriculture to the generation of industries that depend on mechanizations. The era of the Fifth Industrial Revolution (5IR) signifies the current and forthcoming phase of industrial and technological evolution, building upon the legacies of the 4IR. This era marks a significant shift characterized by the convergence of cutting-edge technologies such as artificial intelligence, the Internet of Things, blockchain, biotechnology, and advanced robotics, among others (Alojaiman, 2023). The 5IR transition ushers in a transformative period in human advancement, fundamentally reshaping the structures of systems.

At its essence, the 5IR heralds a profound societal and technological transition, introducing a fundamental shift underpinned by extensive automation, interconnectedness, and data-driven decision-making that permeate every aspect of our lives (Callaghan, 2023). Against the backdrop of the 5IR, there is an urgent need for the cultivation of a new set of skills essential for navigating this transformative landscape. The ability to adapt to rapidly changing technologies and library environments becomes paramount. One of the defining features of the 5IR era is its steadfast commitment to sustainability, environmental responsibility, and ethical considerations. Diverging from its predecessors, this era is not solely about the interplay of human and technological advancement; it is about harnessing these technologies to address pressing global challenges which include rural libraries services (Noble et al., 2022). These challenges span from addressing climate change and healthcare disparities to mitigating resource scarcity and fostering social equity. Furthermore, 5IR is characterized by the convergence of the physical, digital, and biological realms. This fusion transcends traditional boundaries, unlocking new possibilities limited only by the bounds of human imagination (Schwab, 2017). In this context, the development of interdisciplinary skills and the capacity to bridge knowledge gaps between different fields become imperative, as this fusion of knowledge is the driving force behind innovation. The evolution of the 5IR era is intrinsically linked to questions of governance, ethics, and the equitable distribution of its benefits. This revolution challenges societies to rethink and adapt existing systems and structures to ensure that the benefits are inclusive and accessible (Pujihastuti, 2023).

The growing importance of sophisticated technologies in rural public libraries calls for a closer look at how these libraries adapt and evolves in the face of challenges. Research by Rahman & Lim (2023) underscore that rural libraries must continuously innovate to stay relevant and offer sustainable digital solutions for libraries to survive in this 5IR. Therefore, there is a need for a broader strategy that includes technology integrated, staff training, and community outreach efforts that promote long-term digital engagements. While access to digital services is essential, it is also important to examine Librarians' Perception in leveraging on the 5th industrial revolution technologies for sustainable rural library development.

.

Methodology

Descriptive survey was adopted for this study. This was found appropriate because it is more ideal for studying a spread population of librarians across Nigeria. An online Google form questionnaire was used for this study and was distributed to respondents through Nigerian Library Association state chapters. 117 respondents accurately filled the form and as such were considered valid for analysis. Mean score was adopted to analyze the data collected from the respondents. The bench mark for analysis is accepted when the mean 2.50 and above while a mean of less than 2.50 is rejected. The respondents scale and value assigned is SA=4, A=3, D=2 and SD=1

Analysis of data and results

Research objective 1: 5IRS technologies that can promote sustainable rural library development

S/N	ITEMS	SA	A	D	SD	$\bar{x}$	Decision
1	Artificial intelligent technology	47	32	20	18	2.9	Accepted
2	Blockchain technology	35	37	27	18	2.8	Accepted
3	Big data analytics	37	29	24	27	2.6	Accepted
4	Virtual reality	43	38	19	17	2.9	Accepted

5	Mobile library applications	37	32	33	15	2.8	Accepted
6	Social media	40	36	24	17	2.8	Accepted
7	Internet of things	37	30	27	23	2.7	Accepted

Table 1 shows the mean response of the 5th Industrial revolution technologies that can promote rural library development. From the table it shows that librarians recognized; Artificial intelligence technology (2.9), virtual reality (2.9), Mobile library applications (2.8), Social media (2.8), Blockchain technology (2.8), Internet of things (2.7) and Big data analytics (2.6) as 5IR technologies that can promote sustainable rural library development.

Research objective 2: Librarian's perception in leveraging on the 5th industrial revolution technologies for sustainable rural library development

S/N	ITEMS	SA	A	D	SD	$\bar{x}$	Decision
1	I am sure that the potentials of the 5th Industrial Revolution Technologies can transform and Improve rural library development	43	38	20	16	2.9	Accepted
2	I have the required skills to operate the 5th IR technologies for rural library development.	42	37	20	18	2.9	Accepted
3	The 5th Industrial Revolution Technologies will results to the need to train rural dwellers on how to manipulate the technologies	40	35	25	17	2.8	Accepted
4	5th IR technologies may bring about challenges such as data privacy trust deficit and loss of confidence in technology because there may be existence of privacy violation.	39	35	24	19	2.8	Accepted
5	5th IR technologies will improve and promote sustainable rural library development	42	37	21	17	2.9	Accepted
6	5th IR technologies will enhance the efficiency and streamline the delivery of library services to rural dwellers	47	37	18	15	3.0	Accepted
7	With the advent of the 5th Industrial Revolution, rural dweller may become less reliant on seeking information assistance from other sources.	35	32	26	24	2.7	Accepted
8	5th IR technologies may automate tasks, reducing librarian roles to machines	24	20	40	33	2.3	Rejected
9	Implementing 5th IR technologies in developing rural libraries may lead to chaos and crisis	22	17	42	36	2.2	Rejected
10	Implementing 5th IR technologies in developing rural libraries can bridge the gap between rural dwellers and urban dwellers	38	37	25	17	2.8	Accepted

Table 2 shows the mean response of librarian's perception of leveraging on 5th industrial revolution technologies for sustainable rural library development. The table shows that librarians perceived that: 5th IR technologies will enhance the efficiency and streamline the delivery of library services to rural dwellers (3.0), I am sure that the potentials of the 5th Industrial Revolution Technologies can transform and Improve rural library development (2.9), I have the required skills to operate the 5th IR technologies for rural library development (2.9), 5th IR technologies will improve and promote sustainable rural library development (2.9), The 5th Industrial Revolution Technologies will results to the need to train rural dwellers on how to manipulate the technologies (2.8), 5th IR technologies may bring about challenges such as data privacy trust deficit and loss of confidence in technology because there may be existence of privacy violation (2.8), Implementing 5th IR technologies in developing rural libraries can bridge the gap between rural dwellers and urban dwellers (2.8), With the advent of the 5th Industrial Revolution, rural dweller may become less reliant on seeking information assistance from other sources (2.7), while they disagreed that 5IR technologies will; Implementing 5th IR technologies in developing rural libraries may lead to chaos and crisis (2.2) and 5th IR technologies may automate tasks, reducing librarian roles to machines (2.2). this finding revealed that librarians perception are positive on the use of 5IR technologies for sustainable rural library development.

Research objective 3: Perceived skills required by librarians to navigate 5IR technologies for sustainable rural library development.

S/N	ITEMS	SA	A	D	SD	x̄	Decision
1	Proper knowledge and understanding of emerging technologies	45	43	20	9	3.1	Accepted
2	The ability to evaluate and select appropriate 5th IR technologies.	45	40	19	13	3.0	Accepted
3	Collaborative skill	38	35	24	20	2.8	Accepted
4	Communication skill	39	34	25	19	2.8	Accepted
5	Research and analytical skills	37	32	25	23	2.7	Accepted
6	proficiency in programming	36	30	26	25	2.7	Accepted
7	Ability to use virtual reality for library services	37	30	27	23	2.7	Accepted
8	Information management skills	39	35	24	19	2.8	Accepted
9	Digital literacy skill	40	35	25	17	2.8	Accepted

Table 3 shows the mean response of the perceived skills required by librarians to navigate 5IR technologies for sustainable rural library development. From the table it shows that librarians agreed that; Proper knowledge and understanding of emerging technologies (3.1), The ability to evaluate and select appropriate 5th IR technologies (3.0), Collaborative skill (2.8), Communication skill (2.8), Information management skills (2.8), Digital literacy skill (2.8), Research and analytical skills (2.7), proficiency in programming (2.7), and Ability to use virtual reality for library services (2.7) are the perceived skills required by librarians to navigate the 5IR technologies to provide sustainable rural development.

Research objective 4: Challenges of leveraging on the 5th industrial revolution technologies for sustainable rural library development?

S/N	ITEMS	SA	A	D	SD	x̄	Decision
1	Inadequate infrastructure	52	47	15	3	3.3	Accepted
2	Poor funding	54	40	16	7	3.2	Accepted
3	Poor networks	41	32	24	20	2.8	Accepted
4	Limited technical expertise	37	36	25	19	2.8	Accepted

5	Poor digital literacy skills	39	30	25	23	2.7	Accepted
6	Data privacy and security issues	43	30	23	21	2.8	Accepted

Table 4 shows the mean response of the challenges of leveraging on the 5th industrial revolution technologies for sustainable rural library development. From the table it shows identified challenges such as; Inadequate infrastructure that support 5IR technologies (3.3), poor funding (3.2), poor networks (2.8), Limited technical expertise (2.8), Data privacy and security issues (2.8) and Poor digital literacy skills (2.7) are the challenges that librarians can face while leveraging on the 5th industrial revolution technologies for sustainable rural library development

Discussion of finding

The study revealed that, 5IR Technologies that can promote sustainable rural library development are Artificial intelligence technology, virtual reality, Mobile library applications, Social media, Blockchain technology, Internet of things and Big data analytics. This finding corresponds with Isiaka et al. (2024), they identified internet of thing (LoT), artificial intelligence, big data and data analytics, blockchain, virtual reality as key technological advancement with potential benefits to library services. Gorman (2015), pointed out that data analytics is essential to evaluate the strength and weakness of services to improve the services and operations of any organization. Euchedom and Okuoghae, (2021), stated that emerging technologies create librarians and information professionals with the opportunity to get to know their uses more and offer them better services. Also Peru (2019) agreed that libraries are techno-driven with AI and IoT based services and at the forefront of the digital transformation, enhancing the way people live, work, and interact with their environment. Therefore, these technologies hold great potential of improving efficiency, sustainability and overall quality life for rural communities.

The findings of the study revealed that librarians perceived that: 5th IR technologies will enhance the efficiency and streamline the delivery of library services to rural dwellers, I am sure that the potentials of the 5th Industrial Revolution Technologies can transform and Improve rural library development, I have the required skills to operate the 5th IR technologies for rural library development, 5th IR technologies will improve and promote sustainable rural library development, The 5th Industrial Revolution Technologies will results to the need to train rural dwellers on how to manipulate the technologies, 5th IR technologies may bring about challenges such as data privacy trust deficit and loss of confidence in technology because there may be existence of privacy violation, Implementing 5th IR technologies in developing rural libraries can bridge the gap between rural dwellers and urban dwellers, With the advent of the 5th Industrial Revolution, rural dweller may become less reliant on seeking information assistance from other sources, while they disagreed that 5IR technologies will; Implementing 5th IR technologies in developing rural libraries may lead to chaos and crisis and 5th IR technologies may automate tasks, reducing librarian roles to machines

Discussing on the potential of 5IR Technological advancements, Karneli, (2023), agreed that the era of emerging technologies have profound impact on library management practices which enable libraries to operate more efficiently and effectively. Tella et al. (2023) stated that emerging technologies, such as artificial intelligence and machine learning, hold the promise of further revolutionizing library services, from personalized recommendation engines to virtual reality-enhanced learning experiences. Furthermore, Nwobu et al. (2024) asserted that the evolution of libraries in the Fifth Industrial Revolution represents a seismic shift in the way information is accessed, managed, and utilized, the changing roles and responsibilities of librarians, and the impact of technological advancements on library management are reshaping the landscape of knowledge dissemination in profound ways. Pateman and Vincent (2023) further supported the fact that the 5IR technologies offer pathways for improved information literacy, educational outcomes, social inclusion and development for people in the rural communities.

The findings of the study revealed that librarians agreed that for librarians to adopt 5IR technologies skill such as; Proper knowledge and understanding of emerging technologies, The ability to evaluate and select appropriate 5th IR technologies, Collaborative skill, Communication skill, Information management skills, Digital literacy skill, Research and analytical skills, proficiency in programming, and Ability to use virtual reality for library services are required.

In the context of this study, Iyotsha and Madhu (2021), supported the study result that librarians must possess digital literacy skills, communication skill and information management skill to effectively manage information using emerging technological tools for services delivery. Thiruppathi (2024) stated that the acquisition of data management skills is crucial for librarian to collect, analyse, visualize data enabling evidence decision making and promoting service inclusion in remote communities. Furthermore, Apriliyanti (2022) argued that essential skills for librarians include teaching proficiency, good knowledge of technologies, strategic planning, collaborative and creative skills.

The findings of the study revealed challenges such as; Inadequate infrastructure that support 5IR

technologies, poor funding, poor networks, Limited technical expertise, Data privacy and security issues and Poor digital literacy skills are challenges that librarians can face while leveraging on the 5th industrial revolution technologies for sustainable rural library development. In related study carried out by Noah et al (2020) and Alala et al, (2024) they agreed that challenges such as financial constraints, outdated technologies and lack of skils can hinder the adoption and implementation of new technologies in libraries. Yusof and Rahman (2023) added that limited funding is a critical factor that prevent rural libraries from upgrading their technology, impacting on their ability to meet the growing technological demand of users. More so, Mansor and Rafie (2025), pointed out that many persons in rural areas may not possess the necessary skills to effectively use digital tools which leads to underutilization of available library resources and services. They also asserted that many libraries lack staff with technical expertise to offer in-depth training which further limits the potential of 5IR technologies in rural communities. Therefore, overcoming these barriers require a more coordinated effort from administrators, governments and community leaders to ensure that digital technologies are accessible, understandable and effectively utilized by rural populations.

Conclusion

Rural libraries have long been pillars of community development, providing access to information, knowledge and essential services. The heralding of 5IR technologies, libraries are recognized as critical facilitator of emerging technological inclusion, particularly in the underserved rural areas. By integrating 5IR technologies, rural libraries have great potential to empower communities with tools for education, recreation, communication, human development and economic development. The opportunities for 5IR technologies in rural libraries are extensive offering pathways to bridging the digital divide and enhance rural livelihood. Significantly, this study identifies the various 5IR technologies and their potential to enhance rural library services and promote sustainable development. It shows that librarians recognized the need for skills, knowledge and awareness of the 5IR technologies application in rural libraries. The study revealed that inadequate infrastructure, limited fund amongst other can plaque rural libraries in leveraging on 5IR technologies for sustainable rural library development. Therefore, understanding the future, potential and challenges of 5IR technologies is critical for rural library to fully realize it position in providing equitable, sophisticated, goal oriented and advanced information services to ensure rural dwellers are not left out in the technological development in major cities.

Recommendations

This research therefore recommends that;

1. Librarians should create more awareness of the need to adopt 5IR technologies in promoting library services especially in rural libraries.
2. support librarians in learning about industry 5IR technologies.
3. There is need for governments and other agencies to invest in rural libraries. Therefore, librarians need to advocate for rural library support to ensure rural library is adequately funded to patronize 5IR technologies for sustainable rural library development.
4. Libraries and librarians should engage with communities, stakeholders, users to understand their needs and preferences to develop 5IR –based library services.

Implications and future directions of the study

The findings and recommendations of this study are significant for librarians, governments, policymakers, communities and stakeholders. Future research can focus on exploring the impact of 5IR technologies on library services and user engagement in rural areas and developing frameworks and models for leveraging 5IR technologies in rural libraries**.**

Reference

Thiruppathi, K. (2024). Librarian's role in the digital age: reimagining the profession in the era of information abundance. *International Journal of Library and Information Science (IJLIS),* 13(1), 1–9. https://iaeme.com/Home/issue/IJLIS?Vol ume=13&Issue=1

Callaghan, C. (2023). Revisiting how scientific research drives technological change: The Fifth Industrial Revolution. *South African Journal of Science*, 119(7/8).

Ekwueme, I. O., Oluwaseun, B. O., Ajie, I. A., Ofodu, P. N. & Ambrose S. E. (2024). Awareness, perception, and skills of librarians for the implementation of 5th IR in academic libraries: implications on open and distant learning. *Journal of Science Technology and Education* 12(2),

Noble, S. M., Mende, M., Grewal, D., & Parasuraman, A. (2022). The Fifth Industrial Revolution: How harmonious human–machine collaboration is triggering a retail and service revolution. *Journal of Retailing, 98*(2), 199-208.

Karneli, O. (2023). The Role of Adhocratic Leadership in Facing the Changing Business

Environment. *Journal of Contemporary Administration and Management (ADMAN),* 1(2), 77-83.

Nwobu, B. K., Dumbiri, R., Ibia, M. J., & Oladokun, B. D., (2024). Libraries in the Fifth Industrial Revolution: Skills and Knowledge Required in Preparing Librarians for an Uncertain Future. In U. C. Udofot et al. (Eds.), *Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria.* (3 – 13). Port Harcourt: Chadick Printing Press

Tella, A., Bamidele, S. S., Olaniyi, O. T. & Yusuf Ayodeji Ajani (2023). Library and Information Science Graduate Skills Needed in the Fourth Industrial Revolution: A Nigerian. Information Services for a Sustainable Society: *Current Developments in an Era of Information Disorder*, 183, 342.

Pujihastuti, I. (2023). Disruptive Finance: Facing Challenges and Finding Opportunities in a New Era. *Central European Management Journal, 31*(2), 1126-1133

Schwab, K. (2017). The fourth industrial revolution. Currency.

Alala, A. G., Uzoaru, G.C. & Odikwa, N.H. (2024). Advantages challenges of implementing artificial intelligence in academic library services. *International Journal of educational Research and Scientific Development,* 5(1), 15-15. http://ijresd.org/index.php/IJRED/article/view/65/46

Apriliyanti, M. (2022). Challenges of the industrial revolution era 1.0-5.0. University digital Library in Indonesia. *Library Philosophy and Practice,* 1-17

Yusof, S. A., & Rahman, M.M. (2023). Improving rural public libraries' digital services through sustainable practices. *Library Management*, 44(2), 78-93.

Rahman, S.H., & Lim, L. (2024). Digital sustainability in rural libraries : A roadmap for the future. *Information System Journal, 32*(5), 1124-1139

Pateman, J., & Vincent, J. (2023). Rural library services in the digital age. *Library Press*.

Librarians' Perceptions of the Opportunities and Challenges of Using Generative Artificial Intelligence (Gen AI) for Library Services in Nigeria

By

Kennedy Arebamen EIRIEMIOKHALE, Ph.D.
Department of Library and Information Science,
Faculty of Information and Communication Technology,
Kwara State University, Malete, Nigeria.
kennedy.eiriemiokhale@kwasu.edu.ng

Florence Olabisi AJANI, Ph.D.
Deputy University Librarian
Kwara State University, Malate
florence.ajani@kwasu.edu.ng

Shuaib Agboola OLARONGBE, Ph.D.
The Polytechnic Librarian
Kwara State Polytechnic
Ilorin, Nigeria.
Olarongbe.sa@unilorin.edu.ng

Abdulakeem Sodeeq SULYMAN
Department of Library and Information Science
Kwara State Polytechnic
Ilorin, Nigeria.
Sulyman.abdulakeem@obc.ac.uk

Bukola Olutola JAMES
Code for Africa, Abuja, Nigeria.
bukola.james@codeforafrica.org

&
Iskil Arisekola Bolaji
Social Research Department, University of Hull, England
bolaji-2022@hull.com

Abstract

Generative artificial intelligence (Gen AI), an emerging genre of AI, is transforming the library and information landscapes, offering varied opportunities and posing different challenges. This, thus, underscores why this study investigated librarians' perceptions of the opportunities and challenges of Gen AI on library services. Descriptive survey design was used. The population of this study was 46 professional personnel of libraries of University of Ilorin and Kwara State University, Malete, both in Ilorin metropolis, Kwara State, Nigeria. Total enumeration sampling was used to cover all the population. A self-developed questionnaire was used to gather data. Out of the expected responses, only 29, representing 62.93 per cent was received. Data gathered were analysed in frequencies, simple percentages and mean ( ). Findings showed that the respondents have positive perceptions of Gen AI with a Grand mean = 3.24. Also, findings showed that ChatGPT and SciSpace (= 3.17) respectively and Quillbot (= 3.14) are perceived to be used for virtual reference assistance (= 3.66), research guidance (= 3.55), cataloguing and classification, content generation and data analysis (= 3.52) respectively. With respect to opportunities, the respondents perceived that Gen AI can provide tools for content curation and hold great promise for the future of libraries (= 3.34) and Gen AI technologies can automate repetitive tasks such as cataloguing and classification (= 3.28). However, the respondents perceived that intellectual property and copyright issues (= 3.55), ethical concerns, such as bias and fairness (= 3.48), potential job displacement (= 3.45) and staff resistance or lack of buy-in (= 3.41) are challenges to Gen AI utilisation. This study concluded that that librarians in university libraries in Kwara State, Nigeria, have perceived that using Gen AI for library services offer both opportunities and challenges. One of the recommendations of this study is that management of university libraries in Kwara State, Nigeria, should mandate heads of divisions or sections to encourage the use of Gen AI among their personnel.

Keywords: *Challenges, Gen AI, Kwara State, Nigeria, Opportunities, Perceptions, University libraries*

Introduction

University libraries are the heart of the university system, established with the basic purposes of providing university staff, students and other researchers with information and enabling environment that will facilitate teaching, learning and research (Kolawole & Igwe, 2016). According to Ishola (2014), the central objective of a university library is to support teaching, learning and research in ways consistent with and supportive of the institution's mission and goals. In supporting these functions, university libraries draw from the wealth of knowledge and skills of their personnel for advanced library services.

University libraries, being service-oriented institutions designed to provide necessary infrastructure to meet the information needs of the users and support in the intellectual and cognitive development of the users by providing adequate information resources, are massively following the trend of adopting and utilising ICT for their operations and services. One of the ICT devices that is prevalence in the university libraries' services delivery is artificial intelligence (AI), which are intelligent machines programmed for collecting or acquiring, processing, organising, storing, preserving, conserving, locating, accessing, retrieving and disseminating information resources to meet the information needs of the library users (Friday & Onuh, 2022).

Within the short period AI was developed, it has advanced into another dimension known as Generative AI (Gen AI). Generative AI is a type of AI that can produce various types of content, including text, imagery, audio and synthetic data. The growing popularity of Gen AI is being driven by the simplicity of new user interfaces for creating high-quality text, graphics and videos in a matter of seconds (Gimpel et al., 2023). Moreover, the Gen AI provides impetus for more personalised and professional services rendered in university libraries (Wang, 2018).

The emergence of Gen AI is viewed as a disruptive technological advancement that has been beneficial to most readers' services of university libraries (Lee, 2024). This is why Nvidia (2023) claimed that Gen AI is a powerful tool allowing librarians to streamline their workflow and enabling them to quickly generate new contents based on a variety of inputs (contents already on the Internet) to generate outputs (refined contents) in form of texts, images, sounds, animation, 3D models, or other types of contents. The user-friendliness and user-oriented natures of Gen AI necessitates its exploration as a mechanism for redefining the operations and services of university libraries.

Despite this, literature has reported various issues influencing the adoption of Gen AI in university libraries. Among the issues reported is librarians' perceptions. With respect to Gen AI, librarians' perceptions mean their opinions, views or impressions about Gen AI. These could have been informed based on librarians' awareness of Gen AI and their knowledge of it. Perceptions is a fundamental factor in technological adoption and utilisation by all categories of users. Librarians' perceptions can highly determine whether they will adopt or reject Gen AI for their library operations and services.

In emphasising the importance of perceptions on the adoption of AI and its evolving variants, Eiriemiokhale and Sulyman (2023), for instance, reported that librarians perceived AI as a positive technological advancement that can be used to perform some tasks initially perform by librarians. This corroborates the claim of Owolabi et al. (2021) that several librarians see the introduction of AI as an excellent innovation to library practices. AI-driven chatbots and virtual assistants provide instant support to library users by answering queries, assisting with navigation and offer information about library resources and services.

There have been countless studies on the adoption and utilisation of AI in Nigerian university libraries with variations in the positives and negatives of the available studies (Eiriemiokhale & Sulyman, 2023, Isiaka et al., 2024). On the positive side, Oyekale and Zubairu (2023) reported that 80% of librarians in Osun State University libraries have a positive perception regarding AI. The need to determine whether the positive perceptions about AI by librarians could be transmitted to Gen AI forms the basis for this study to investigate librarians' perceptions of the opportunities and challenges of Gen AI on library services.

Statement of the Problem

Technological advancements have penetrated the library and information landscapes, causing significant disruptions in information creation and delivery. This notion is well captured by Ahenkorah-Marfo (2015) who stated that the disruptions caused by technologies have reached an extent that threatens the survival of libraries unless they respond positively to the contemporary mode of information dissemination. In supporting this, Oyekale and Zubairu (2023) affirmed that AI is here to make library routine easier and not take their job from them. This explains why Bassey and Owushi (2023) found that Nigerian librarians have not lagged behind in utilising Gen AI for their operations and services.

However, despite the prominence being gained by AI and its variants, it has been observed by these researchers and reported in various studies including those of Eiriemiokhale and Sulyman (2023) as well as Tella (2020) that librarians in Nigeria tend to be reluctant to use AI for library operations and services due to their perceptions. The negative perceptions of librarians made it difficult for them to acquaint themselves with Gen AI advancements and exhibiting fear that Gen AI will take over their jobs. Noting that perceptions have a crucial role to play on Gen AI adoption and utilisation among librarians necessitated tailoring this study towards investigating librarians' perceptions of the opportunities and challenges of Gen AI on library services.

Objectives

The main objective of this study is to investigate librarians' perceptions of the opportunities and challenges of Gen AI on library services. The specific objectives are to:

1. ascertain librarians' perceptions of use of Gen AI for university library services;
2. identify librarians' perceived types of Gen AI used for university library services;
3. determine librarians' perceived areas of applications of Gen AI for university library services;
4. examine librarians' perceived opportunities of using Gen AI for services in university libraries; and,
5. examine librarians' perceived challenges facing the use Gen AI for services in university libraries.

Questions

This study seeks to answer the following questions:

1. What are librarians' perceptions of use of Gen AI in university library services?
2. What are librarians' perceived types of Gen AI used for university library services?
3. What are librarians' perceived areas of applications of Gen AI for university library services?
4. What are librarians' perceived opportunities of using Gen AI for services in university libraries?
5. What are librarians' perceived challenges facing the use Gen AI for services in university libraries?

Review of Related Literature

The advent of Gen AI marks a transformative era in technological progression, reshaping people's interaction and integration with technology. This advanced AI genre is celebrated for its ability to create novel contents and innovative solutions, catalyses a revolution in serving the library users (Narayanan, 2024). Literature have clearly revealed that Gen AI have the potential of redefining the operations and services of university libraries. This is because Gen AI tools utilise large language models to generate unique text or image-based responses to user prompts (BMJ, 2024). It can write reports, provide user support, perform data analysis, summarize users research, develop training materials, automate emails, schedule appointments, generate users' profiles and much more (Morper, 2023).

Gen AI instills a significant transformation in libraries beyond enhancing traditional readers' services (Leiker et al., 2023). It is about reimagining the role of libraries in the increasingly digitalised context (Narayanan, 2024). Gen AI exceeds being a mere tool; it signifies a paradigm shift, fundamentally altering the landscape of information creation, access and engagement. It redefines traditional methods of readers' services, paving the way for an era where human-AI collaboration blurs the line between technological aid and human inventiveness (Mello et al., 2023).

The Gen AI is an advanced genre of AI. The import of this is that being that Gen AI it still at its early stages of development (Subaveerapandiyan et al., 2023). There is a dearth of studies on Gen AI's perceptions among librarians. Nevertheless, the available studies on AI's perceptions, awareness, readiness and utilisation can be relied upon to establish an informed literature. For instance, Eiriemiokhale and Sulyman (2023) reported that librarians believed that the invention of AI has greatly enhanced the potential of libraries' services. This means that if librarians maintain the similar positive perceptions they have about AI, they would not have problems with forming positive perceptions about Gen AI. Librarians' positive perceptions of AI has been professed by Tella (2020) who noted that AI improves libraries' operational efficiency by optimising collection analysis, visualisation, cataloguing, preservation, and reducing the expenses associated with service delivery.

Hussain (2022) claimed that Gen AI is a widely used technology in library services that can transform libraries' operations and services to the best. Gen AI is impacting the way information is processed and searched for and information professionals will be able to use these exciting new technologies to enhance their services and help users find and access specific information more easily and quickly. Isiaka et al. (2024) reported that the usefulness of AI technologies for efficient library operations such as AI chatbots can be useful for reference services, cataloguing and classification of library materials, expert search tools for information search and automating library routines.

Tella (2020) asserted that the usefulness of AI for university libraries' operations has the potential to transform traditional library services, making them more efficient, user-friendly and responsive to the evolving needs of academic communities. Hussain (2022) stressed that Gen AI can handle directional questions on a library website, alert when a book is due, point a user to relevant library resources or answer simple informational requests enabling librarians have insight into how their clients search for and use information and can therefore actively support the development. By observing and exploring how information flows within their organisation, librarians can identify points at which information could be transformed or used in entirely new ways.

It can be deduced from the available literature that librarians' perceptions of Gen AI influenced their usage of it. Isiaka et al. (2024) reported that librarians perceived Gen AI tools including ChatGPT, CoPilot, QuillBot, Gemini, ChatSonic, Socratic, Tome, Galileo AI, Midjourney, GPTZero, Consensus, SciSpace, StyleGAN, DALL-E 2, GPT-4, LibraryH3lp, Alma, Dialogflow to be encouraging. The potential library operations and services Gen AI could be used for include content generation, book recommendations, virtual librarians, interactive learning, accessibility support, creative projects, data analysis, customization,

curation assistance, virtual reference assistance, translation services, cataloguing and classification, collection analysis, research assistance and research guidance.

Despite the potential opportunities of Gen AI, studies have reported many challenges that could hinder librarians' positive perceptions of them. For instance, Asim et al. (2023) claimed that librarians are of the opinions that Gen AI's usage requires high integrated technological infrastructure, high funding/cost, collaboration between AI experts and professionals, library users' feedback, requirement of a highly networked and integrated environment, lack of budget, high cost of AI technologies and lack of staff expertise. Similarly, Sambo, Imran and Akanbi (2022) perceived problems such as power failure, lack of digital equipment, cost of digital skills training and lack of basic AI literacy skills.

Additionally, Obiano et al. (2022) perceived low level of institutional support, lack of needed AI tools and inadequate planning as the bane of Gen AI adoption and utilisation. Eiriemiokhale and Sulyman (2023) reported that librarians perceived poor Internet connectivity, lack of expertise, potential loss of job, high risk of maintenance, technical problems, epileptic electricity or power supply, and inadequate ICT facilities for AI technologies (Isiaka et al., 2024) as challenges associated with AI among librarians.

On the sides of Qomariyah et al. (2020) librarians' perceptions with Gen AI are being affected by problems including documents about policies and procedures, technical know-how and organisational resources, such as human and technological resources. Kaushal and Yadav (2022) perceived that despite the huge advantages of AI chatbots for improving university libraries' operations and services, their major drawback include ethical concerns, such as bias and unfairness, intellectual property, copyright issues, intrusion on privacy, doubting the quality and accuracy of generated content, leading to plagiarism, cheating, abuses of data privacy and security.

Methodology

This study is quantitative in nature. This justifies why descriptive survey design was adopted to assess librarians' perceptions on the opportunities and challenges of utilising Gen AI for services of university libraries in Kwara State, Nigeria. The population of this study is 46 professional staff of public university libraries in Kwara State, namely; University of Ilorin and Kwara State University, Malete. Total enumeration sampling was used to select all members of the population since it is small, manageable and can be covered by the researchers. A self-developed questionnaire, which was face validated by two professors of library and information science was used for data collection. From the 46 questionnaires administered, only 29 representing 62.93% were returned and found usable for analysis. Data collected were analyzed using descriptive statistics.

Data Analysis

Table 1: Demographic Information of Respondents

Options		F	%
Gender	Male	12	40.0
	Female	17	56.7
	Total	**29**	**100**
Respondent's library	University of Ilorin	19	63.3
	Kwara State University	10	33.3
	Total	**29**	**100**
Age range	21-30 years	7	23.3
	31-40 years	14	46.7
	41-50 years	8	26.7
	51 years and above	0	0.0
	Total	**29**	**100**
Academic qualifications	BLIS	17	58.7
	MLIS	9	31.1
	PhD	3	10.6
	Total	**29**	**100**
Work experience	0-4 years	8	26.7
	5-9 years	14	46.7
	10-14 years	7	23.3
	15 years and above	0	0.0
	Total	**29**	**100**

Total29100Source: Researchers' Field Survey, 2025

Table 1 shows that majority of the respondents 17 (56.7%) were females, followed by male (12 40.0%). Respondents from University of Ilorin were 19 (63.3%), while only 10 (33.3%) are from Kwara State University, Malete. Also, respondents within the age range 31 – 40 years are 14 (46.7%), followed by 41 – 50 years 8 (26.7%) and 21 – 30 years (7 23.3%). Moreso, BLIS has the highest representation with 17 (56.7%), followed by MLIS with 9 (31.1%), while PhD has 3 (10.6%). Finally, respondents with 5 – 9 years work experience are 14 (46.7%), followed by 0 – 4 years (8 26.7%) and 10 – 14 years are 7 (23.3%). The import of this data is that majority of the respondents have appreciable years of work experience and academic qualifications, which could have exposed them to varying technological evolutions in libraries. It is believed that their exposures can influence their perceptions about the opportunities and challenges of GAI utilisation in libraries.

Table 2: Librarians' perceptions of Gen AI on university libraries' services

Options	$\bar{x}$	DR
I believe Gen AI tools have the potential to benefit library services and operations	3.38	SA
I think Gen AI is capable of automating library routines/tasks	3.31	SA
I feel Gen AI will offer new ways to improve services	3.28	SA
I feel Gen AI can enhance accessibility	3.24	A
I feel Gen AI is transforming and changing libraries	3.24	A
I feel Gen AI can enhance user experiences	3.17	A
I feel Gen AI will enable libraries to adopt to the changing needs of users	3.03	A
Grand mean = 3.24		

Decision Rule: If mean (X) is 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).

Table 2 reveals that the respondents' perceptions are positive with (Grand mean = 3.24), indicating that they agreed with the options provided. Specifically, the respondents strongly agreed by believing that Gen AI tools have the potential to benefit library services and operations (X= 3.38), followed by thinking that Gen AI is capable of automating library routines/tasks (X= 3.31) and feeling Gen AI will offer new ways to improve services (X = 3.28). This means that the respondents perceived that Gen AI have the potential to benefit library services and operations, capable of automating library routines/tasks and offer new ways to improve services.

Table 3: Librarians' perceived types of Gen AI used for university library services

Options	$\bar{x}$	DR
ChatGPT	3.17	A
SciSpace	3.17	A
QuillBot	3.14	A
Midjourney	3.07	A
LibraryH3lp	3.07	A
Dialogflow	3.07	A
Tome	3.03	A
GPT-4	3.00	A
ChatSonic	2.97	A

GPTZero	2.97	A
Consensus	2.97	A
Socratic	2.93	A
DALL-E 2	2.90	A
StyleGAN	2.86	A
Gemini	2.83	A
Alma	2.83	A
CoPilot	2.76	A
Galileo AI	2.72	A
Grand mean = 2.97		

Decision Rule: If mean (X) is 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).

Table 3 shows that the respondents' agreed with the types of Gen AI that could be used for library services (Grand mean = 2.97). Specifically, the respondents agreed that ChatGPT and SciSpace could be used for library services with (X= 3.17) respectively, followed by Quillbot (X= 3.14), while Midjourney and LibraryH3lp have (X= 3.07) respectively. Other options were also agreed that they could be used for library services. This implies that the respondents perceived that ChatGPT, SciSpace, Quillbot, Midjourney and LibraryH3lp could be used for library services.

Table 4: Librarians' perceived applications of Gen AI for university library services

Options	$\bar{x}$	**DR**
Virtual reference assistance	3.66	SA
Research guidance	3.55	SA
Cataloguing and classification	3.52	SA
Content generation	3.52	SA
Data analysis	3.52	SA
Shelf organization	3.48	SA
Interactive learning	3.45	SA
Curation assistance	3.41	SA
Staff training	3.41	SA
Circulation management	3.34	SA
Book recommendations	3.31	SA
Virtual libraries	3.31	SA
Customization	3.28	SA
Translation services	3.28	SA
Collection analysis	3.17	A
Creative projects	3.17	A
Grand mean = 3.40		

Decision Rule: If mean (X) is 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).

Table 4 indicates that the respondents' perceived application of Gen AI for library services is positive with (Grand mean = 3.40). Specifically, the respondents strongly agreed that Gen AI can be applied to virtual reference assistance (X= 3.66), followed by research guidance (X= 3.55) and cataloguing and classification, content generation and data analysis (X= 3.52) respectively. This shows that the respondents' perceived that Gen AI can be applied to virtual reference assistance, research guidance, cataloguing and classification, content generation and data analysis.

Table 5: Librarians' perceived opportunities of using Gen AI for services in university libraries

Options	$\bar{x}$	DR
Gen AI can help address the problem of information overload	3.38	SA
Gen AI can provide tools for content curation, analysis and recommendations	3.34	SA
Gen AI has the potential to enhance the efficiency, availability and usability of information resources	3.34	SA
Gen AI can hold great promise for the future of libraries	3.34	SA
Gen AI technologies can automate repetitive tasks such as cataloguing and classification	3.28	SA
Gen AI can provide personalized recommendations	3.24	A
Gen AI can enable users to find relevant resources quickly and easily	3.21	A
Gen AI can help address resource scarcity	3.21	A
Gen AI algorithms can shift through large datasets to identify trends, topics and patrons, helping librarians make informed decision	3.17	A
Gen AI chatbots can offer instant support to users, answering questions and guiding them to relevant resources	3.17	A
Gen AI will enable libraries to provide personalized reading suggestions to patrons	3.10	A
Grand mean = 2.95		

Decision Rule: If mean (X) is 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).

Table 5 shows that the respondents' perceived opportunities of using Gen AI for services in university libraries is positive with (Grand mean = 2.95). Specifically, the respondents strongly agreed that Gen AI can help address the problem of information overload (X= 3.38), followed by Gen AI can provide tools for content curation, analysis and recommendations, Gen AI has the potential to enhance the efficiency, availability and usability of information resources and Gen AI can hold great promise for the future of libraries (X= 3.34) respectively and Gen AI technologies can automate repetitive tasks such as cataloguing and classification (X= 3.28). This means that the respondents' perceived opportunities of using Gen AI for services in university libraries include Gen AI can help address the problem of information overload, can provide tools for content curation, analysis and recommendations, has the potential to enhance the efficiency, availability and usability of information resources and can hold great promise for the future of libraries.

Options	$\bar{x}$	DR
Intellectual property and copyright issues	3.55	SA
Inadequate funding to acquire resources needed for Gen AI implementation	3.48	SA
Ethical concerns, such as bias and fairness	3.48	SA
Potential job displacement	3.45	SA
Staff resistance or lack of buy-in	3.41	SA
Doubting the quality and accuracy of generated content	3.41	SA
High subscription fee for accessing advanced features	3.38	SA
Data privacy and security	3.34	SA
Ensuring accessibility and inclusivity of AI tools for users	3.34	SA
Reducing human-to-human interactions	3.31	SA
Provision of unreliable information	3.31	SA
Technical expertise and resource requirements	3.31	SA
Restricting learning autonomy and narrow learning experiences	3.28	SA
Risk to privacy and data security	3.24	A
Provision of inaccurate or false references	3.17	A
Leading to plagiarism and cheating	3.17	A
Grand mean = 3.16		

Grand mean = 3.16Decision Rule: If mean (X) is 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).

Table 6 reveals that the respondents' perceived that challenges are associated with using Gen AI for services in university libraries with (Grand mean = 3.16). Specifically, the respondents strongly agreed that to the challenges such as intellectual property and copyright issues (X= 3.55), followed by Inadequate funding to acquire resources needed for Gen AI implementation and ethical concerns, such as bias and fairness (X= 3.48) respectively, potential job displacement (X= 3.45) and staff resistance or lack of buy-in (X= 3.41). This implies that the respondents' perceived challenges of using Gen AI for services in university libraries include intellectual property and copyright issues, inadequate funding to acquire resources needed for Gen AI implementation and ethical concerns, such as bias and fairness, potential job displacement and staff resistance or lack of buy-in.

Discussion of Findings

It can be discovered from the findings that the respondents have positive perceptions about GAI by perceiving that GAI have the potential to benefit library services and operations, capable of automating library routines/tasks and offer new ways to improve services. The respondents' perceptions of GAI affirm the position of Wang (2018) that GAI provides impetus for more personalised and professional services rendered in university libraries. The results also confirmed the findings of Eiriemiokhale and Sulyman (2023) that librarians perceived AI as a positive technological advancement that can be used to perform some tasks initially perform by librarians. The results are similar to the situation of Osun State, Nigeria, where Oyekale and Zubairu (2023) reported of that most of librarians in Osun State University libraries have a positive perception regarding AI.

Moreso, it is interesting to find that the respondents perceived that GAI including ChatGPT, SciSpace, Quillbot, Midjourney and LibraryH3lp could be used for different library services. The respondents' positive perceptions about all the options represented their believe in the use of GAI for different library services. This informs the respondents' choices of perceiving that GAI could be used for virtual reference assistance, research guidance, cataloguing and classification, content generation and data analysis. The findings validate the arguments of Morper (2023) that GAI can write reports, provide user support, perform data analysis, summarize users research, develop training materials, automate emails, schedule appointments and generate users' profiles.

Furthermore, it is insightful to discover that the respondents have perceptions that GAI poses opportunities for services of university libraries because GAI can help address the problem of information overload, provide tools for content curation, analysis and recommendations, has the potential to enhance the efficiency, availability and usability of information resources and hold great promise for the future of libraries. One of the imports of these findings is that the respondents perceived that GAI offers variety of opportunities to libraries.

Moreover, the findings affirm the notion of Hussain (2022); Tella (2020) that AI-related technologies have the capacities to impact the way information is processed and searched for, improve libraries' operational efficiency by optimising collection analysis, visualisation, cataloguing, preservation, and reducing the expenses associated with service delivery. Also, the respondents' perception that GAI hold great promise for the future of libraries is consistent with the points of Leiker et al. (2023); Narayanan (2024) that GAI instills a significant transformation in libraries beyond enhancing traditional readers' services and reimagining the role of libraries in the increasingly digitalised context.

In spite of the encouraging perceptions of the respondents about GAI and the enormous opportunities GAI promises to offer university libraries, findings showed that the respondents perceived that harnessing the potential of GAI can be hampered by many factors including intellectual property and copyright issues, inadequate funding to acquire resources needed for GAI implementation and ethical concerns, such as bias and fairness, potential job displacement and staff resistance or lack of buy-in. These findings revealed a consistency of trend in the perceptions and adoption of technologies for library operations and services in the Nigerian context, where librarians believed that technologies would displace them of their jobs, therefore resisting its adoption.

Interestingly, discovering that the respondents perceived intellectual property and copyright issues as challenges to GAI adoption indicated that these problems are not limited to the perceptions of Nigerian librarians alone; Kaushal and Yadav (2022); Qomariyah et al. (2020) also raised the issues of intellectual property and copyright as hindrances to GAI adoption in libraries globally. They concluded that the utilisation of GAI by librarians with minimal information and AI literacies will result to privacy intrusion, doubting the quality and accuracy of generated content, plagiarism, cheating, abuses of data privacy and security.

Also, the issue of inadequate funding to acquire resources corroborates the submissions of Asim et al. (2023); Eiriemiokhale and Sulyman (2023); Sambo, Imran and Akanbi (2022) that the adoption of AI-related tools for service delivery in libraries is capital-intensive and in countries where their libraries are grappling with inadequate funding, this issue compounds the challenges of libraries, resulting in the non-provision of the required technological infrastructure, erratic power supply and inability to afford digital skills acquisition training.

Conclusion

This study has unearthed some mysteries surrounding librarians' perceptions of opportunities and challenges of using Gen AI for university libraries' services. This study brings into fore that librarians in university libraries in Kwara State, Nigeria, have perceived that using Gen AI for library services offer both opportunities and challenges. With regards to the opportunities, librarians in university libraries in Kwara State, Nigeria, perceived that by using the likes of ChatGPT, SciSpace, Quillbot and Midjourney for virtual reference assistance, research guidance, cataloguing and classification, content generation and data analysis, libraries can overcome the problem of information overload, have access to tools for content curation, and hold great promises for the future of libraries.

Despite these opportunities, librarians in university libraries in Kwara State, Nigeria, also perceived that Gen AI may be difficult to utilise for services due to problems including intellectual property and copyright issues, inadequate funding to acquire resources needed for Gen AI implementation, ethical concerns, such as bias and fairness, potential job displacement and staff resistance or lack of buy-in. These challenges, if not adequately responded to, can halt the potential of utilising Gen AI for services in university libraries in Kwara State.

Recommendations

Based on the findings, the study recommended the following:

1. Management of university libraries in Kwara State, Nigeria, should endeavour to provide dedicated funding for Gen AI implementation in their libraries. This will help them provide adequate resources needed in the acquisition of Gen AI infrastructure and training their personnel on the use of Gen AI.
2. Management of university libraries in Kwara State, Nigeria, should endeavour to partner with Gen AI developers to provide necessary training to their personnel. This will equip the university library personnel with the skills of using Gen AI for library services by avoiding ethical concerns and other abuses associated with Gen AI usage in the library.
3. Management of university libraries in Kwara State, Nigeria, should mandate heads of divisions or sections to encourage the use of Gen AI among their personnel. This will increase the AI efficacy of the personnel and boost their confidence in using it; thus, changing their perceptions about Gen AI taking over their jobs.

References

Ahenkorah-Marfor, M. (2015). Knowledge and use of social media by reference and user services librarians in public and private universities in Ghana. Published MSc Thesis submitted to the Department of Information Studies, University of Ghana, Legon available in http:/ugspace.ug.ed u.gh

Asim, M., Arif, M., Rafiq, M. & Ahmad, R. (2023). Investigating applications of Artificial Intelligence in university libraries of Pakistan: An empirical study. *The Journal of Academic Librarianship*, 49(6), 1-17. https://doi.org/10.1016/j.acalib.2023.102803

Bassey, M.M. & Owushi, E. (2023). Adoption of Artificial Intelligence in Library and Information Science in the 21st Century: Assessing the perceived impacts and challenges by librarians in Akwa Ibom and Rivers States. *International Journal of Current Innovations in Education*, 6(1), 75-85

BMJ (2024). Publishers' and journals' instructions to authors on use of generative artificial intelligence in academic and scientific publishing: Bibliometric analysis. 384 doi: https://doi.org/10.1136/bmj-2023-077192

Eiriemiokhale, K. A. & Sulyman, A.S. (2023). Awareness and perceptions of artificial intelligence among librarians in university libraries in Kwara State, Nigeria. *Indonesian Journal of Librarianship*, 4 (2), 107-118. DOI: https://doi.org/10.33701/ijolib.v4i2.3364

Gimpel, H. et al. (2023). Unlocking the power of Generative AI models and systems such as GPT-4 and ChatGPT for higher education: A guide for students and lecturers. *Hohenheim Discussion Papers in Business, Economics and Social Sciences, No. 02-2023, Universität Hohenheim, Fakultät Wirtschafts- und Sozialwissenschaften, Stuttgart*. https://nbn-resolving.de/urn:nbn:de:bsz:100-opus-21463

Hussain, A. (2023). Use of artificial intelligence in the library services: prospects and challenges. *Library Hi Tech News*, 40(2), 15-17. https://doi.org/10.1108/LHTN-11-2022-0125

Ishola, B.C. (2014). Funding problems in Nigerian university libraries: Fee-based library and information services to the rescue, Focus on pricing. *Library Philosophy and Practice. 1176.* http://digitalcommons.unl.edu/libphilprac/1176

Isiaka, A.O., Olarongbe, S.A., Sulyman, M.O., Aremu, B.A. & Saba-Jibril, S. (2024). Perceived awareness and usefulness of artificial intelligence technology for efficient library operations in university libraries in Kwara State, Nigeria. *Journal of Library Services and Technologies*, 6(1), 120 – 134. DOI: http://doi.org/10.47524/jlst.v6i1.121

Kolawole, A.A. & Igwe, K.N. (2016). Treatise on library and information science in an African society

(Rev.ed.). Lagos: Waltodanny visual concepts.

Koushal, K., Gour, R. & Mitra, T. (2012). Advanced applications of neural networks and artificial intelligence: A review. *International Journal of Information Technology and Computer Science*, 4(6), 57–68.

Lee, A.V.Y. (2024). Staying ahead with generative artificial intelligence for learning: challenges and opportunities. *Asia Pacific Journal of Education*, DOI: 10.1080/02188791.2024.2305171

Leiker, D., Gyllen, A. R., Eldesouky, I., & Cukurova, M. (2023). Generative AI for learning: Investigating the potential of synthetic learning videos. arXiv preprint arXiv:2304.03784. http://arxiv.org/abs/2304.03784v2

Mello, R. F., Freitas, E., Pereira, F. D., Cabral, L., Tedesco, P., & Ramalho, G. (2023). Education in the age of Generative AI: Context and recent developments. *arXiv preprint* arXiv:2309.12332. http://arxiv.org/abs/2309.12332v1

Morper, M. (2023). How to use Generative AI to improve operations while protecting sensitive data. Route 50, 29 p. NA. Gale Academic OneFile, link.gale.com/apps/doc/A774685692/AONE?u=anon~2e76022&sid=googleScholar&xid=cf6bcfbb .

Narayanan, N. (2024). The era of Generative AI: Transforming academic libraries, education, and research. in empowering minds collaborative learning platform for teachers (pp. 282–293). essay, St. Agnes College. https://zuscholars.zu.ac.ae/works/6351/.

Nvidia, H. (2023). What is Generative AI? https://www.nvidia.com/en-us/glossary/generative-ai/

Obiano, D.C., Onuoha, C.O., Adeoye, A.A., Nwosu, J.C. & Folarin, M. (2022). Aiding the exploration of artificial intelligence in Nigerian academic libraries in the 21st century. *Information Technology and Librarianship*, 2(1&2), 1-13

Ogwo, U.; Ibegbulem, F.; & Nwachukwu, V. N. (2023). Applications and Perceived Impact of Artificial Intelligence in University libraries in Nigeria. *Library Philosophy and Practice (e-journal). 7907*. https://digitalcommons.unl.edu/libp hilprac/7907.

Oyekale, J.O. & Zubairu, A.N. (2023). Assessment of awareness, perceptions, and adoption of artificial intelligence in university libraries In Osun State, Nigeria. *Tin-City Journal of Library, Archival & Information Science*, 12(1), 132-138.

Qomariyah, A.; Mursidah, G. & Wahyun, D. (2020). Analysis of organizational readiness towards library 4.0: A case study at x library. *Record and Library Journal*, 6(2), 1-23. DOI: https://doi.org/10.20473/rlj.V6-I2. 2020.110-119

Sambo, A.S., Imran, A.A., & Akanbi, M.L.A. (2022). Digital literacy skills among certified librarians in Nigerian Libraries: Library overview. *Journal of Digital Learning and Education,* 2(2), 70-79.https://doi.org/10.52562/jdle.v2i 2.316.

Subaveerapandiyan, A., Sunanthini, C. & Amees, M. (2023). A study on the knowledge and perception of artificial intelligence. *International Federation of Library Associations and Institutions*, 49(3), 503–513. https://doi.org/10.1177/03400352231180230

Tella, A. (2020). Robots are coming to the libraries are librarians ready to accommodate them? *Library Hi Tech News*, 37(8), 13–17. DOI: https://doi.org/10.1108/LHTN-05- 2020-0047.

Libraries as Dynamic Partners for the Future of Research and Development (R&D)

Ifeoma Abigail Ajie *Ph.D. CLN*
Department of Library and Information Science
Faculty of Education
National Open University of Nigeria, Abuja
iajie@noun.edu.ng +2348022220090
Ukoha O. Igwe *Ph.D., CLN*
Department of Library and Information Science,
Faculty of Education
National Open University of Nigeria, HQ Abuja. Nigeria
uigwe@noun.edu.ng +234 8164825001
Patricia Ngozi Ofodu Ph.D (CLN
Department of Library and Information Science
Faculty of Education
National Open University of Nigeria, Abuja
pofodu@noun.edu.ng +2348035163812

Abstract

In today's digitally driven world marked by swift technological progress, academic libraries are playing an increasingly vital role in advancing research and development (R&D). This paper examined how libraries are transforming to promote innovation, share knowledge, and encourage interdisciplinary cooperation in the digital landscape. It explores the ways in which libraries incorporate modern technologies, such as artificial intelligence, machine learning, data analytics, and digital repositories, to improve research effectiveness, expand access to information, and support global academic collaboration. The study also addresses the major challenges librarians faced, including limited funding, digital archive maintenance, collaboration difficulties, intellectual property issues, and the ongoing need for professional up skilling. Drawing on international best practices and real-world examples, the research highlighted the transition of libraries from traditional knowledge keepers to proactive contributors in the research ecosystem. The findings underscored the essential role played by libraries in building research capacity, enhancing skills, managing data, and creating inclusive, forward-thinking academic spaces. Ultimately, the study affirmed that libraries are crucial players in driving the future of R&D within knowledge-based economies.

Keywords: Libraries, Dynamic partners, Research, Development.

Introduction

In the digital age, libraries must continuously evolve to meet the needs of 21st-century users by redefining how they deliver information services and products. The rapid advancement of information technologies has placed libraries at a critical crossroads compelling library to either adapt and thrive or risk becoming obsolete. This challenge raises a probing question for librarians on how to ensure that these libraries remain relevant in an era of constant technological disruption. To stay at the forefront of knowledge dissemination, modern librarians must not only embrace emerging technologies but also integrate innovative solutions that promote research and development (R&D). R&D and Innovation as cited by Emezie, (2018) in Lubanga, and Mumba, (2021) have become essential pillars of contemporary academic librarianship, driving the transformation of library services, products, and practices in response to the digital revolution.

Libraries are no longer just custodians of knowledge; they have evolved into proactive collaborators that adapt to technological advancements and the changing needs of researchers and users. Their ability to provide open access platforms, digital repositories, and advanced data management tools positioned them as indispensable partners in the future of research and development. Technology is revolutionizing education and research by transforming how knowledge is accessed and shared, compelling academic libraries to continuously upgrade their digital collections, technological infrastructure, and user interfaces to meet evolving user needs. By integrating cutting-edge technologies and research support services, libraries played a crucial role in enhancing the R&D process and reinforcing their position as vital hubs for research and learning in the digital age (Nasir & Tyagi, 2023). The integration of cutting-edge technologies has transformed library services by equipping researchers with advanced tools such as open access, digital resource management systems, artificial intelligence (AI) and machine learning (ML) applications, collaboration tools, cloud computing, data analytics, and digital repositories. All of these are aimed at enhancing research efficiency, facilitate seamless information discovery, enable remote access, automate cataloguing, preserve data, and foster interdisciplinary collaboration, ultimately strengthening libraries' role in supporting research and knowledge dissemination.

Moreover modern libraries have increasingly integrated technology and established collaborative networks with various sectors and stakeholders to facilitate the sharing of research findings, recognizing research outputs as key drivers of development, while research and development (R&D) serve as systematic and creative processes that expand knowledge in areas such as culture, society, and technology, ultimately leading to new innovations (Lubanga & Mumba, 2021; Nitecki & Davis, 2019; Mwilongo, 2021). Globally, the industrial sector collaborates with academic libraries to leverage research outputs and R&D programs

for economic development, with empirical evidence showing that such collaborations have significantly contributed to advancements in several European Union (EU) regions, as well as in countries like the United States, China, Japan, and South Korea, which have actively engaged academic library research collections to drive industrial innovation, technological progress, and global market competitiveness (Huang et al., 2021; Khan, 2015; Mwilongo & Kotoroi, 2021; UNESCO, 2019). To remain relevant in a rapidly evolving knowledge economy, modern libraries and librarians must embrace globalization by fostering partnerships with industries, policymakers, and other stakeholders, continuously refining research output policies and services, and transitioning from traditional service providers to intellectual entrepreneurs who actively shape the research landscape and contribute to global innovation (Lubanga & Mumba, 2021; Mushi et al., 2020; Tella, 2020).

Statement of the problem

In the digital era, academic libraries face a critical challenge: to remain relevant and effective amidst rapid technological advancement and shifting user expectations. Once seen primarily as custodians of knowledge, libraries are now compelled to transform into dynamic, technology-driven institutions that actively support research, innovation, and knowledge dissemination. The proliferation of emerging technologies such as artificial intelligence (AI), machine learning (ML), digital repositories, and data analytics has redefined how information is accessed, managed, and shared. Consequently, academic libraries must integrate these tools and align their services with the evolving needs of researchers, institutions, and industries.

Despite the global recognition of research and development (R&D) as a driver of societal and economic progress, many academic libraries, particularly in developing regions, struggle to adapt to this new paradigm. There remains a significant gap in how libraries leverage innovative technologies and collaborative networks to enhance their role in supporting R&D. The inability to keep pace with digital transformation not only limits libraries' contributions to the research ecosystem but also threatens their relevance in a knowledge economy driven by globalization and interdisciplinary collaboration (Lubanga & Mumba, 2021).

This situation raises a fundamental question: How can academic libraries effectively redefine their roles, integrate emerging technologies, and foster strategic partnerships to support and sustain research and development in the digital age? Addressing this problem is essential to ensuring that academic libraries evolve into proactive hubs of innovation and remain vital to the advancement of knowledge and societal development.

Objectives of the study/ Research questions

1. Discuss the basic roles of libraries in supporting research and development
2. Identify the technological innovations in libraries for research and development
3. Suggest the challenges faced by librarians supporting research and development
4. Identify the best practices of research & development initiatives in libraries

Review of Related Literature

The Role of libraries in Supporting Research and Development

Seeking information is crucial for both researchers and academic librarians, with data playing a pivotal role in this process. Libraries are increasingly focused on developing research data management policies and services, recognizing them as a vital aspect of their future role, with emerging priorities like providing training and workshop services on topics pertinent to researchers Cox,& Pinfield2013).Kamposiori (2017) asserts that libraries are shifting from being service providers to active participants in research and development, thereby enhancing the recognition of the library profession in the field of research for research support and guidance. Libraries have been granted the freedom to be 'different,' positioning the library as a central hub for showcasing innovative approaches such as collaborating and networking within the academic community (Holloway,2004).

Information specialists work in a dynamic environment that requires adapting to technological changes and other developments, meaning that the evolution of research support services will be influenced not only by researchers but also by the expertise of information professionals such as offering advice on research methodologies and helping with data management (Forsman, Ndinoshiho & Poteri,2012). Academic libraries play a crucial role by `encouraging researchers to utilize open access repositories in conjunction with their local repositories for data storage and sharing thereby facilitating the researchers to a wide range of resources (Yu,2017). In 2008, Sacchanand explored the role of the Thai Library Association (TLA) in advancing library development, LIS research, community services, and international relations. The study emphasized the importance of expanding the libraries' objectives to adapt to changes and more effectively achieve its goal of enhancing librarianship research. It also highlighted the value of seminars and workshops as platforms for dialogue, knowledge exchange, and addressing various challenges within the field of librarianship.

Libraries as Collaborative Partners: Enhancing Capacity and Skill Development

Libraries play a vital role in education and research by acting as key collaborators in capacity building and

skill enhancement. They provide students and researchers with access to essential resources, training, and support in areas such as research methodologies and information literacy. According to Momoh and Folorunso (2019), modern libraries have transitioned from being mere book repositories to dynamic centers of knowledge creation, digital literacy, and lifelong learning. They offer up-to-date information, helping users locate and utilize relevant materials efficiently. Libraries also serve as knowledge hubs that foster intellectual growth and support human capacity development.

By working closely with educational institutions, faculty, and researchers, libraries contribute significantly to academic success. They promote interdisciplinary learning and facilitate open-access research, ensuring that scholarly knowledge reaches a wider audience. Ashikuzzaman (2024) highlights libraries as "academic hubs" where students and faculty engage in collaborative research using scholarly databases, digital repositories, and research assistance services. This collaborative environment fosters creativity and enhances the research capabilities of students and faculty, driving innovation and knowledge advancement.

Moreover, libraries partner with community organizations and industry stakeholders to promote research-based learning and skill development. University libraries, for instance, collaborate with online learning platforms such as Coursera and LinkedIn Learning to provide free or subsidized courses. These initiatives bridge gaps in digital literacy and research skills, equipping users with the ability to find, evaluate, and ethically utilize digital information. Libraries also provide access to digital resources like e-books, online databases, and digital archives, along with offering technology training programs and workshops that help users become proficient in computers, the internet, and other digital tools (Inamdar, 2021).

Strengthening Capacity Through Library Services

Libraries play a crucial role in capacity building by equipping students and researchers with essential academic and professional skills. This is achieved through various initiatives:

1. **Workshops and Training Programmes** – Libraries offer training in academic writing, citation management, and data analysis using tools such as SPSS. Das and Banerjee (2021) emphasize the importance of libraries providing training on modern research tools, including anti-plagiarism and reference management software. Singh and Siwach (2023) note that libraries often subscribe to scholarly resources, granting users access to databases like Scopus, JSTOR, and EBSCOhost, which significantly aid research efforts.
2. **Digital Repositories and Open-Access Resources** – Many libraries provide institutional repositories and open-access journals, fostering knowledge sharing. Open access removes financial barriers, enabling researchers, educators, students, and policymakers to freely access and build upon academic research (Ashikuzzaman, 2023).
3. **Grant Writing and Research Support** – Libraries assist researchers in securing funding by offering grant-writing workshops and guidance on research proposal development. Otter, Wright, and King (2017) advocate for librarians' involvement in the grant application process, helping researchers identify research gaps and refine proposals, increasing their chances of securing funding.

Skill Development: Research Methodologies and Information Literacy

A core function of modern libraries is to educate students and researchers on research methodologies and information literacy. Libraries collaborate with academic departments to provide lectures and guidance on research projects. Roy and Habib (2024) emphasise the importance of collaboration between university libraries and library schools to support students in their academic endeavors.

Information literacy, which involves locating, evaluating, and using information effectively, is crucial in higher education. Harrison and Deans (2021) stress that information literacy skills, as outlined by the ACRL framework, are essential for navigating today's information landscape. As technology evolves, students must learn to use digital tools to access vast amounts of information online. Mishra (2019) highlights that information literacy benefits students by enhancing their ability to identify credible sources, retrieve information efficiently, and develop lifelong learning habits. Libraries promote information literacy through:

- **Instructional Sessions** – Academic libraries integrate information literacy courses into curricula to strengthen students' research skills.
- **One-on-One Research Consultations** – Librarians provide personalized guidance on research strategies and ethical information usage.
- **Plagiarism Prevention and Citation Management** – Libraries teach students how to use citation tools like Zotero, Mendeley, and EndNote to maintain academic integrity.

Studies show that students who participate in library-led research methodology workshops perform better in academic writing and critical analysis. This structured training enhances their ability to synthesize and critically engage with scholarly sources.

Challenges Faced by Librarians in Supporting Research and Development

Despite their critical role, librarians face numerous challenges in supporting research and development:

- **Financial Constraints** – Limited budgets restrict access to essential academic resources and digital tools. George, Fadimu, and Babatunde (2024) note that many libraries struggle to afford

subscriptions to high-impact journals, affecting scholarly access. Budget cuts further hinder the acquisition of emerging research technologies.

- **Sustainability of Digital Archives** – Maintaining digital repositories requires long-term investment and technological upkeep. Digital archives face risks such as data degradation, outdated formats, and cybersecurity threats. Yakubu, Noorhidawati, and Kiran (2022) suggest that sustained funding and strategic preservation measures are crucial for ensuring long-term accessibility.
- **Collaboration with Researchers** – Effective collaboration requires strong relationships and an understanding of diverse research needs. Borrego and Pinfield (2020) note that librarians often balance multiple research projects and face challenges in securing recognition for their contributions. Strengthening research partnerships and proactively engaging with academic communities can enhance collaboration.
- **Intellectual Property and Copyright Issues** – Librarians must navigate complex legal frameworks to balance copyright restrictions with open access. Tutu (2018) highlights the challenges posed by digital resources, as their easy reproduction complicates copyright management. Staying informed about evolving copyright laws is crucial in promoting responsible academic use.
- **Supporting Interdisciplinary Research** – Assisting researchers across multiple disciplines requires specialized knowledge and access to diverse resources. Borrego, Ardanuy, and Urbano (2018) emphasize that collaboration with faculty and leveraging digital tools can bridge gaps in interdisciplinary research support.
- **Bridging the Digital Divide** – Socioeconomic disparities affect access to digital resources. Jutras (2023) underscores the need for digital literacy training and expanded open-access resources to ensure equitable access for all researchers.
- **Ongoing Training and Skill Development** – Librarians must continuously update their knowledge to keep pace with technological advancements. Moonasar (2024) stresses that professional development programs and collaborations with academic departments are essential to maintaining high-quality library services.

An overview of best practices of R & D initiatives.

Frederick, A., & Run, Y. (2019) carried out a study titled "The Role of Academic Libraries in Research Data Management: A Case in Ghanaian University Libraries". The study showed that some academic libraries are beginning to establish frameworks for these services, with varying degrees of success, as policies are being developed, infrastructures are being built, library staff are receiving training, and awareness and advocacy campaigns are being conducted with academic staff and researchers. Rasul, A., & Singh, D. (2010) investigated a study titled "The role of academic libraries in facilitating postgraduate students' research". The study examined postgraduate students' perspectives on the role of academic library services in supporting their research at four Malaysian public universities. The findings revealed that 90.1% recognize the library's importance in facilitating their research, and 72.5% are satisfied with the services offered. However, students suggested improvements, particularly in extending library opening hours for physical visits, despite the availability of remote access options.

Ali, N., Shoaib, M., & Asad, I. H. (2021) examined a study titled "Research is a Scientifific Capital: The Role of University Libraries in Higher Education Institutions". The findings revealed a notable difference in research support facilities between government and private sector university libraries in the Punjab Province, as well as a significant disparity in the training of library staff regarding research support activities across university types. It recommended that training on research support services be offered to library staff, researchers, and students to ensure optimal use of library services. Chiware & Mathe, (2015) carried out a study titled "Academic libraries' role in research data management services: a South African perspective" The study highlights how the university library is leveraging user requirements to create tools like data management plans, electronic laboratory journals, and systems that integrate with institutional research workflows. The study further discussed how an international collaborative approach has enabled the library to contribute to the development of an open-source platform for managing the entire research lifecycle in support of research data management (RDM). The paper concludes by outlining ongoing skills development within the library to enhance data services and addresses potential challenges for the future growth of these services.

Kennan, M.A., Corrall, S. and Afzal, W. (2014), investigated a study titled " Making space" in practice and education: research support services in academic libraries ". The study found that most academic libraries are either providing or planning services in Bibliometric and data management, with growing demand for additional research support services like e-research support, journal publishing platforms, and grant writing assistance. The study also highlighted the need for broader staff education, focusing on understanding the evolving research landscape, disciplinary research cultures, and technological advancements. Furthermore, there was strong support for developing more specialized LIS education to better prepare professionals for comprehensive research support roles. A study titled "Designing Libraries for Research Collaboration in the Network World: An Exploratory Study" was conducted by Corrall (2014). The study explained that technological advancements and shifts in higher education and research are prompting libraries to reassess the services they offer to researchers and how these services are delivered. The author further explained that librarians are transitioning to "higher-end support" and adopting new service models focused on "deep collaboration" with academic partners, marking a shift away from integrated library and

computing services. The findings also revealed new roles for librarians that complement traditional librarianship, as well as the development of specialized positions, dedicated spaces, working groups, and integrated websites to promote collaborative research.

Conclusion

In conclusion, libraries are set to become game-changing allies in the future of research and development. By tapping into their special strengths in managing data, fostering interdisciplinary teamwork, providing access to resources, and offering research support, libraries can really boost the quality, efficiency, and accessibility of research and development efforts. They're not just traditional places that hand out resources; they're vibrant centers for innovation, knowledge sharing, and ethical practices, actively working to push scientific progress forward. As they continue to evolve, their role will be vital in creating a research environment that's more inclusive, transparent; in simple terms, a place where researchers feel empowered and ideas flow freely. However, librarians faced challenges in collaboration, intellectual property management, financial constraints, supporting interdisciplinary research, bridging the digital divide, and maintaining ongoing skill development to keep up with evolving needs in academic environments. With librarians' steadfast dedication to knowledge and community, libraries are truly key players in shaping the future of research and development.

Recommendations

1. Libraries can aid in the organization, curation, and maintenance of research data over time. Given the increasing focus on Open Science and empirical Open Science, libraries are now notably situated to act as crucial stakeholders in the management of research data repositories, as well as in data advocacy and non-ethical datamining. As R&D partners, libraries can facilitate the procurement and accessibility of scholarly journals, books, and other subject-specific databases which would normally researchers may find difficult to subscribe.
2. Libraries can facilitate cross-disciplinary efforts through collaborating tools, which can also help find materials for research. With the right tools, knowledge gaps can be bridged, which is the goal libraries pursue while aiding research teams. Researchers are also equipped with essential skills through training in data literacy, methodological research, citation writing, and even scholarly writing taught by libraries. These tools given to researchers make R&D more productive and effective. Furthermore, libraries can create opportunities for researchers to collaborate and share knowledge irrespective of their geographical locations. The platforms can aid in sharing research results, sparking ideas, and forming relationships which will lead to further R&D activities.
3. Libraries can play a key role in integrating new technologies like AI, Machine Learning, and Data Analysis into educational R&D by offering access to these technologies, organizing workshops, and providing testing facilities. They contribute to the advancement of science by promoting open data, open-source software, and open peer review. Libraries also help researchers navigate ethical and legal challenges related to open science and offer specialized services, materials, and training to enhance research. By understanding researchers' needs, libraries can provide effective support for R&D activities.
4. Libraries can help connect R&D and the public by actively participating in outreach programs that the public understanding of research's R&D outcomes. They help ensure that society benefits, and contributes in a positive manner, to the discourse. They serve as advocates for ethical research practices by providing information on research integrity, openly offering ethical guidelines, and promoting responsible publishing If libraries promote inclusivity, then diversity within the R&D ecosystem is greatly enhanced.

References

Ali, N., Shoaib, M., & Asad, I. H. (2021). Research is a scientific capital: The role of university libraries in higher education institutions. *Library Philosophy and Practice*, 0, 1-18. https://www.proquest.com/openview/c357c4924b64a09feedc49f69a72e33e/1?cbl=54903&pq-origsite=gscholar

Ashikuzzaman, M. D (2023). The transformative impact of open access initiatives in libraries. *Library & Information Science Education Network.* https://www.lisedunetwork.com/the-transformative-impact-of-open-access-initiatives-in-libraries/

Ashikuzzaman, M. D. (2024). The Role of University Libraries in Research and Innovation. *Library & Information Science Education Network.* https://www.lisedunetwork.com/the-role-of-university-libraries-in-research-and-innovation/

Borrego, A., Ardanuy, J. & Urbano, C. (2018). Librarians as Research Partners: Their Contribution to the Scholarly Endeavour Beyond Library and Information Science. *The Journal of Academic Librarianship,* 44(5). https://doi.org/10.1016/j.acalib.2018.07.012

Borrego, Á. & Pinfield, S. (2020). Librarians publishing in partnership with other researchers: roles, motivations, benefits, and challenges. portal: *Libraries and the Academy*, 20 (4). https://doi.org/10.1353/pla.2020.0031

Chiware, E., & Mathe, Z. (2015). Academic libraries' role in research data management services: A South African perspective. *South African Journal of Libraries and Information Science, 81*(2), 1-10.

https://doi.org/10.7553/81-2-1563
Corrall, S. (2014). Designing libraries for research collaboration in the network world: An exploratory study. *LIBER Quarterly, 24*(1), 17-48. https://d-scholarship.pitt.edu/21993/
Cox, A. M., & Pinfield, S. (2013). Research data management and libraries: Current activities and future priorities. *Journal of Librarianship and Information Science, 46*(4), 299-316. https://doi.org/10.1177/0961000613492542
Das, A. & Banerjee, S. (2021). Optimising research support services through libraries: A review of practices. *Library Philosophy and Practice (e-journal)*. 5515. https://digitalcommons.unl.edu/libphilprac/5515
Forsman, M., Ndinoshiho, J., & Poteri, E. (2012). Research support services of university libraries: Today and in the future. https://repository.unam.edu.na/server/api/core/bitstreams/a4d88819-be9b-4756-9c56-6694ce41b3a0/content
Frederick, A., & Run, Y. (2019). The role of academic libraries in research data management: A case in Ghanaian university libraries. *Open Access Library Journal, 6*, 1-16. https://doi.org/10.4236/oalib.1105286
George, L. A., Fadimu, A. A. & Babatunde, M. A. (2024). Exploring budget constraints on collection development practices in Nigerian academic libraries. *International Journal of Library and Information Technology* (IJLIT), 6. file:///C:/Users/pofod/Downloads/1110-4188-1-PB.pdf
Harrison, S. J. & Deans, M. O. (2021). The methodology used to deliver information literacy instruction by a select group of academic librarians: A case study. Asian Association of Open Universities *Journal.* DOI: 10.1108/AAOUJ-01-2021-0006
Holloway, K. (2004). The significance of organizational development in academic research libraries. https://www.ideals.illinois.edu/items/1814
Inamdar, S. A. (2021). The role of libraries in promoting digital literacy in the 21st century. Journal of Emerging Technologies and Innovative Research (JETIR), 8(8). http://www.jetir.org/papers/JETIR2108666.pdf
Jutras, J. (2023). The library's educational role in bridging the digital divide. *Pathfinder: A Canadian Journal for Information Science Students and Early Career Professionals*, 4(1). 19-27. https://doi.org/10.29173/pathfinder85
Kennan, M. A., Corrall, S., & Afzal, W. (2014). "Making space" in practice and education: Research support services in academic libraries. *Library Management, 35*(8/9), 666-683. https://doi.org/10.1108/LM-03-2014-0037
Kamposiori, C. (2017). The role of research libraries in the creation, archiving, curation, and preservation of tools for the digital humanities. *RLUK Report*. http://www.rluk.ac.uk/wp-content/uploads/2017/07/Digital-Humanities-report-Jul-17.pdf
Larsen, G. (2006). Preparing for new and changing roles in research libraries–the need for continuing professional development. *LIBER Quarterly: The Journal of the Association of European Research Libraries, 16*(3-4). https://doi.org/10.18352/lq.7863
Lubanga, S., & Mumba, J. (2021). Research and Development (R&D), Creativity and Innovation in Academic Libraries in Malawi: A Way To Rethink Library Development in the 21st Century. *Creativity and Innovation in Academic Libraries in Malawi: A Way To Rethink Library Development in the 21st Century (June 15, 2021)*.https://doi.org/10.2139/ssrn.3867430
Mishra, R. (2019). Information Literacy Framework for Higher Education. *Library Waves*, 5(2). file:///C:/Users/pofod/Downloads/9.+Rajani+Mishra_Library+Waves_5.2.pdf
Moonasar, A. (2024), Continuing professional development and the changing landscape of academic libraries. Library Management, 45(3/4). https://doi.org/10.1108/LM-09-2023-0100
Momoh, E. O. & Folorunso, A. L. (2019). The evolving roles of libraries and librarians in the 21st century. Library Philosophy and Practice (e-journal). 2867. https://digitalcommons.unl.edu/libphilprac/2867
Otter, M. E., Wright, J. M. &King, N. V. (2017). Information services for developing research grants. New Review of Academic Librarianship. DOI: 10.1080/13614533.2017.1330219
Rasul, A., & Singh, D. (2010). The role of academic libraries in facilitating postgraduate students' research. *Malaysian Journal of Library and Information Science, 15*(3), 75-84. https://samudera.um.edu.my/index.php/MJLIS/article/view/6943
Roy, P. & Habib, M. A. (2024). Fostering effective collaboration between library and information science academics and practitioners in Bangladesh: Insights, challenges and recommendations. Sage Journals, 50(3). https://doi.org/10.1177/03400352241236737
Sacchanand, C. (2008, April). Thai Library Association in the time of change. In *2nd Meeting of CONSAL XIV Executive Board*, Ho Chi Minh City, Vietnam. https://research.ebsco.com/c/atxoct/viewer/pdf/7ci34m2qhv
Singh, K. &Siwach, A. K. (2023). Library Research Support Services (LRSS) vis-a-vis the Research Life Cycle. *A Quarterly Peer Reviewed Research Journal of Oriental Studies*.https://www.researchgate.net/publication/382218490_Library_Research_Support_Services_LRSS_vis-a-vis_the_Research_Life_Cycle/stats
Tutu, J. M. (2018). Intellectual Property Challenges in Digital Library Environments. *IGI Global. DOI: 10.4018/978-1-5225-3093-0.ch012*
Yakubu, H., Noorhidawati, A. & Kiran, K. (2022). Sustainability of digital collections for Nigerian academic libraries: An exploration of conception, indicators for fulfillment and accrued benefits. *Malaysian Journal of Library & Information Science*, 27(1). https://doi.org/10.22452/mjlis.vol27no1.5
Yu, H. H. (2017). The role of academic libraries in research data service (RDS) provision: Opportunities and challenges. *The Electronic Library, 35*(4), 783-797. https://doi.org/10.1108/EL-10-2016-0233

Library and Information Science Education and Training in the 5th Industrial Revolution: An Analytical Review

By
Prof. Katamba A. Saka; Hussaini Musa (PhD) & Musa Baba Adamu (PhD)
Federal University of Technology, Minna-Nigeria
Corresponding Author: s.katamba@futminna.edu.ng

Abstract

The paper explores issues surrounding Library and Information Science Education and Training with reference to the Fifth Industrial Revolution. The specific objectives of this paper is to identify the role of Fifth Indusrial Revolution in LIS Education; the need for librarians to be equiped with relevant skills to provide efficient services as well as the importance of emmerging technologies in promoting LIS education and training; the challenges involved as well as conclusion and recommendations The Fifth Industrial Revolution (5IR) is characterised by technological advancement and societal transformation which will have positive impact on education and training for library and information science and therefore expect librarians to develop new skills to enable them adapt to new technologies to offer efficient information services to learner/students. The methodology adopted in this paper is the analytical review reserch type which harvest literatures relevant to LIS education and training particularly in the 5IR. There is the need for collaboration between librarians and machines, digital literacy, continous learning/professional development and adoptabilty, critical thinking, problem-solving and emotional intelligence. The fifth industrial revolution has reshape LIS education for smater future. The fifth industrial revolution bring about the integration of advance technologies and human-centric-value so as to revolutionize and personalized learning experience, immersive learning with augumented reality and virtual reality as well as enhanced collaboration and global connectivity. The fifth industrial revolution technologies can make LIS education more accessible to disadvantaged learners and develop future skills; encourage lifelong learning. The challenges to the 5IR interms of LIS education and training and include: data privacy, digital inclusion, resource allocation, sustainability, technological and funding issues particularly in the developing countries. The paper concludes by assessing the role of 5IR in reshaping education in general and LIS education and training in particular. The recommendations centered on the need for collaboration among libraries, library schools as well as information and communication technology to address the above-enumerated challenges.

Keywords: *Education and Training; Emerging technologies; Challenges; Fifth indusrial revolution; Information service delivery; Library and information science, Societal transformation*

Introduction

The rapid technological advancements associated with the 5th Industrial Revolution (5IR), which integrates human intelligence with artificial intelligence (AI), machine learning, robotics, and other emerging technologies, are significantly transforming various sectors, including Library and Information Science (LIS) education and training. As a discipline, LIS traditionally focuses on the management, organization, and dissemination of information. However, the rise of new digital platforms, big data, cloud computing, and artificial intelligence has led to a rethinking of how information professionals are trained to meet the evolving needs of the society. Library and Information Science (LIS) education has historically emphasized knowledge organization, reference services, cataloging, and information retrieval (Vaughan, 2020). Yet, with the onset of the 5IR, the demand for more advanced skills such as data analytics, digital content management, and AI-powered information systems has grown significantly (Bawden & Robinson, 2019). The traditional role of librarians, who were once primarily tasked with physical collection management, has evolved into a dynamic and technology-driven field. Modern LIS education must now focus on preparing future professionals to manage and curate vast quantities of information, particularly in digital formats, and to guide users in navigating a highly digitized and automated world.

The 5IR is particularly characterized by the fusion of cyber-physical systems, the Internet of Things (IoT), and the increasing automation of processes. These technologies have led to a shift in the way information is created, accessed, and used, making it necessary for LIS education to adapt and incorporate new subjects and skills. This includes the incorporation of data science, artificial intelligence (AI), and digital literacy into LIS curricula, alongside traditional topics like cataloging, information retrieval, and reference services (Johnson et al., 2021). At the heart of LIS education in the 5IR is the need for an interdisciplinary approach that bridges technology, information management, and user-centered services. The changing role of the librarian as a digital curator, a data analyst, and an information strategist requires a comprehensive reevaluation of LIS education and training programs. In this context, LIS professionals are expected to not only be information managers but also technological innovators capable of designing, maintaining, and

optimizing digital systems that enable the efficient flow of information in an increasingly connected world (JISC, 2018). LIS educators and institutions have increasingly focused on retooling their curricula to emphasize these new competencies, reflecting the transformative nature of the 5IR. This includes offering specialized programs that focus on the convergence of technology with library science, such as digital libraries, information systems design, and data management. In addition, there is a growing emphasis on lifelong learning and the continuous updating of skills to keep pace with technological advancements (Kriewaldt, 2022).

To prepare information professionals for the challenges and opportunities presented by the 5IR, it is crucial that LIS education and training programs not only focus on technical expertise but also on fostering critical thinking, ethical considerations, and user-centered practices in information management. These factors will be pivotal in ensuring that information professionals remain adaptable, forward-thinking, and capable of harnessing the potential of emerging technologies to address the evolving needs of society.

Objectives of the study

The specific objectives of this documentary study are to:

1. Identify the role of the fifth industrial revolution in library and information science (LIS) education
2. Examine the need for librarians to be equipped with skills in the 5th industrial revolution to provide efficient services
3. Assess the importance of emerging technologies in promoting LIS education and training in the 5th industrial revolution
4. Identify the challenges faced by LIS education and training in the 5th industrial revolution
5. Proffer practical recommendations to tackle the challenges

Literature Review

The core of the analytical review methodology involves an exhaustive literature review to gather relevant articles, books, conference papers, and reports. A focus would be placed on publications that discuss innovations in LIS education, technological advancements, and competency requirements in the 5IR era. Studies would be sourced from academic journals, industry reports, and LIS-specific publications such as the *Journal of Education for Library and Information Science* and *Library and Information Science Research*.

Key areas of interest might include:

- Role of the fifth industrial revolution in library and information science (LIS) education
- Need for librarians to be equipped with skills in the 5th industrial revolution to provide efficient services
- Importance of emerging technologies in promoting LIS education and training in the 5th industrial revolution
- Challenges faced by LIS education and training in the 5th industrial revolution
- Recommendations to tackle the challenges

However the literature review allign with the results and discussion of findings

Inclusion criteria: Research published in the past 10 years, primarily focusing on the intersection of technology and LIS education, and studies that specifically address the context of the 5th Industrial Revolution. However, 16 sources/literature were searched from journal articles and textbooks, mainly from physical collections and electronic as well as online resources and used for the study.

Data Extraction and Analysis: After collecting the relevant studies, the next step is to extract key themes, trends, and findings. The search strategy adopted were through gathering of relevant documentary sources, content analysis and online search which were browsed through, read on after the other to identify the relevant areas to the research in question in line with objectives of the study. This involves categorizing the literature based on commonalities such as:

- **Technological Integration**: How technologies like AI, machine learning, and data analytics are being incorporated into LIS curricula.
- **Pedagogical Approaches**: The teaching strategies and methods employed to ensure that LIS students gain the skills required for the 5IR.
- **Competency Frameworks**: The specific competencies (technical, cognitive, and soft skills) needed for future LIS professionals in the context of the 5IR.
- **Global Perspectives**: Differences in LIS education across various geographical locations, with particular attention paid to how different regions are responding to technological trends.

The analysis can include a synthesis of different perspectives, identifying where there is agreement and where contradictions or gaps in the literature exist (Booth et al., 2016).

Critical Evaluation: A key feature of the analytical review methodology is the critical evaluation of the gathered literature. This step involves assessing the strengths and weaknesses of the studies reviewed, identifying areas that have been well-researched, and highlighting gaps or areas for further exploration.

Synthesizing Findings and Providing Recommendations: The final phase of the analytical review involves synthesizing the findings and offering recommendations for LIS education and training moving forward.

Methodology

This study employs an analytical review research methodology to explore how LIS education and training are evolving to meet the challenges and opportunities presented by the 5th Industrial Revolution. Analytical review research methodology is a systematic approach to synthesizing and analyzing existing research literature, identifying trends, gaps, and providing an evaluation of the current state of knowledge on a specific topic. This method is commonly used when researchers seek to evaluate a broad topic by integrating findings from multiple studies, offering a comprehensive and critical analysis of the subject matter (Cooper, 2010).

In the case of LIS education and training in the context of the 5IR, an analytical review allows for a thorough examination of the current literature surrounding how LIS programs are integrating emerging technologies, how curricula are adapting to new industry standards, and the challenges faced by educators and professionals. The key steps in this methodology include:

Identifying the Scope of the Study: The scope for the study would be focused on the integration of 5IR technologies (such as AI, blockchain, and big data) into LIS education and training. A particular emphasis would be placed on understanding how LIS programs around the world are adapting to these changes, what new competencies are being emphasized, and what gaps still exist in training future professionals.

Results and Discussion

Based on documentary and content analysis, the following findings/results were obtained, present and discussed with the support of relevant literature/sources in line with the stated specific objectives of the study. The results/discussion are strictly based on the five (5) specific objectives of the analytical study covering the role of 5th IR in LIS education; need for librarians to be equiped with skills; importance of emerging technologies; challenges and practical recommendatios. Thus, the results and discussion are as follows:

The Role of the Fifth Industrial Revolution in Library and Information Science (LIS) Education

The Fifth Industrial Revolution holds immense potential for transforming LIS education. By incorporating emerging technologies, human-centered design, ethical considerations, and data-driven decision-making, LIS programs can prepare students to thrive in a world where information is not only abundant but increasingly complex. Educators must embrace these shifts and ensure that future library and information professionals are equipped with the skills necessary to navigate this new era. The integration of the Fifth Industrial Revolution into LIS education will empower the next generation of information professionals to leverage technology responsibly while fostering inclusivity and innovation in library services and beyond.

1. ***Adapting to Technological Advances in LIS Education***

The rapid advancements in AI, machine learning, and data science are central to the 5IR and are reshaping LIS education. Traditionally, LIS programs have focused on core competencies such as information organization, retrieval systems, and library management. However, with the integration of AI, big data, and automation, LIS education must evolve to incorporate new skills and knowledge in emerging technologies (Kroski 2019). For example, library professionals are now expected to understand data analytics, digital curation, and information systems that rely on AI algorithms.

2. ***Human-Centered Design and Ethical Considerations***

The Fifth Industrial Revolution emphasizes human-centric technology, requiring LIS professionals to not only focus on technological aspects but also consider ethical and societal impacts. With the rise of AI and machine learning, issues such as privacy, data security, and algorithmic bias are of particular concern in the information field. LIS education must equip future professionals with the ability to critically evaluate and address these ethical challenges (Cowan & Manning 2021). Incorporating courses on data ethics, privacy

laws, and digital inclusion into LIS curricula is essential. Moreover, LIS educators should foster a deeper understanding of the human impact of technological innovations, helping future professionals make informed decisions about information management practices that consider ethical implications.

3. ***Collaboration with Emerging Technologies***
The integration of emerging technologies like robotics, the Internet of Things (IoT), and blockchain in LIS is one of the most transformative aspects of the Fifth Industrial Revolution. Libraries are increasingly adopting these technologies for cataloging, inventory management, and providing enhanced user services. LIS education needs to incorporate an understanding of these technologies to prepare students for the evolving demands of the profession (Sweeney, 2022). For instance, blockchain technology is being explored for secure information sharing and digital rights management, while IoT is being used to automate library systems and improve user experiences. Educators must expose students to these technologies, ensuring they are prepared for a digitally integrated future in libraries and information organizations.

4. ***Data-Driven Decision Making***
The Fifth Industrial Revolution is fundamentally data-driven. Libraries are collecting more data than ever, from usage statistics to user preferences. This wealth of data offers new opportunities for library services but also necessitates new skills in data analysis and decision-making. LIS education must prioritize teaching students how to handle big data, derive insights, and apply them to improve library services (Arlitsch & Dugan 2019). Curricula should incorporate training on data management tools, data analytics, and visualization techniques, which will enable LIS professionals to make evidence-based decisions. Understanding how to use data to optimize collections, improve user engagement, and enhance library operations is becoming essential in LIS education.

5. ***Transforming Library Services and Learning Environments***
As the 5IR continues to shape the future of work, libraries themselves are evolving into more dynamic spaces. They are transforming from traditional quiet reading rooms into collaborative hubs that encourage creativity and innovation. LIS educators must prepare students to manage and design these future libraries that blend physical and digital spaces. Understanding how to integrate innovative technologies into library spaces, such as virtual reality (VR) or augmented reality (AR), will be crucial for future professionals (Gailey & Freeman 2020). Furthermore, libraries are becoming hubs for learning, offering immersive learning experiences and digital literacy training. LIS education needs to prepare future professionals to manage these evolving environments, providing both technical expertise and pedagogical strategies.

The Need for Librarians to be Equipped with Skills in the 5th Industrial Revolution to Provide Efficient Services
In the 5th Industrial Revolution, librarians are expected to be much more than traditional custodians of knowledge—they must become skilled technology integrators, data managers, and user educators. To provide efficient services, librarians must be proficient in a wide range of advanced skills, including technological competence, data management, digital literacy, AI integration, and ethical decision-making. Continuous professional development is essential to ensure librarians remain at the forefront of these changes and continue to offer services that are both relevant and responsive to the needs of their communities in an increasingly digital world.

1. Technological Proficiency in Emerging Tools and Systems
In the 5IR, librarians are increasingly called upon to manage and curate digital content, often utilizing tools like AI-powered systems, cloud computing, and data analytics. These technologies have become integral to library operations such as cataloging, information retrieval, and user engagement (Bawden & Robinson, 2019). For instance, AI systems can assist in automating tasks, improving information retrieval systems, and even personalizing user experiences (Liu, 2020). Librarians must possess proficiency in using these technologies to ensure libraries remain relevant and efficient in providing access to a growing array of digital content.

2. Data Management and Big Data Competence
The explosive growth of big data in the digital age has made data management one of the most crucial skills for librarians in the 5IR. Librarians need to be capable of organizing, curating, and preserving massive datasets, ensuring that data is accessible, usable, and reliable (Kovacs et al., 2019). Understanding how to implement data analytics tools to track user behavior and optimize library resources is becoming an essential aspect of modern librarianship. Additionally, libraries are increasingly tasked with managing open access repositories and preserving data for long-term access, which requires a specialized skill set in data curation and digital preservation techniques (Vaughan, 2020).

3. Information Literacy and Digital Literacy
As information sources proliferate in both digital and traditional formats, the role of librarians in promoting information literacy becomes even more critical. In the 5IR, information literacy extends beyond the ability to search for information—it encompasses the skills to critically evaluate sources, discern credible information, and navigate complex digital environments (Murray, 2021). Librarians must be equipped to teach these skills to users in a world increasingly defined by misinformation and rapidly changing digital platforms. Furthermore, digital literacy, including the ability to use advanced technologies such as AI, virtual reality (VR), and augmented reality (AR), has become an essential competency for librarians to guide users effectively in their information-seeking journeys.

4. AI and Automation Skills
AI and automation technologies are reshaping library services, from automating cataloging systems to implementing chatbots for customer service (Kohl, 2020). Librarians must not only understand how these systems function but also how to design, deploy, and manage them in ways that improve library services and user experiences. For example, AI-driven chatbots can help librarians provide 24/7 reference services, while automated circulation systems can streamline borrowing processes, reducing the need for manual interventions. As AI becomes more integrated into library services, librarians need to develop both technical and strategic skills to leverage these technologies while maintaining a user-centered approach.

5. Adaptability and Lifelong Learning
The rapid pace of technological change in the 5IR underscores the importance of adaptability for librarians. The tools, systems, and practices that librarians use today may become obsolete within a few years, so continuous professional development and lifelong learning are essential to ensure that librarians remain effective in their roles (Kriewaldt, 2022). Librarians must be prepared to embrace new technologies and methodologies, learning how to incorporate them into their existing practices. This includes keeping up-to-date with advances in AI, data science, machine learning, and digital preservation techniques through ongoing training and collaboration with experts in these fields.

6. User-Centered Service and Ethical Considerations
As libraries become more technologically advanced, librarians must balance the use of emerging technologies with the ethical considerations that arise from their application. Issues such as data privacy, algorithmic bias, and the ethical use of AI are central to librarianship in the 5IR. Librarians must possess the skills to not only use these technologies but also to ensure that they are applied in ways that are transparent, fair, and ethically sound (Johnson et al., 2021). This includes ensuring that library services remain accessible to all users, regardless of their digital literacy levels or technological capabilities. Furthermore, as the user base becomes increasingly diverse, librarians must be able to provide tailored, personalized services that meet the unique needs of each individual. This requires the ability to analyze user behavior through data analytics and AI tools to offer services that are responsive to user preferences and challenges (Liu, 2020).

Importance of Emerging Technologies in Promoting LIS Education and Training in the 5th Industrial Revolution
The role of LIS education and training is evolving rapidly to address the demands of these technological advancements, ensuring that future information professionals are equipped to deliver efficient, innovative, and user-centered services. Emerging technologies are not only transforming library operations but also revolutionizing the way LIS education and training programs are delivered, thus enhancing the ability of information professionals to meet the demands of the digital age. By equipping LIS students with the skills needed to navigate and leverage these technologies, LIS education ensures that libraries remain central to the knowledge economy, fostering learning, creativity, and community engagement in the digital age.

1. Enhancing Learning and Curriculum Delivery
Emerging technologies, including e-learning platforms, virtual classrooms, and massive open online courses (MOOCs), have revolutionized LIS education by making learning more accessible, flexible, and interactive. Through the use of cloud computing and mobile technologies, LIS students can access resources and participate in collaborative projects from anywhere in the world, thereby expanding the reach of LIS programs and promoting lifelong learning (Liu, 2020). Technologies such as AI and machine learning also enable personalized learning experiences, where students can receive tailored content and feedback based on their learning patterns, interests, and performance (Murray, 2021). Moreover, virtual reality (VR) and augmented reality (AR) are increasingly being incorporated into LIS education. These immersive technologies provide students with hands-on training in digital library management, information retrieval systems, and data visualization tools, preparing them to work effectively with

emerging library technologies in the real world (Kriewaldt, 2022). The integration of these technologies allows students to engage in simulated environments, making it possible to learn complex tasks in a safe and controlled manner, which is especially beneficial in practical, real-world library training.

2. Enabling Data-Driven Decision Making

The growth of big data and data analytics tools is a key component of the 5IR and is having a profound impact on LIS education and training. Emerging technologies that support big data analysis enable librarians and LIS students to analyze user behavior, optimize library resources, and make data-driven decisions regarding collections, services, and outreach programs (Kovacs et al., 2019). For instance, data analytics tools can help library managers assess usage patterns, user satisfaction, and resource allocation, allowing for more informed decision-making (Bawden & Robinson, 2019). Integrating data science into LIS education is therefore essential for future professionals to acquire the skills necessary to leverage these technologies and deliver services that meet the evolving needs of library users. Additionally, the incorporation of data visualization tools, such as Tableau and Power BI, into LIS curricula is essential for developing students' skills in presenting complex data in a meaningful and accessible manner (Johnson et al., 2021). By training future librarians to work with these technologies, LIS programs ensure that graduates are prepared to manage and interpret large datasets, making them more effective in supporting research and improving library services.

3. Automation and AI in Library Operations

AI and automation technologies are central to transforming library services, from resource management to customer interaction. In LIS education, emerging technologies are being used to train future librarians in the integration of AI-driven tools that can automate routine tasks, such as cataloging, resource discovery, and customer service. For example, AI-powered systems can analyze large volumes of text and metadata, improving cataloging accuracy and efficiency (Kohl, 2020). Additionally, machine learning algorithms can help predict trends in library usage, enabling librarians to proactively manage collections and resources (Vaughan, 2020). Incorporating AI and automation training into LIS education equips students with the skills needed to implement and manage these technologies within library systems. As libraries continue to adopt these technologies, the need for professionals who can optimize and troubleshoot these systems will be crucial. Emerging technologies are helping to prepare the next generation of librarians for roles that require both technological expertise and a commitment to enhancing user experiences.

4. Promoting Collaborative and Interdisciplinary Learning

The 5IR encourages the convergence of multiple disciplines, and this is reflected in the evolving nature of LIS education. The integration of emerging technologies such as collaborative software tools, cloud platforms, and social media applications fosters interdisciplinary learning and collaboration. Students can now work together on projects, share resources, and engage in real-time discussions with peers and mentors across the globe. This is particularly important as libraries are increasingly viewed as spaces for collaboration and community engagement (Liu, 2020). Moreover, the 5IR highlights the importance of a multidisciplinary approach to library and information science. By integrating courses on data science, digital humanities, AI, and information ethics, LIS programs can prepare students for the interdisciplinary challenges they will face in modern library environments (Kriewaldt, 2022). This approach encourages students to think critically about how to integrate technology with library services and to understand the broader societal implications of technological advancements.

5. Improving Information Access and User-Centered Services

Emerging technologies have the potential to enhance user experiences and make information more accessible, which is a core objective of LIS. AI-powered recommendation systems, for example, can personalize user experiences by suggesting relevant resources based on their previous interactions and interests (Bawden & Robinson, 2019). Additionally, virtual assistants and chatbots powered by AI can provide users with immediate responses to information requests, improving the efficiency of library services and reducing response times (Kohl, 2020). Incorporating training in these emerging technologies into LIS programs ensures that future librarians are able to adopt and implement these technologies effectively to improve user services. As information increasingly becomes digital and dispersed across platforms, equipping librarians with skills in managing and optimizing user-centered technologies is essential to ensuring that libraries remain hubs of accessible, user-friendly knowledge.

Challenges to LIS Education and Training in the 5th Industrial Revolution

LIS education and training in the 5th Industrial Revolution face numerous challenges, including the need to adapt curricula to emerging technologies, manage limited resources, balance traditional LIS skills with new technological competencies, and address ethical concerns. Overcoming these challenges will require significant investments in infrastructure, faculty development, and interdisciplinary collaboration. By addressing these issues, LIS education can better prepare future information professionals to meet the demands of the digital age and provide efficient services that align with the evolving needs of library users.

1. Curriculum Adaptation to Emerging Technologies

One of the most significant challenges faced by LIS education is the need to constantly update and adapt curricula to incorporate emerging technologies such as AI, data science, machine learning, and cloud computing (Bawden & Robinson, 2019). Traditional LIS programs, which primarily focused on cataloging, reference services, and information retrieval, must now integrate new subjects that reflect the technological landscape of the 5IR.

However, many LIS schools face difficulties in keeping their curricula current due to rapid technological advancements, a lack of resources, and the challenge of balancing traditional LIS concepts with cutting-edge technological skills (Vaughan, 2020). For example, while some programs have incorporated courses on data management and digital curation, there is still a gap in offering specialized training in AI applications, machine learning, and big data analytics, which are essential for managing the digital transformation of libraries (Murray, 2021). This gap in training can result in graduates lacking the necessary skills to effectively manage modern library services and technologies.

2. Technological Infrastructure and Resource Limitations

The implementation of emerging technologies in LIS education often requires significant investment in technological infrastructure, such as high-performance computing systems, specialized software, and access to cloud-based platforms. Many LIS schools, particularly in developing regions, face challenges in acquiring these resources due to financial constraints (Kriewaldt, 2022). As a result, students may have limited exposure to the tools and technologies that are critical for future library practices.

Furthermore, the integration of these technologies into LIS training requires highly skilled educators who can teach complex technical subjects such as AI, data analytics, and digital content management. However, many LIS programs struggle to attract and retain faculty members with the necessary technical expertise, which hinders the quality of education and training provided (Kovacs et al., 2019). The lack of appropriate infrastructure and qualified instructors limits the ability of LIS education programs to adequately prepare students for the challenges and opportunities of the 5IR.

3. Balancing Traditional LIS Skills with Technological Proficiency

While the 5IR requires LIS professionals to be technologically proficient, it is equally important that they retain core skills in information organization, information retrieval, reference services, and user engagement (Bawden & Robinson, 2019). One of the key challenges for LIS education is finding the right balance between teaching traditional library skills and equipping students with the new technological competencies required in the digital age. Overemphasis on technology may lead to the erosion of fundamental LIS competencies, while focusing too much on traditional skills may leave graduates unprepared for the technological demands of the 5IR (Liu, 2020).

For example, students who are trained solely in emerging technologies like AI or data analytics might lack critical skills in information ethics, privacy, and user-centered design, which are essential in the ethical management of digital information (Kriewaldt, 2022). Therefore, LIS education must strive to provide a holistic approach that combines technological skills with traditional information science principles to ensure graduates are well-rounded professionals capable of addressing the full spectrum of library and information management challenges.

4. Keeping Pace with the Rapid Evolution of Technologies

The pace of technological change in the 5IR is another significant challenge for LIS education. Emerging technologies, particularly AI, machine learning, and big data analytics, are evolving at an unprecedented rate, which makes it difficult for LIS programs to keep curricula up-to-date (Vaughan, 2020). For instance, AI algorithms and data analytics tools that are state-of-the-art today may become obsolete in a few years as new advancements are made. This rapid evolution creates a moving target for LIS educators who must constantly update their course content and training materials to ensure they remain relevant.

Additionally, keeping up with new technologies requires ongoing professional development for faculty members, who need to stay current on industry trends and innovations. However, many LIS educators face time and resource constraints that limit their ability to engage in continuous learning and professional development (Johnson et al., 2021). Without proper training, educators may struggle to effectively teach emerging technologies, which impacts the quality of LIS education and training.

5. Ethical and Privacy Concerns

The increasing reliance on emerging technologies in libraries, particularly AI, big data, and automation, raises significant ethical concerns. Librarians and LIS educators must ensure that these technologies are used in ways that respect user privacy, ensure fairness, and avoid reinforcing biases (Kohl, 2020). For example, AI-powered systems that recommend resources or personalize services could inadvertently discriminate against certain user groups if the underlying algorithms are biased or flawed. Similarly, the use of big data analytics to track user behavior raises questions about data privacy and the responsible use of personal information.

LIS education must prepare students to address these ethical issues by incorporating courses on information ethics, privacy laws, and the responsible use of AI and data analytics into their curricula (Murray, 2021). However, this can be challenging given the rapidly changing nature of ethical standards in the digital age. Educators must stay informed about evolving regulations and ethical frameworks to ensure they are teaching students the best practices for managing these complex issues.

6. Promoting Interdisciplinary Learning

The interdisciplinary nature of the 5IR requires LIS students to develop expertise not only in information science but also in fields such as data science, computer science, and digital humanities (Johnson et al., 2021). However, the integration of interdisciplinary learning into LIS education can be difficult due to the siloed nature of many academic institutions. Collaboration between LIS departments and other fields of study, such as computer science and engineering, is often limited, which can hinder the development of comprehensive LIS programs that address the technological needs of the 5IR.

Promoting interdisciplinary learning requires faculty members from different disciplines to work together and design curricula that incorporate diverse perspectives and expertise. Additionally, students must be encouraged to engage in cross-disciplinary research and projects that prepare them to work in a technology-driven, collaborative environment.

Conclusion

As the 5th Industrial Revolution reshapes the library landscape, it is essential that LIS education and training programs adapt to prepare future professionals for the technological challenges and opportunities ahead. By integrating emerging technologies into the curriculum, fostering interdisciplinary learning, prioritizing ethical practices, and promoting practical training and continuous professional development, LIS programs can equip students with the skills needed to provide efficient, innovative, and user-centered services. These efforts will ensure that libraries continue to play a critical role in the digital age, fostering access to information and supporting lifelong learning.

Recommendations for LIS Education and Training in the 5th Industrial Revolution

To ensure that future library and information professionals are equipped with the necessary skills to provide efficient services in this new era, several recommendations can be made. These recommendations emphasize the integration of emerging technologies, the importance of interdisciplinary education, and the need to focus on ethical practices, among other factors.

- LIS programs should introduce specialized courses on topics like AI in libraries, data science, digital curation, and advanced information retrieval systems. Furthermore, practical training in using cloud-based platforms and data management tools should be incorporated into the curriculum to ensure students are equipped with the skills required to manage and analyze vast amounts of digital information (Murray, 2021).
- LIS programs should foster interdisciplinary collaboration by offering joint courses or programs with departments like computer science, data science, and digital humanities. This collaboration will allow students to acquire a broad set of skills and insights into the technical, social, and ethical aspects of technology-driven library services (Johnson et al., 2021). Promoting collaborative projects and research between LIS students and students from other disciplines will further enrich their learning experience and provide real-world problem-solving opportunities.
- LIS education should place a stronger emphasis on information ethics and privacy issues, incorporating them into the core curriculum. Courses on information law, data ethics, digital privacy, and the social implications of emerging technologies should be required for all LIS students (Kriewaldt, 2022). Furthermore, case studies and real-world examples should be integrated into lessons to help students critically analyze and address ethical dilemmas in library practices.
- LIS programs should include more opportunities for practical, hands-on training in emerging technologies. This could involve internships, co-op programs, lab sessions, or partnerships with libraries that have adopted cutting-edge technologies. Real-world projects involving AI-based tools, data analysis, and automation would give students the confidence to apply their theoretical knowledge in a practical context (Liu, 2020). Additionally, virtual simulations of library environments powered by VR or AR can provide students with immersive training experiences.
- Continuous professional development programs should be implemented for LIS faculty to help them stay current with technological developments. Faculty members should have opportunities to attend conferences, workshops, and training sessions on the latest innovations in library technology (Bawden & Robinson, 2019). Encouraging faculty collaboration with industry experts and technology developers will ensure that teaching materials and course content remain cutting-edge.
- LIS education should promote lifelong learning by encouraging graduates to participate in ongoing professional development opportunities, such as workshops, webinars, and certification programs. Libraries themselves should invest in training programs to upskill their staff in new technologies and innovative practices (Murray, 2021). Partnerships with professional organizations and

technology companies can also offer LIS professionals access to resources and certifications that will enhance their expertise.

- Academic institutions should establish partnerships with libraries, technology firms, and other relevant organizations to create a feedback loop that informs the development of LIS curricula. Joint research initiatives, internships, and technology pilot programs can help LIS educators and students stay informed about the latest industry trends and practices (Kovacs et al., 2019). By involving industry professionals in curriculum design, LIS education can become more responsive to the needs of modern libraries and their users.
- LIS programs should emphasize the importance of maintaining user-centered practices in the implementation of new technologies. Training should include how to use AI and automation tools to improve user services while ensuring that libraries remain accessible and inclusive to all patrons (Vaughan, 2020). Additionally, students should learn how to conduct user research and apply user feedback to the design and improvement of library services, ensuring that technological solutions are aligned with user needs and preferences.

References:

Arlitsch, K. A., & Dugan, R. E. (2019). *Big data in libraries: New opportunities for librarians and LIS educators*. Information Technology and Libraries, 38(3), 11-28.

Bawden, D., & Robinson, L. (2019). *Introduction to Information Science*. 2nd edition. Routledge.

Booth, A., Sutton, A., & Papaioannou, D. (2016). *Systematic approaches to a successful literature review* (2nd ed.). Sage Publications.

Cooper, H. (2010). *Research synthesis and meta-analysis: A step-by-step approach* (4th ed.). Sage Publications.

Cowan, L., & Manning, R. (2021). *Human-centered AI in LIS education: Challenges and opportunities*. Journal of Library and Information Science Education, 35(2), 108-121.

Gailey, R., & Freeman, M. (2020*). Redefining libraries: Preparing for the future of collaborative and learning spaces in LIS education. Library Management*, 41(1), 45-60.

JISC. (2018). *Librarianship in the Digital Age: Challenges and Opportunities*. Retrieved from https://www.jisc.ac.uk/

Johnson, C., Weller, M., & Bennett, S. (2021*). Library and Information Science Education in the Digital Age: Preparing Professionals for the 5th Industrial Revolution*. *Journal of Education for Library and Information Science,* 62(4), 369-383.

Kohl, D. (2020). Technological Competence in Libraries: Transforming Services for the Digital Age. *Library Journal*, 145(12), 22-30.

Kovacs, D., Williams, K., & Wiggins, M. (2019). *Data Management in Libraries: A Guide for Librarians in the Digital Era*. Academic Press.

Kriewaldt, J. (2022). *Shaping the Future of Library and Information Science Education in the 5th Industrial Revolution*. *The Journal of Information Science*, 48(3), 234-245.

Kroski, E. (2019). *The role of artificial intelligence in libraries*. Library Technology Reports, 55(4), 1-24.

Liu, Y. (2020). AI in Libraries: Opportunities and Challenges in the 5th Industrial Revolution. *Library Technology Reports*, 56(1), 15-23.

Murray, S. (2021). *User-Centered Services in Libraries: Best Practices for Today's Information Professionals*. American Library Association.

Sweeney, R. (*2022). Exploring the impact of blockchain and IoT in LIS education. Library Journal*, 147(5), 36-40.

Vaughan, L. (2020). *Developing Information Literacy in the Digital Age: A Guide for Library and Information Professionals*. Emerald Publishing.

Library and Information Science (LIS) Education and Training in Nigeria in the 5th Industrial Revolution: The Skills Requirements

By
Prof. Bappah Magaji Abubakar
University Library,
Federal University of Health Sciences, Azare, Bauchi State
bmagaji02@gmail.com, librarian@fuhsa.edu.ng
Cell: 08063514814, **(WhatsApp no: 09075437934)**
and
Amina Suleiman Hamza (CLN)
Department of Library and Information Science,
Northwest University, Kano, Kano-State
E-mail: suleiman.amina@rocketmail.com
Cell: 08033553420 (**WhatsApp no: 08033553420)**

Abstract
The Fifth Industrial Revolution also known as Industry 5.0 is an innovative and evolving period of industrialization that ensures humans work together with advanced technologies and Artificial intelligence (A.I.) power-driven robots to improve workplace methods and processes. Furthermore, its emergence has fundamentally transformed the different means and modalities of information generation, access, management, sharing, as well as storage. This development has serious implications for LIS education and training globally. Similarly, the Fifth Industrial Revolution has also brought about new concepts such as sustainability, human-centeredness, improved resilience, competence, biotechnology and concern for the environment. Other critical emerging areas that are associated with the period include AI, Internet of Thing (IoT), and big data to mention just a few. Consequently, future information professionals must acquire vital skills both hard and soft in the area of information/data curation, data/knowledge and digital literacy, and, also the acceptance of AI and all the new emerging trends that has become inevitable in the new digital landscape. The paper provides an overview of LIS education in Nigeria with a specific focus on university-based LIS education and training. It identifies the various skills needed by the would-be LIS graduates in the era of the Fifth Industrial Revolution that include among others; leadership skills, efficient communication skills, flexibility and adaptability skills, teamwork/interdisciplinary skills, critical thinking and problem-solving skills, proper time management, customer service skills and interpersonal skills. The paper discusses the major challenges affecting LIS education and training in Nigeria which could hinder the acquisition of the critical skills needed. It further suggests strategies for overcoming the identified challenges. The paper concludes by stressing that the acquisition of these skills is essential in ensuring effective and seamless service delivery that is user-centred by LIS graduates in the 5th Industrial Age.
Keywords: *Library and information science, LIS education, Training, 5th Industrial revolution, skills, Nigerian universities.*

Introduction

In the middle of the evolutionary waves and other innovative processes of the Fifth Industrial Revolution (5th IR), there is a remarkable and fundamental shift in the way and manner information, data and knowledge are handled. This shift has also changed the roles of information professionals, their education and training including the customers they are serving. As a result of these developments, changes in Library and Information Science (LIS) education worldwide have been intense, sweeping and diverse. This is, due to the fact that, LIS education since its commencement has always been a profession that is concerned with the education and training of future information professionals. Additionally, these developments have implications for the profession in general.

With the inception of the Fifth Industrial Revolution, which is notable by its certain distinctive and unique features that include among others; the Internet of Things (IoT), artificial intelligence, virtual and augmented reality, robotics, blockchain and cloud computing, the role of libraries and the LIS education sector in particular are witnessing fundamental revolution. These technologies are reshaping how information is generated, use, stored, disseminated and retrieved. According to Davim (2025), Industry 5.0 attempts to combine human and technological competencies to create a more resilient and sustainable manufacturing environment. Further to Davim's description of the Industry 5.0 era, Martini, Bellisario and Colleti (2024) provide a convincing metaphor that demonstrates the objectives of Industry 5.0, stating that "Industry 5.0 aims to revitalize the presence of human labour in factories, where humans and machines would work together to increase process efficiency by fully leveraging human intellectual abilities and creativity through their integration with current intelligent systems". Additionally, according to the same authors, Industry 5.0 includes the interoperability of network sensor data with current intelligent systems some of which include smart additive manufacturing, predictive maintenance, hyper-customization in industry, cyber-physical cognitive systems, and the introduction of collaborative robots.

The Fifth Industrial Revolution (5IR) embodies the modern phase of technological advancement that is restructuring industries, economies, and societies in general (Enakrire, Oladokun, Nsirim and Gaitanou, 2024). Similarly, according to Schwab (2017), the Fifth Industrial Revolution is an innovative force that surpasses boundaries and speeds up innovations across several domains. The emergence of the 5.0

Industrial Revolution has affected all sectors of life, including institutions providing information services and the LIS education sector (Ilham & Apriliyanti, 2022).

Furthermore, the revolutionary nature of the Fifth Industrial Revolution has the potential to reform industries, address global challenges and shape the future. Hence, this shift from the traditional setting to the new era of remarkable change and innovation has demanded that the training of information professionals in new skills and knowledge become inevitable. This is necessary to ensure that they move with the current global trends in information services provision and also for them to continuously meet their expected roles and for the sustainability of the profession as well. It is important to note that there are sweeping changes across various sectors due to the emergence of the Fifth Industrial Revolution. Moreover, sustainable development in the training and education of information professionals in the Industry 5.0 era can only be guaranteed when LIS education strives to move with the current global trends in all its segments mainly through the infusion of Information and Communication Technologies (ICTs) and other modern technologies to the LIS education and training. This is in addition to developing a market-driven curriculum and the provision of necessary infrastructure to produce information professionals that have the skills and capabilities that are in line with the current trends and perspectives i.e. the Industry 5.0 needed skills. Additionally, it is important to note that the National Universities Commission (NUC) which is the regulatory body for university education in Nigeria has developed a new Core Curriculum and Minimum Academic Standards (CCMAS) for all programmes including the LIS discipline. The implementation of the CCMAS has since commenced in the 2022/2023 academic session.

In view of the foregoing, this paper identifies and discusses the various skills needed by the would-be LIS graduates in Nigeria in the era of the Fifth Industrial Revolution. It also chronicles the development of LIS education in Nigeria with specific emphasis to LIS education and training in Nigerian universities.

Overview of Library and Information Science Education in Nigeria

In Nigeria, the development of LIS education has a long tradition as its history can be traced back to the UNESCO-organized seminar of 1953 on the "Development of Public Libraries in Africa", which was held at the University of Ibadan in Nigeria, which acknowledged the need for the establishment of professional courses, and the need for the development of libraries in the country (Abubakar & Maidabino, 2022). According to Simisaye (2014), Nigeria is the origin of LIS training in West Africa. However, before that time, education and training in librarianship were only available abroad, specifically in the United Kingdom and later the United States and the certificates obtained were mostly non-graduate types like the British ALA Examinations.

The beginning of actual university-based LIS education in Nigeria commenced with the establishment of the first Library School in 1960 at the University College Ibadan, (as it was then called), later known as the Department of Library, Archival, and Information Studies. The LIS School was established with financial support from the Carnegie Corporation of New York who sent Harold Lancour in 1957 to survey the library situation and propose how the Corporation can provide support in terms of library development. After Harold Lancour's two-month survey, he recommended that a postgraduate level LIS education be mounted, which was launched at the Institute of Librarianship. Moreover, the school started with a Diploma in Librarianship meant for graduate students (Abubakar, 2024).

According to Abubakar (2021), the next school of librarianship in Nigeria was opened at the Ahmadu Bello University, Zaria which commenced with an undergraduate programme. This was based on the 1963 F.A. Sharr's report on library needs in Northern Nigeria which led to the establishment of the second LIS School in Nigeria in 1965 to educate and train librarians at the undergraduate level against that of Ibadan's postgraduate Diploma programme. At its beginning, the Ibadan LIS School strongly opposed the Ahmadu Bello undergraduate programme, because it was a "dangerous" deviation from the norm, an offensively conceived programming a subtle way to weaken the standards of the profession. (Uhegbu, 2011). After the establishment of the first two university-based LIS schools, other LIS schools were later opened in different universities in Nigeria that include among others: Bayero University, Kano (1977); University of Maiduguri (1978); Imo State University (1981); and University of Nigeria Nsukka (1983).

Presently, many universities are offering LIS programmes in universities, although no definitive statistics are available about their total number. Such institutions exist in federal, state and private universities.

Required Skills for Information Professionals in the Fifth Industrial Revolution

The emergence of the Fifth Industrial Revolution has brought about new skills requirements for LIS graduates which LIS schools in Nigeria must frontally address. In the first instance, it is important to stress that the Fifth Industrial Revolution emphasizes one key significant aspect i.e. collaboration between human beings and machines. It builds upon the fourth industrial revolution and it is facilitated by advancements in Information and Communication Technologies (ICTs). According to Ajani and Oladokun (2024), the beginning of the 5th Industrial Revolution signifies a transformative era marked by extraordinary technological advancements forcing libraries to re-examine themselves within a rapidly changing world. Ibinaiye and Jiyane (2021) added that in the LIS domain, information professionals can apply the 5IR wireless communications to improve service provisions for their clientele which in turn necessitates the need for new skills and additional training, especially in ICTs. Consequently, information professionals are required to obtain certain relevant skills for them to become key players' not just mere spectators in the Industry 5.0 era. Besides, it is imperative to note that the Industry 5.0 era is swiftly changing almost everything we do and is taking us into an era of amazing technological advancements and revolutions. As the future of libraries and information professionals in the Industry 5.0 era is greatly accompanied by remarkable innovations to meet the changing needs of their clients, the following key skills should be given

priority by LIS schools:

1. Leadership skills: Leadership skills in this context are critical to the survival of information professionals in the era of the 5th Industrial Revolution, hence its acquisition is inevitable. There is no denying the fact that information professionals are expected to take on leadership roles which involve leading, managing, mentoring and training people. This specifically includes bringing innovations aimed at accomplishing organizational goals and success, encouraging and inspiring colleagues and setting innovative and encouraging examples all to meet the expectations of the new era.
2. Efficient communication skills: Efficient communication skills are important for information professionals whose duty is to deliver multifaceted information with clarity and precision. It involves both oral, written and active listening skills. According to Nonthacumjane (2011), LIS professionals serve as facilitators in searching for information as well as effective communicators with good command of speaking, presentation and writing. Oral communication is essential in maintaining proper interactions with clients, sponsors, and coworkers. Written communication, on the other hand, is desirable because it ensures seamless report writing, creation and maintaining digital content and ensures their availability for proper use as well as appropriate documentation. All these are critical to survival in the 5.0 industry era and should be squarely addressed by the LIS schools when training their students.
3. Flexibility and adaptability skills: The ability to be versatile, dynamic and flexible is critical to the survival of the LIS profession and its professionals in the Industry 5.0 era. Consequently, the Fifth Industrial Revolution requires that information professionals should be vastly dynamic, adaptive and flexible to be amenable to new developments and perspectives. They are also expected to subscribe to new ideas and trends, eager to learn new skills and ideas and adapt to new changing environmental forces. This is all in an attempt to meet the requirements of the ever-changing globalized environment. Furthermore, as the world is rapidly transforming, LIS schools must produce information professionals who are resourceful and can adapt to new changing situations and are willing to update their knowledge and skills. Also, they should possess the acumen to develop new strategies to serve their clients in a technologically compliant environment.
4. Collaboration/interdisciplinary skills: In this context, interdisciplinary skills especially in the area of collaboration are essential. Solid teamwork entails that LIS professionals should have the capacity to collaborate with others from other disciplines, exchange knowledge and ideas and actively contribute to shared goals and objectives. Oladokun, Ayinde and Enakrire (2024) stated that competent teamwork in the Industry 5.0 era requires the ability of the information professionals to cooperate with others, exchange knowledge and make a strong impact on collective objectives. This requires appreciating and accepting diverse viewpoints. Similarly, according to the authors, they also need conflict resolution skills for them to manage and resolve effectively differences constructively so that that collaborative efforts would be sustained in the transformative era.
5. Critical thinking and problem-solving skills: To be relevant in the Industry 5.0 era, information professionals are expected to have robust critical thinking skills and problem-solving capabilities to squarely address the multifaceted and burning issues that arise in the Industry 5.0 era. According to Nonthacumjane (2011), information professionals are expected to be critical thinkers with the ability to be responsive to the fast pace of the digital era. This requires an update in their skills. Additionally, critical thinking skills encompass the ability to identify, synthesize and scrutinize in the most cost-effective manner information with objectivity and precision, review different scenarios and make up-to-date resolutions as they relate to the changing period. Likewise, problem-solving abilities include finding out the source of problems, finding ground-breaking solutions to such challenges, and putting them into sound practice to meet the expectations of the transformative era. These skills are fundamental if information professionals are to be relevant. Thus, attaching importance to the teaching of critical thinking and problem-solving skills by the LIS schools in Nigeria should not be handled with levity.
6. Proper time management skills: Effective time management is essential for the survival of information professionals in the Industry 5.0 era. As a result, LIS schools in Nigeria should factor in time management skills in their curriculum. For this reason, the ability of information professionals to manage time effectively is an important skill that needs to be developed in the Industry 5.0 era. Such skills include strong organizational skills, prioritization, goal setting, effective communication, planning which involves thinking before action and problem-solving among others. All these would ensure effective and efficient service delivery, sustainability, proper record keeping, and enhancing productivity which are all critical requirements of the Industry 5.0 era.
7. Customer service skills: The success of any information service provided by information professionals depends to a large extent on strong customer service skills. It is a known fact that information professionals interact with different clientele who are becoming more sophisticated in the Industry 5.0 era. Thus, in the evolutionary era, robust customer service skills are desirable. They should possess forward-thinking initiatives aimed at identifying, and selecting the needs and experiences of clients and providing tailor-made responsive services to meet the demands

of the new digital landscape. This is particularly important if information professionals are to remain relevant. Therefore, attaching importance to customer service skills by LIS schools in Nigeria is crucial to the survival of information professionals in the Industry 5.0 period.

8. Interpersonal skills: Interpersonal skills can include networking skills and empathy which go a long way in determining how effective information professionals interact with others, particularly users. According to Oladokun, Ayinde and Enakrire (2024), interpersonal skills are crucial for building and sustaining positive professional relationships with peers, mentors, and experts which in turn facilitates knowledge exchange and professional growth, especially in a multicultural setting. This, according to the authors, is indispensable in a globalized world where information professionals regularly interrelate with individuals from diverse cultural contexts.

Challenges Confronting LIS Education in Nigeria

The challenges created by the Fifth Industrial Revolution mainly lie in how organizations can adjust and accept eagerly the new emerging trends and concepts together with their complexities. Beyond that, many obstacles could serve as a stumbling block to the LIS schools in Nigeria in their quest to impart to their students the right type of knowledge and skills that is in tandem with the requirements of the Industry 5.0 era. Foremost, among the challenges is that of persistent and perennial gross underfunding of education and LIS programmes in Nigeria Abubakar (2024), stated that the major challenge facing the development of education in Nigeria is inadequate funding, which impedes educational development and LIS education in the country.

A further challenge is the unfortunate state of infrastructure/teaching and learning resources which arises as a result of the chronic underfunding situation and misappropriation. According to Abubakar and Maidabino (2022), most LIS schools in Nigeria are deficient in modern-day ICT infrastructural facilities that are critical to the Industry 5.0 era for the proper education and training of their students. This negatively hampers the training of information professionals who are expected to efficiently manage the complexities of the digital era and facilitate knowledge management, information accessibility and the advancement of digital literacy among others. Other disturbing challenges were discussed by Abubakar (2024, 2021, & 2019), Salawu & Igwe 2018, and Nwosu (2016) in the following manner:

1. Creation of LIS schools without compliance with standards. The rate at which LIS schools proliferate without compliance with standards in the areas of curriculum development and resources is harmful to the desired training needed in the Industry 5.0 era.
2. Inappropriate development, implementation and review of LIS curricula as well as the lack of participation of professional bodies in the accreditation of LIS programmes in Nigeria can also serve as a stumbling block in the Industry 5.0 period.
3. Inadequate ICT training for information professionals in Nigeria due to the failure of LIS schools to inject ICT and innovative related courses into their curricula. Some of the unique features of Industry 5.0 are the emergence of the Internet of Things (IoT), artificial intelligence, and robotics among others which all work with proper technological skills and knowledge. In a situation where LIS professionals are deficient in technology, compliance with the requirements of Industry 5.0 could remain a mirage rather than a reality.
4. Inadequate partnerships among LIS schools, exchange and linkages programmes both within and outside the country could also serve as an obstruction to the training and education of information professionals in the Fifth Industrial Revolution era.
5. Differences in nomenclature and organizational placement for LIS departments in the country. Some LIS schools in Nigerian universities are accommodated under faculties of education, some in social sciences, while a few are under faculties of information and communication etc.; (Abubakar, 2019). This trend adversely impedes sustainable education and training of information professionals in the Industry 5.0 age.
6. The nonchalant attitude of the professional associations towards LIS education in Nigeria is also negatively affecting its sustainable development which could in turn affect the training and education of information professionals in the 5.0 period.

Strategies for Overcoming the Challenges

To ensure adequate and realistic compliance with the requirements of the Industry 5.0 era in the training of information professionals, the following recommendations are offered:

1. There is a need for improvement in funding and infrastructural facilities in the LIS schools in Nigeria. This denotes that governments and other sponsoring agencies of LIS schools should change their attitudes. Besides, LIS schools should develop new practical strategies for generating more funds to supplement their financial allocation to acquire critical infrastructure for meaningful LIS education. The Industry 5.0 era demands a critical infrastructure that will allow humans to connect with machines and data.
2. There is also the need to address aggressively the proliferation of LIS schools in Nigeria without adequate deployment of relevant and necessary human and material resources including information and communication technologies. This is necessary if LIS schools are to comply with the requirements of the Industry 5.0 period.
3. LIS schools should continuously review their curricula to introduce new programmes and inject modern courses to meet the changing needs of society, the Industry 5.0 era and the labour market. According to Ilham & Apriliyanti, (2022), curriculum construction in LIS schools for the present

and future should emphasize digital literacy skills, service, life skills, and ability to collaborate, as well as critical thinking and creativity i.e. information professionals should understand the working and use of IoT (Internet of Things), the use of virtual and augmented reality, and the incorporation of AI (Artificial Intelligence) and machine learning among other things. These technologies not only modernize and enhance information services but also transform such services.

4. There is also a pressing need to address the crises in the nomenclature of LIS programmes and the placement of LIS departments. This is crucial if LIS schools are to meet up with the demands of the Industry 5.0 age.
5. LIS schools should improve on their faculty who are the backbone of any educational programme. This indicates that vibrant, exciting and ICT-compliant lecturers should always be hired this should be complemented with the training and retraining of the existing lecturers in contemporary information service provision and delivery. All these are necessary since the Industry 5.0 era emphasizes service-centric and collaborative approaches and community engagement.

Conclusion

The status and survival of LIS schools in Nigeria during the 5th Industrial Revolution rest so much on their level of commitment and compliance with the dictates of the 5th Industrial Revolution. The period demands the infusion and harvesting of a fresh set of skills by information professionals for meaningful service delivery in the transformative age. Hence, for information professionals to prosper in the new period, the acquisition of critical skills particularly digital skills is imperative and unavoidable. This paper, therefore, concludes that LIS schools in Nigeria and even beyond should realize that the training and education of information professionals in Industry 5.0 must equip students with new knowledge, skills and techniques needed to effectively manage and disseminate information in this rapidly changing digital environment. They need robust and sound skills since it is generally believed that such skills are essential for promoting active collaboration, user-centred services/delivery, and human-machine interactions which are all hallmarks of the Fifth Industrial Revolution.

References

Abubakar, B.M. (2021). Library and information science (LIS) education in Nigeria: Emerging trends, challenges and expectations in the digital age. *Journal of Balkan Libraries Union,* 8(10), 57-67.

Abubakar, B.M. (2024). Strategies for ensuring innovation in financing library and information science (LIS) education in Nigeria for sustainable development. *Gadawur Journal Educational Research and Development,* 1(2), 1-12.

Abubakar, B.M. (2019). Current trends in library and information science (LIS) education in Nigeria. *A paper presented at the 21st Conference of the Nigerian Association of Library and Information Science Educators (NALISE)* held at the Ignatius Ajuru University of Education, Port Harcourt, 9th 13th September, 2019.

Abubakar, B.M. & Maidabino, A.A. (2022). Library and Information Science (LIS) Education and training in Nigerian universities: 1962-2022. *A paper presented at the 60th National Conference & Annual General Meeting of the Nigerian Library Association* held at Bolton Event Centre, Wuse, Abuja, from 3rd – 8th July, 2022.

Ajani, Y. A. & Oladokun, B.D. (2024). Advocacy for intelligent libraries in the era of the fifth industrial revolution. *Folia Toruniensia,* 24, 29-51

Davim, J.P. (2025). Perceptions of Industry 5.0: Sustainability perspective. *BioResources*, 20(1), 15-16.

Enakrire, R.T., Oladokun, B.D., Nsirim, O. & Gaitanou, P. (2024). Paperless libraries: The trending way to go in the fifth industrial revolution. *Business Information Review*, 4(4), 164-173.

Ibinaiye, I.D. & Jiyane, G.V. (2021). The prospects of 5th industrial revolution and academic library services: Exploring the role of data science in the post-pandemic period. 4th International Conference on Information Technology in Education and Development. Available at: https://www.semanticscholar.org (accessed 16 January, 2025)

Ilham, M. & Apriliyanti, M. (2022). Challenges of the Industrial Revolution era1.0 to 5.0: University Digital Library in Indonesia. *Library Philosophy and Practice (e-journal)* 6994. Available at: https://digitalcommons.unl.edu/libphilprac/6994 (accessed 16 January, 2025.

Martini, B., Bellisario, D. & Colleti, P. (2024). Human-centred and sustainable artificial intelligence in industry 5.0: Challenges and perspectives. *Sustainability*, 16, 5448. Available at: https://doi.org/10.3390/su16135448 (access 29 January 2025).

Nonthacumjane, P. (2011). Key skills and competencies of a new generation of LIS professionals. *IFLA Journal,* 37(4), 280-288.

Nwosu, C.C. (2016). Curricular implications of sustainable development for library and information science education in Nigeria. J*ournal of Library and Information Sciences,* 4(2)15-20.

Oladokun, B.D., Ayinde, L. & Enakrire, R.T. (2024). The fifth industrial revolution: Information professionals and skills. Information Matters, 4(7), 1-4.

Salawu, K.Y. & Igwe, K.N. (2018). Education for library and information science in Nigerian polytechnics: The case for information and knowledge management and innovative Higher National Diploma specializations. *Ebonyi Journal of Library and Information Science,* 5(2), 464 – 475.

Schwab, K. (2017). The fourth industrial revolution. *Crown Business*, London: Penguin UK.

Simisaye, A.O. (2014). Training of library and information professionals for the 21st-century job market in Nigeria: Implications for curricula re-design. *Journal of Education and Practice,* 5(27), 103-110.

Uhegbu, A.N. (2011).Quality library and information science education in Nigeria: The place of public-private collaboration. *IFLA Journal,* 37(3) 228–234.

Library and Information Science Education and Training in the 5th Industrial Revolution

By
Nura Mohammed Musa[1], Abubakar Usman[2] and Dr. S.U. Mabera[3]
nuramusam@gmail.com1 , usmania2018@gmail.com2 and sumabera@gmail.com3
College Library, Federal College of Education Odugbo, Benue state.
+2347068832685, +2348034610338 and 08060001519

Abstract

In recent years, the 5th industrial revolution has transformed the way we live, work, and learn. As technology continues to advance at an unprecedented rate, academic institutions need to adapt their curriculum to prepare students for the future. One area that is greatly impacted by the 5th industrial revolution is library and information science (LIS) education and training. With the rise of digital information and the increasing need for efficient information management, the role of the LIS professional has become more crucial than ever. The 5th industrial revolution has brought about new challenges and opportunities for LIS education and training. It is no longer enough for students to just learn traditional library skills; they must also be equipped with the knowledge and skills to navigate the digital landscape. This includes understanding emerging technologies, data analytics, and information literacy. In addition, the 5th industrial revolution has also led to a shift in the job market for LIS professionals. With the rise of e-learning and digital libraries, library and information science education and training centers do face a lot of challenges in the fifth industrial revolution, which include inadequate skilled workers, outdated technologies, financial constraints, resistance to change and skills gap. To meet these challenges and prepare students for the future, there is a need for curriculum reform, academic institutions are integrating new technologies and courses into their LIS programs. As we continue to move towards a more digital world, this paper recommend that, academic institutions must evolve their LIS education and training program to equip students with the necessary skills and knowledge for success in the library, LIS programs should incorporate emerging technologies, collaboration with computer science, data analytics, and business fields should be encouraged to expand LIS professionals' competencies, training workshops, certification programs, and lifelong learning initiatives should be promoted, educational institutions should invest in smart libraries, in order to provide practical exposure to students policy and institutional support should be taking with utmost respect.

Keyword: *Curriculum 5.0, Curriculum Reform, Fifth Industrial Revolution, Library and Information Science.*

Introduction

The fifth industrial revolution (5IR) marks a transformative era in which information resources and services not only transition into technology-driven formats accessible anytime and anywhere through ICT devices, but also emphasize human values, ethics and inclusivity in shaping the future of work and society. In the field of library and information Science(LIS), this emerging paradigm underscores the need to cultivate professionals who are not information-literate but also socially responsive, emotionally intelligent and ethically grounded. Libraries are adapting to incorporate advanced technologies and collaborative methods, with libraries playing a pivotal and inclusive services to students in Education and training in Industrial revolution. The consistent demand for increased customization and flexibility in information dissemination and services reflects positive changes in library activities driven by information and communication technology (ICT) and including the impact of Industrial Revolution (IR) (Ziatdinov, 2024). According to Petcu et al., (2020), the Industrial Revolution, spanning from Industry 1.0 to Industry 5.0, has revolutionized the way we work and live. It introduced mechanization, mass production, and the rise of e-commerce. The 4th Industrial Revolution integrated advanced technologies like IoT and AI, transforming production into a decentralized model. The 5th Industrial Revolution, Industry 5.0, aims to optimize resource efficiency and production output by reshaping human-machine interactions (Golić, 2019). Industry 5.0 aims to redefine industrial processes and human machine interactions, highlighting the collaboration between humans and intelligent systems. It also emphasizes the bio-economy, utilizing renewable biological resources for industrial purposes, and circular economy principles to enhance resource utilization and minimize waste. The 5th industrial revolution has applications across various industries, including libraries (Rame et al., 2024). In the LIS domain, information specialists can apply the 5IR wireless communications to enhance service provisions for their clients, which in turn requires the need for further training in the specific areas of demand. The 5th IR includes applications of mechanical and digital machines to communication devices for information transfer over the network, including the Internet of Things (Prajapati et al., 2019).

Going memory lane, the first industrial Revolution (1st IR) commence in the mid-18th century between 1750 and 1850, triggering significant advancement in agriculture, manufacturing, mining and transportation. Machines began to replace humans and animals in various tasks, enhancing workload efficiency. The need for energy to power these machines led to the innovation in arrears such as pipes, water, gas and electricity, driving further industrial growth (Taskan et al., 2020). The 2nd Industrial Revolution (19th-20th century): Libraries expanded as centers of knowledge with mass production of books. The third Industrial Revolution (20th century) emerged post-world war II, marking the onset of the digital age. This period saw the rise of computers, consoles and cell phones, revolutioning communication and productivity. The fourth Industrial Revolution (21st century) ushered in the era of interconnected technologies, including artificial intelligent, robotics, cloud storage and the fusion of technologies that blur the boundaries between physical, digital and

biological spheres known as cyber-physical system. This era categorized advancement into biological, digital and physical domain with development like 3D printing, IoT and shaping daily lives (Apriliyanti, 2022). This rapid progress led to the discussion about the fifth I.R.

The 5th industrial revolution (Present and Future) is based on 4th industrial revolution and focuses on resilience, sustainability, human, environmental, and social factors, including intelligent robots and machines working alongside humans. The 5th IR is a balanced integration of human intelligence with AI, fostering ethical and sustainable information management (Schwab, 2020). The 5th industrial revolution aims to balance automation and human intervention, enabling critical thinking and adaptability while leveraging machine precision. The fifth industrial revolution (5th IR) marks a pivotal shift towards enhancing human well-being through the collaborative relationship between humans and robots across various domains. The introduction of collaborative robots with decision-making capabilities aims to elevate service standards and boost production efficiency, promoting a harmonious collaboration between humans and sophisticated human-machine systems. Research indicates that the 5th IR was based on the advances made by the 4th IR, including AI, robotics, IoT, cloud computing, big data, and 3D printing technologies. The fifth IR improves these technologies by focusing on increased flexibility and integration, especially for new communication devices such as drones and moving robots (Ibinaiye & Jiyane, 2021). It emphasizes the use of mechanical and digital machines to improve information transfer and communication between networks, including loT.

According to Ziatdinov et al., (2024), the transition from the 4th to the 5th IR highlights a shift from a focus on productivity and versatility to sustainability and worker welfare. Climate change, exacerbated by industrial greenhouse gas emissions, has underscored the need for more sustainable practices in the fifth industrial revolution. The era emphasizes energy transformation and changes in workplace dynamics, where robots are increasingly taking on repetitive tasks. It marks a transformative period where information resources and services transition into a technologically driven format accessible anytime, anywhere through ICT devices. The integration of cutting-edge technologies such as big data analytics, AI, and the IoT defines the skills and competencies required in the 5th IR across various industries, including education and libraries. Librarians play a crucial role in adapting to technological changes and ensuring inclusive access to library services, particularly for users in open and distance learning institutions. Proficiency in data management, including data collection, analysis, and visualization, is essential for supporting evidence-based decision-making and enhancing service inclusion (Thiruppathi, 2024). Librarians should also possess expertise in information retrieval to cater to diverse learning needs, sourcing material from online databases and digital repository to facilitate the adoption of new technologies (Bokoh et al., 2023).

In the library service domain, the 5th IR represents collaboration between humans and machines to enhance the efficiency of information service delivery to library users. Essential technologies for implementing the 5th IR include big data analytics, IoT, collaborative robots, Block chain, digital twins, and forthcoming 6G systems (Adel, 2022). As we transition from the fourth to the fifth industrial revolution, technological advancements in service provision have shifted libraries from manual to computer-based operations, leading to online service delivery. The utilization of AI and robotics in service provision and delivery have expanded access to services for learners across different locations. Despite the benefits, librarians may face challenges in implementing the 5th industrial revolution in service provision, such as a lack of requisite skills, infrastructures and funding. Addressing these issues requires librarians to acquire new skills through various learning avenues. Introducing robots into dynamic, human-populated environments necessitates their ability to learn new skills through diverse methods, mirroring the cognitive adaptability of humans. These acquired skills will enable librarians to effectively collaborate with collaborative robot capabilities in the information service delivery process, thereby enhancing personalized library services for users.

The purpose this paper is to critically analyze how library and information science education and training can be restructured to meet the evolving demands of the fifth Industrial Revolution. It aims to provide actionable insights and recommendations that will inform curriculum development, policy formulation and institutional planning, thereby ensuring that LIS professionals are well-equipped to contribute meaningfully to knowledge societies in the 5IR era. The relevance and effectiveness of LIS education are contingents upon its ability to respond to emerging societal and technological trends. The 5IR presents both challenges and opportunities for the LIS field, including the need to foster interdisciplinary thinking, ethical leadership, social responsibility and digital fluency without losing sight of the professions core value. Many existing LIS programs are still anchored in outdated pedagogies and curricula that may not fully prepare graduates for the demands of this new era. of It is upon this bedrock that this conceptual study seeks to investigate the librarians and the fifth industrial revolution skills, challenges, and strategies for providing library services in education and training.

Library and Information Science Education and Training

The evolution of Library and Information Science (LIS) education and training has been deeply influenced by the various industrial revolutions, with each phase reshaping the competencies required of information professionals. As the world transitions into the Fifth Industrial Revolution (5IR), characterized by human-centric technologies and collaboration between humans and intelligent machines, LIS education must adapt to prepare graduates for increasingly dynamic information environments (Schwab, 2020).

Several scholars argue that LIS education is yet to fully align with emerging realities. Ocholla and Shongwe (2021) note that many African LIS schools still follow traditional curricula, which may not sufficiently address competencies required in data analytics, digital preservation, and AI tools. Similarly, Ahmed and Nwagwu (2020) emphasize the need for curriculum reform to reflect changes in the knowledge economy and the role of libraries in supporting innovation and research.

Moreover, the pedagogical approaches in LIS education must also evolve. Traditional classroom methods may not suffice in developing the critical thinking, adaptability, and cross-disciplinary skills needed in the 5IR. Blended learning, experiential learning, and collaboration with tech industries are seen as vital strategies (Ifijeh & Yusuf, 2020).
Igwe (2024) underscored the need to advance the education and training of librarians, information professionals, and knowledge managers in the era of the knowledge economy, the fourth industrial revolution (4IR) and the emerging fifth industrial revolution (5IR). As outline above the 5IR heralds the integration of cutting-edge technologies like artificial intelligence, robots, biotechnology, and the loT, demanding individuals to possess critical skills such as creativity, critical thinking adaptability, digital literacy, emotional intelligence, resilience, and cross-cultural competency (Ikenga & Sijde, 2024). Librarians, crucial in this transition, must adapt to technological changes and ensure diverse and inclusive library services, particularly for those in open and distance learning environments (Ziatdinov et al., 2024). Essential competencies for librarians in the 5IR era include learning and innovation skills, digiti literacy skills, and career and life skills, encompassing creativity, critical thinking, communication, collaboration, flexibility, adaptability, initiative, social interaction, productivity, accountability, and leadership (Ikenga & Sijde, 2024). Moreover, librarians need competencies in critical thinking, analytical thinking, emotional intelligence, problem-solving, technology use and development, self-management, and leadership competency to thrive in the 5IR (Demir & Ercan, 2019).

Skills for Librarians in the 5th Industrial Revolution

Leadership skills are crucial for guiding the integration of humans and intelligent systems, managing diverse teams, adapting to technological progress, and fostering effective communication and collaboration (Ikenga & Sijde, 2024). Librarians must also exhibit networking and collaboration abilities to enhance the inclusiveness of library services (Chisita et al., 2019). In the context of the 5IR, librarians must possess digital literacy skills to effectively manage information using digital tools and technology for service delivery (Jyotsna & Madhu, 2021). The acquisition of data management skills which involve data to extract meaningful insights to service delivery are crucial for librarians to collect, analyze, and visualize data, enabling evidence-based decision making and enhancing service inclusivity (Thiruppathi, 2024).
In the 5IR, librarians must leverage tools like the IoT, virtual and augmented reality and AI to enhance library services delivery. Essential skills for librarians include teaching proficiency, technology commercialization, strategic planning and consulting, along with being tech-savvy, cooperative, creative, and risk-aware (Apriliyanti, 2022). Also, librarians need to acquire Science, Technology, Engineering, and Mathematics (STEM) skills, including creativity, critical analysis, collaboration, and problem-solving skills competency, to adapt to the demands of the 5IR and meet the changing needs of users (Demir & Ercan, 2019; Ikenga & Sijde, 2024). By continuously updating their skills and embracing digital literacy, librarians can effectively navigate the challenges and opportunities presented by the 5IR, ensuring that library services remain inclusive, diverse, and responsive to evolving technological advancements. The adoption of the 5th Industrial Revolution will enrich service provision and delivery for all user categories, regardless of their specific requirements. Zaid and Nduka (2023) observe that, many librarians are already cognizant of the importance of diversity and inclusive library services for visually impaired students, indicating that embracing diverse and inclusive library services brought about by the 5th revolution is beneficial for students. Trivedi and Negi (2023) suggested that, the incorporation of an advanced technology like 5th industrial revolution in the traditional open and distance learning model is urgently required which will enable the higher institution to develop a blended or hybrid learning model.
Jones et al., (2023) posited that the shift to a human-centered technological environment requires LIS professionals to develop the following skills:

1. Digital Literacy: Competence in AI, data analytics, and cybersecurity.
2. Ethical Decision-Making: Understanding of data privacy and ethical AI use.
3. Human-Machine Collaboration: Ability to work alongside intelligent systems.
4. Lifelong Learning: Continuous skill development to adapt to technological advances.

Curriculum Development for Library and Information Science (LIS) Education in 5IR era

Significant changes have begun since the industrial revolution of the eighteenth century and have continued up to the present. Recently, economic events have highlighted the rising interconnection among world economies. This upheaval in the global landscape has affected education as well, and educational institutions now need to figure out how to adjust to these shifts and generate graduates who will prosper in a knowledge-based and innovation-driven society. But it's still difficult to close the gap between what academia generates and what industry needs (Volzer et al., 2021; Schwab, 2020). Many countries, especially developing countries including Nigeria, have struggled to embrace a curriculum that is ahead of its time and have failed to keep up with industry innovations (Barrot, 2021). The Nigerian Universities Commission recently changed from Basic Minimum Academic Standard (BMAS) to Core Curriculum and Minimum Academic Standards (CCMAS) all in an attempt to synchronize the universities programmes to catch-up with current realities. Indeed, according to estimates, 65% of children entering primary school today would end up in jobs that don't exist yet (Schwab, 2020). The skills gap is a social catastrophe brought on by these difficulties. The competencies that the industry requires but that graduates lack are referred to as the "skills gap."
In Nigeria today, there appears to be a significant level of disconnection between the nature of education and training for library and information science (LIS) on one hand, and the actual practice on the other hand as a result of the emerging fifth industrial revolution (5IR) (Igwe, 2024). The author advanced that education

and training in the knowledge economy require producing digitally skilled and technologically-driven graduates as critical thinkers who solve complex world problems. Ajani et al., (2022) conducted a study with alumni from all LIS schools in Nigeria and found that the participants (i.e., the alumni) are fully aware of the technologies of the 4IR and, consequently, the emerging 5IR. They also criticized the inadequate training of information professionals with inadequate skills because of a lack of industry synergy, a lack of motivation for trainers, and a shortage of qualified personnel. The authors found that the course material and curriculum of many LIS programs at Nigerian universities contradict the pressing need to prepare librarians and information workers for the 4IR and upcoming 5IR eras. Finally, they argued for a basic yet comprehensive curriculum that meets the demands of the fourth and fifth industrial revolutions.

Rahmah (2020) asserts that quick responses to real-world uses of digital technologies, such as artificial intelligence, big data, the Internet of Things, cloud-based services, and other emerging technologies in the curriculum for education and training, are therefore necessary for the careers of librarians and information professionals in the 4IR and, consequently, the 5IR. In order for libraries and librarians to survive the 4IR and emerging 5IR tsunami, Hussain (2020) adds that they must adopt a new mentality, connect holistically with emerging technologies, and acquire strong digital abilities, particularly those of trainee information professionals. Studies have showed that, companies and business leaders estimated that between 40% and 94% of the workers require reskilling. These gaps are most prominent in the field of Education (68.2%), Energy Utilities and Technologies (70.6%), and Mining and Metals (73.3%) (Schwab, 2020).

Redesigning the curriculum for education and training and creating new fields in the information profession that are in line with the reality of the knowledge economy are unquestionably essential to tackling the aforementioned challenges (Igwe, 2024). Developing a curriculum that is innovative and prepared for the future is one way to solve this educational dilemma. As the fifth industrial revolution (5IR) draws near, our curriculum must adapt to this new reality. Therefore, the purpose of this paper is to provide information about the adoption and use of Curriculum 5.0 in LIS education. Curriculum 5.0 is a cutting-edge curriculum designed to meet the demands of the 5IR environment and future employment.

In order to prepare graduates for the work and entrepreneurial demands of the 5IR, Tella (2020) advised African LIS schools to rebrand and repackage their curricula, taking into account digital applications, emerging technologies, and in-demand skills. In particular, Nigerian LIS institutions need to improve their curricula in order to produce graduates who are prepared for the digital knowledge economy (Abubakar, 2021). Additionally, the 5IR call for librarians to possess knowledge and abilities related to digital scholarship, which can be obtained through workshops, education, and on-the-job training courses offered by LIS school programs (Sibiya, 2023). These arguments support the idea that LIS programs should be in charge of guiding librarians' and information workers' training to be relevant in the 4IR and 5IR eras.

As the fifth Industrial Revolution (5IR) began, the educational landscape experienced a radical change. The increasing focus on automation, artificial intelligence (AI), digitization, and the Internet prompted reflection on the place of people in a technologically advanced age. 5IR's effects on LIS education are especially fascinating, as they have prompted a study of various viewpoints on how technology and humanity are interdependent, particularly from the perspective of LIS educators and practitioners. Simply put, 5IR is the humanistic variant of 4IR, with the ultimate goal of improving human life quality rather than replacing people. These changes essentially force the education sector to change (Education 5.0) and create multi-literate students who can participate in and contribute to this knowledge-based, innovation-driven society. Many nations' educational institutions have responded by reviewing and strengthening their curricula to meet the needs of the economy and society. However, the goal of these curriculum changes should be to create employable, ICT-literate students as well as productive, socially conscious adults (Jackson, 2014).

As the concept and implementation of cutting-edge technologies like 5IR has become relevant, there is the urgent need to review the current LIS curriculum in line with the current reality. An LIS curriculum is a document usually prepared by a government education agency which serve as a guide for LIS educators, teacher–trainers, textbook developers, and other important stakeholders. As the field of LIS education grows, this educational material is always changing. LIS educators are encouraged to think about adopting a paradigm shift in curriculum development in light of the current state of LIS education and technological advancements. A cutting-edge LIS curriculum should be able to anticipate the future and align its target skills with the needs of society and future employment. A curriculum may be classified as process-based (highlights teaching and learning process), content-based (emphasizes subject-matter topics), or product-based (emphasizes output or outcomes) [there are other ways of classifying a curriculum – perhaps you could say something like, a common way of classifying curriculum is...]. All curriculum must be "ahead of its time" and move toward Curriculum 5.0, which may be modified for use in a variety of subject areas (Barrot, 2022).

The components of the several curricula are combined in Curriculum 5.0, which is essentially a layered curriculum. To put it briefly, it places equal emphasis on using procedures and content knowledge to get the intended learning objectives or competences (Barrot, 2015, 2019). The curriculum heavily incorporates learning methods as an essential part of the learning plan in order to achieve this. In addition to demonstrating their command of relevant knowledge and abilities, teachers are expected to model the performance or output that students are expected to produce and to illustrate the procedures. A dynamic curriculum ensures LIS graduates are prepared for the evolving job market. To align with 5IR, LIS curricula must:

1. Incorporate Technology Courses: AI, data science, and digital preservation.
2. Emphasize Soft Skills: Critical thinking, adaptability, and ethical considerations.

3. Encourage Practical Experience: Internships and collaborations with tech-driven libraries.
4. Promote Interdisciplinary Learning: Partnerships with computer science, business, and social sciences (Williams & Ahmed, 2023).

Conclusion

As the world transitions into the fifth Industrial Revolution (5IR), characterized by human-centric innovation, artificial intelligence and advanced technologies working in harmony with human values, the field of Library and Information Science (LIS) must evolve to remain relevant and impactful. This paper explores the critical need for reimaging LIS education and training to meet the demands of a rapidly changing technological and social landscape. Key arguments emphasized the importance of integrating emerging technologies, fostering digital literacy, promoting interdisciplinary collaboration and nurturing soft skills such as creativity, ethic and empathy. The future of LIS education lies in its ability to produce professionals who are not only tech-savvy but also deeply attuned to the ethical, social and cultural dimensions of information. Training must shift from traditional models to dynamic, flexible curricula that embrace experiential learning, continuous professional development and global perspectives. The 5IR offers a unique opportunity for LIS professionals to lead in areas such as digital inclusion, data stewardship, information ethics and knowledge democratization to meet the demands of modern information services.

RECOMMENDATION

In light of the evolving demands of the Fifth Industrial Revolution (5IR), it is imperative that regulatory and professional bodies such as the Library Registration Council of Nigeria (LRCN), the Nigerian Library Association (NLA), and the National Universities Commission (NUC) undertake proactive reforms in Library and Information Science (LIS) education and training. These bodies should:

1. Revise LIS Curricula: Collaboratively develop and enforce a dynamic, future-oriented curriculum that integrates emerging technologies such as artificial intelligence, robotics, blockchain, data analytics, and human-centered digital tools. This curriculum should emphasize interdisciplinary skills, innovation, and ethical considerations.
2. Mandate Continuous Professional Development (CPD): Enforce policies that require librarians and LIS educators to undergo periodic training and certification in digital competencies, with support for capacity building, mentorship, and incentives.
3. Foster Strategic Industry Partnerships: Facilitate collaboration between LIS schools and industries in tech, education, and knowledge management sectors to ensure practical exposure, internships, and joint research projects that align academic output with real-world needs.
4. Empower Lecturers and Institutions: Provide funding, training, and infrastructure to enable LIS lecturers and institutions to adopt innovative pedagogies such as blended learning, experiential education, and the use of simulation labs or AI tools.
5. Investment in Infrastructure: Educational institutions should invest in smart libraries, AI tools, and digital repositories to provide practical exposure to students.

By implementing these recommendations, regulatory bodies will position Nigeria's LIS professionals to effectively navigate the complexities of the 5IR and contribute meaningfully to national development.

Reference

Abubakar, B.M. (2021). Library and information science education in Nigeria: Emerging trends, challenges and expectations in the digital era. Journal of Balkan Librraies Union, 8 (1)1, 57-67

Adel, A. (2022). Future of industry 5.0 in society: human-centric solutions, challenges and prospective research areas. Journal of Cloud Computing 11 (40). 002-00314 https://journalofcloudcomputing.springeropen.com/articles/

Ahmed, A., & Nwagwu, W. E. (2020). Reimagining LIS curricula for the knowledge economy in Africa. Library Philosophy and Practice, 1–19.

Ajani, Y. A., Dunmade, A., Tella, A., & Adeniran, C. O. (2022). Information professionals of the future and their prospects in the era of fourth industrial revolution: The need for transformative potential in Nigeria. Mousaion: South Africa Journal of Information Studies, 40 (3). https://doi.org/10.25159/2663-659X/12219.

Apriliyanti, M. (2022). Challenges of the industrial revolution era 1.0 to 5.0: University Digital Library in Indonesia. Library Philosophy and Practice 1-17. https://www.proquest.com/openview/

Barrot, J. S. (2015). A sociocognitive-transformative instructional materials design model for second language (L2) pedagogy in the Asia Pacific: development and validation. The Asia Pacific Education Researcher, 24(2), 283–297.

Barrot, J. S. (2019). English curriculum reform in the Philippines: Issues and challenges from a 21st century learning perspective. Journal of Language, Identity & Education, 18(3), 145–160.

Barrot, J. S. (2021). K to 12 curriculum reform in the Philippines: Towards making students future ready. Asia Pacific Journal of Education, 1–15.

Barrot, J. S. (2022). Curriculum 5.0 for the twenty-first century higher education: A way to move forward. International Handbook on Education Development in Asia Pacific (pp. 1-15). Singapore: Springer Nature Singapore.

Bokoh et al. (2023). Use of library resources and services as correlates of research activities among postgraduate

students in southwest federal universities, Nigeria. Library Philosophy and Practice (e-journal), 1-40. https://digitalcommons.unl.edu/libphilprac/

Chisita et al., (2019). Media, libraries, and archives unearthing the missing link in Zimbabwe. In cooperation and collaboration initiatives for libraries and related institutions, 243-272 https://doi.org/10.4018/

Demir, S., & Ercan, F. (2019). The effect of a self-awareness and communication techniques course on the communication skills and ways of coping with stress of nursing students: An interventional Study in Ankara, Turkey. J park Medical Association, 69(5), 659-665.

Golić, Z. (2019). Finance and artificial intelligence: The fifth industrial revolution and its impact on the financial sector. Zborni Radova Ekonomskog Fakultela u Istocnom Sarajevu, (19), 67-81.

Hussain, A. (2020). Industrial revolution 4.0: Implication to libraries and librarians. Library Hi Tech News, 37 (1) 1 – 5.

Ibinaiye, I. D. & Jiyane, G. V. (2021). The prospect of 5th industrial revolution and academic library services: Exploring the role of data science in the post pandemic period. 4th international conference on information technology in education and development. 87-99 http://event.academiainformationtechnology.org/proceedings/

Ifijeh, G., & Yusuf, F. (2020). Library and information science education in Nigeria: A framework for future development. Education for Information, 36(2), 133–145.

Igwe, K. N. (2024). The discipline of information studies in Nigerian universities: Proposal for unbundling viable independent academic programmes for the knowledge economy Communicate: Journal of Library and Information Science, *26*(1), 356-375.

Ibinaye, I. D. & Jiyane, G. V. (2021). The prospect of 5th industrial revolution and academic library services: Exploring the role of data science in the post pandemic period. 4th International Conference on Information Technology in Education and Development. . 87 – 99. Retrieved from http://even.academiainformationtechnology.org.proceedings/14.pdf.

Ikenga, U. G. & Sijde, P. (2024) Twenty-first century competencies About competencies for industry 5.0 and the opportunities for emerging economies, 1-17. https://www.preprints.org/manuscript/202403.0143/v1/

Jackson, L. (2014). Muslims and Islam in US Education: Reconsidering Multiculturalism. Routledge, New York.

Jones, L., Smith, R., & Taylor, P. (2023). Digital literacy and lifelong learning in LIS education. Journal of Library and Information Studies, 45(2), 89-104.

Jyotsna, R. & Madhu, P. (2021). Digital literacy competency among library users of the central university of Jharkhand: a study. Library Philosophy and Practice (e-journal), 1-12. https://digitalcommons.unl.edu/

Ocholla, D., & Shongwe, M. (2021). Transforming LIS education and training in Africa in the context of the Fourth and Fifth Industrial Revolutions. Journal of Librarianship and Information Science, 53(3), 405–418. https://doi.org/10.1177/0961000621994327

Petcu, I. et al., (2020). Shaping the future: Between and challenges of the ongoing 4th and the forthcoming 5th industrial revolution. In The 16th International Scientific Conference eLearning and Software for Education (pp. 91). Bucharest. https://doi.org/10.12753/

Prajapati et al., (2019, May). Enhancing reliability of power systems through iiot-survey and proposal. In 2019 IEEE/IAS 55th industrial and commercial power systems technical conference (I&CPS) (pp. 1-7).

Rame, R., Purwanto, P., & Sudarno, S. (2024). Industry 5.0 and sustainability: An overview of emerging trends and challenges for a green future. Innovation and Green Development, 3(4), 100173–100173. https://doi.org/10.1016/j.igd.2024.100173

Schwab, K. (2020). The Fourth Industrial Revolution. World Economic Forum.

Sibiya, P. T. (2023). Knowledge, skills and competencies of the Library and Information Science School's graduates on digital skills in South Africa. Internet Reference Services Quarterly, 27 (2), 83 – 101.

Taşkan, B., Karatop, B., & Kubat, C. (2020). Impacts of industrial revolutions on the enterprise performance management. A literature review. JBM, https://jbm.johogo.com/pdf/volume/2601/

Tella, A. (2020). Repackaging LIS professionals and libraries for the fourth industrial revolution. Library High Tech News, 37 (8), 1 – 6.

Thiruppathi, K. (2024). Librarian's role in the digital age: reimagining the profession in the era of information abundance. International Journal of Library and Information Science (IJLIS), 13(1), 1-9. https://iaeme.com/Home/issue/JLIS

Trivedi, S., & Negi, S. (2023). Rethinking distance education in the era of industry 5.0 and its integration with social and emotional learning. In Exploring Social Emotional Learning in Diverse Academic Settings (337-347pp.), IGI Global https://www.researchgate.net/publication/

Williams, P., & Ahmed, S. (2023). Interdisciplinary approaches to LIS education in the 5IR era. Education for Information, 41(1), 59-74.

World Economic Forum, (2016). The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution. World Economic Forum, Geneva, Switzerland.

Zaid, Y., & Nduka, S. (2023). Evidence-based strategies for promoting diversity and inclusion of library services for students with visual impairment in Nigeria University of Lagos experience. https://ubuntunct.net/app/uploads/

Ziatdinov, R. Atteraya, M.S. & Nabiyev, R. (2024). The fifth Industrial Revolution as a transformative step towards society 5.0 Societies 14 (2), 1-19. https://doi.org/10.3390/sos14020019

Library Educators' Perceptions of Artificial Intelligence Technologies for Research Writing in Tertiary Institutions in South-South and South-East, Nigeria

Esther David Josiah Okai, PhD[1], Bolaji David Oladokun[2], Daniel Toriste O. Kolawole[3], Justice Nnamdi Okorie, PhD[4] & John Obioma Okamgba[5]

1. Department of Library and Information Science, Abia State University, Uturu, Abia State / kachiokai@gmail.com /08036679585
2. Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom State / Bolaji.oladokun@yahoo.com /08050563725
3. Department of Library and Information Science, University of Uyo/ Kolawoledaniel@rocketmail.com /08161265083
4. Department of Library and Information Science, Abia State University, Uturu, Abia State/ justice.okorie@abiastateuniversity.edu.ng /07033545804
5. Department of Library and Information Science, Abia State University, Uturu, Abia State Okamgba.john@abiastateuniversity.edu.ngokamgba.john@abiastateuniversity.edu.ng /08068364889

Abstract

This study investigated library and information science (LIS) educators' perceptions of artificial intelligence (AI) technologies in research writing within tertiary institutions in South-South and South-East Nigeria. The study aimed to assess the level of awareness, usage, frequency of use, and challenges associated with AI technologies among LIS educators. A descriptive survey research design was adopted, involving 109 LIS educators selected through total enumeration. A structured questionnaire administered via Google Forms served as the data collection instrument, and responses were analysed using descriptive statistics, including means and standard deviations. Findings revealed high awareness of tools such as ChatGPT, Meta AI, and Grammarly, but lower awareness of tools like DALL-E and Propensity AI. While educators commonly used AI for summarizing abstracts, formatting citations, and proofreading, the use of AI for full academic writing remained low. The frequency of AI tool usage mirrored these patterns. Major challenges identified included internet dependency, data privacy concerns, alignment with academic standards, and potential impacts on creativity. However, AI tools were not perceived as difficult to use or overly costly. The study concludes that although LIS educators are aware and receptive to AI tools, actual use remains cautious and selective. It recommends structured training, curriculum integration of AI literacy, the development of ethical use policies, and the promotion of AI as a complementary research aid rather than a replacement for scholarly thinking.

***Keywords**: Artificial Intelligence, Research Writing, Library Educators, Academic Integrity, AI Tools Utilization.*

Introduction

Technology and its attendant impacts have brought so many changes in the mannerism of events globally touching all facets of life and existence including academic writings. It has been an evolving phenomenon moving from one stage of invention and innovation to another.

Today, the world has reached the information age. According to Adeleke and Ajakaye(2023), the general public began to embrace and accept the Information Age in the late 1980s and continued into the 21st century, although the original technologies and intellectual concepts were established slightly earlier in the 20th century. The information age is prevalent with digitalisation and computer of which Artificial Intelligence (AI) is at the forefront.According to Bonk and Wiley (2020), there has been an appreciable introduction of artificial intelligence which is seen as the simulation of human intelligence in machines that are programmed to think, learn, and make decisions with minimal human intervention as a recent innovation in technology.

AI broadly is the ability of machines or computational systems to perform tasks that typically require human intelligence, such as learning, reasoning, decision-making, and language understanding AI encompasses a variety of subfields, including machine learning (ML), natural language processing (NLP), computer vision, and robotics, which enable automated systems to adapt and optimize performance based on data-driven insights. (Ashraf*et al.,* 2024; Bernaerts*et al.*, 2024). According to Ashraf *et al.* (2024), AI is experiencing a pivotal transformation, with new frameworks integrating communication theory and ethical considerations, particularly in autonomous decision-making. Cummings (2024) reinforces this by emphasizing that AI is no longer just a set of computational algorithms but a socio-technical system that interacts with human decision-making processes.

The application of AI in human endeavours is achieved through the use of its varying technologies. AI technologies refer to a diverse set of computational systems, algorithms, and methodologies designed to enable machines to simulate human intelligence in performing tasks. These technologies are built on advanced data-driven models, statistical learning, and computational heuristics to process and analyse vast amounts of information, often in real-time, with high efficiency and accuracy. AI technologies have evolved into highly sophisticated systems that can process vast amounts of data in real-time, automate complex decision-making, and adapt autonomously to dynamic environments (Liang*et al.*, 2024). The

rapid evolution of AI technologies has led to transformative applications across multiple domains, including healthcare, finance, security, education, research and scholarly writing, manufacturing, and entertainment. The integration of AI into these sectors has not only enhanced efficiency and accuracy but has also raised critical discussions on ethics, transparency, and accountability in AI-driven decision-making, especially in academia (Cavaliere *et al.,* 2020).

Scholarly writing and productivity have been a catchphrase in the global academic space as it is the indication of the output level of members of the academia in a given institution or region. Scholarly writing has become so much elevated in academia that it is either done or unproductive (Owan & Asuquo, 2022). In other words, publish or perish is the ever-present threat hanging over the heads of many scholars bearing serious implications for their academic lives and careers. According to Gabi (2022),scholarly writing is a fundamental pillar of academic discourse, serving as the primary mode of communication within and across disciplines. It is used for communicating research findings, advancing knowledge, and engaging in academic discourse. It is a structured, rigorous, and evidence-based form of writing that facilitates the development, critique, and dissemination of knowledge. Through structured reasoning, critical engagement with existing literature, and meticulous citation of sources, scholarly writing ensures the credibility and reliability of knowledge production (Owan & Asuquo, 2022).

Library educators are also faced with the publish or perish statement in their careers and are expected to constantly publish scholarly writing. According to OsuchukwuandWagwu (2020), LIS educator contributes to the profession's principles, knowledge of information in daily life, emphasis on various literacies, learning and collaboration spaces, addressing technological requirements and competencies, and supporting open data. This is done through scholarly writing. Unlike other forms of writing, scholarly writing is characterized by its clarity, precision, and commitment to critical engagement with existing literature, ensuring that knowledge is rigorously examined and expanded.Evidence-based and objective, structured and coherent, adherence to academic conventions, peer review and revision, and engagement with academic discourse are few among the many defining characteristics of scholarly writing.

Scholarly writing, however, can be challenging and these often impede both novice and experienced scholars. These challenges span various dimensions, including structural, linguistic, cognitive, and ethical considerations. They are outlined to include but not limited to rigour and complexity of academic language, structuring and organizing arguments, mastering citation and academic integrity, peer review and constructive criticism, balancing objectivity and personal voice, writing for a global audience, managing time and overcoming procrastination, integrating artificial intelligence and ethical dilemmas (Dugglebyet *al.*, 2025; Henriksen*et al.*, 2025; Laher, 2025; Youn*et al.,* 2025). AI capabilities are known to ease many of the challenges LIS educators face, but the rate at which LIS educators make use of AI tools is unknown. This paper highlights library educators' perceptions of AI technologies for research writing in tertiary institutions in south-south and south-east, Nigeria.

Objectives of the Study

The objectives of the study are to:

i. ascertain the level of awareness of AI technologies for research writing among LIS educators;
ii. examine the usage of AI technologies for research writing among LIS educators;
iii. determine the frequency of use of AI technologies for research writing among LIS educators;
iv. explore the challenges associated with the use of AI technologies for research writing among LIS educators

Statement of the Problem

The rapid integration ofAI technologies in academic research writing has significantly transformed scholarly communication and knowledge production. The growing reliance on AI-assisted research tools notwithstanding, there is limited empirical evidence on how library educators perceive, utilize, and regulate AI technologies in academic writing. Though Malik *etal.* (2023); Joseph *etal.* (2024); and Al-Bukhrani*etal.* (2025), discussed the use of artificial intelligence tools in research writing, the emphasis was on students' use of AI in research writing. Preliminary observation therefore shows that none has accurately measured library educators' perceptions of AI technologies in research writing. Hence this study is necessary and tends to bridge the knowledge gap.

Literature Review

Scholarly writing is an integral part of research, distinguished by the organized articulation of concepts., data-driven arguments, and logical reasoning. It involves working with large amounts of information and the use of complex tools that pose a great challenge to many in academia. This has given rise to a surge in applying technology in carrying out scholarly research or writing. Some of the AI tools used in carrying out research or writing are ChatGPT, Gemini, DeepSeek, DALL-E, Meta AI, Grammarly, Propensity AI, and Consensus AI. The integration of Al technologies in academic research brings unprecedented opportunities for efficiency, innovation, and the exploration of complex scientific questions. Al empowers researchers to engage in data-driven discovery by efficiently processing and analysing massive datasets. This capability is particularly valuable in fields such as genomics, environmental science, and social sciences, where large-scale data is prevalent.

Al has become a cornerstone in reshaping the landscape of academic research, from data-driven insights to enhanced experimentation and collaboration, the integration of Al technologies offers unprecedented opportunities for researchers to advance knowledge, address complex challenges, and drive innovation across diverse academic disciplines. As the field continues to evolve, embracing Al responsibly and ethically remains crucial for ensuring the integrity and impact of academic research (Bergen*et al.,* 2019).

The use of AI in research writing even with its numerous advantages, comes with its challenges. According to Fasola (2024), LIS educators often face barriers such as limited access to advanced AI tools and inadequate technological infrastructure. These constraints hinder the effective integration of AI into research writing and teaching practices, especially in regions where resources are scarce or rapidly evolving technologies outpace institutional capabilities. According to Gustilo *et al*. (2024), a significant challenge is the perceived lack of knowledge and self-efficacy regarding the use of AI tools. Many educators feel unprepared to utilize AI technologies effectively due to insufficient training and a lack of structured professional development programs.

There are widespread concerns about the impact of AI-driven writing tools on academic integrity, including issues related to plagiarism, originality, and the authenticity of scholarly work. Ali *et al.* (2024) pointed out that educators worry that reliance on AI may undermine creativity and critical thinking, raising questions about the ethical use of such technologies in academic settings. Ali *et al.* (2024) and Luan *et al.* (2020), expressed concerns about data confidentiality and the ethical handling of information generated or processed by AI tools are prominent. Ensuring the privacy of research data and compliance with institutional and legal standards is a persistent challenge for educators using AI in research writing.

Despite high awareness and positive perceptions of AI's potential, actual usage among LIS educators remains limited due to resistance to change (Fasola, 2024). The fast pace of AI development presents a challenge for educators to stay current with new tools and best practices. This resistance is often rooted in uncertainty about the pedagogical value of AI, scepticism about its reliability, and apprehension about shifting traditional teaching and research paradigms. The continual evolution of AI technologies can make it difficult for LIS educators to keep up, leading to a lag in adoption and effective use in research writing(Gustilo *et al*., 2024).

Related Studies

Abdulah*et al.* (2024) investigated artificial intelligence integration in academic writing: insights from the University of Duhok. It employed survey method for the study. A population of 674 postgraduates were involved in the study. The instrument for data collection was questionnaire (Google Forms). The method adopted for data analysis was the frequency counts and simple percentages. The findings indicated that less than half of the respondents had employed Artificial Intelligence Technologies in academic writing. It also revealed that the primary sources of information were friends or colleagues, and social media for the AI technology users. The findings showed that younger individuals and those holding master's degrees used AI in academic writing more than other groups and ChatGPT was the most widely used AI tool used mainly for text paraphrasing and information retrieval. The study concluded that only one-third of University of Duhok faculty members utilize AI and suggested the adoption of AI by postgraduate students and academic staff.

Malik *et al.* (2023) explored artificial intelligence in academic essay: higher education student's perspective. It adopted descriptive survey research design. A total of 245 undergraduate students from 25 tertiary institutions in Eastern and Central Indonesian provinces were used for the study. Structured questionnaire (Google form) was used as the instrument for data collection. Statistical Package for the Social Sciences (SPSS) version 27 was used to analyse the data. The study shows a positive reception of AI-powered writing tools, with students acknowledging their benefits in grammar checks, plagiarism detection, language translation, and essay outlines. It also revealed that AI was found to enhance students' writing abilities, self-efficacy, and understanding of academic integrity though some expressed concerns about potential impacts on creativity, critical thinking, and ethical writing practices. The study emphasised a balanced approach to AI integration, where AI collaborates with human authors. It concluded that AI plays significant role in supporting academic writing but upholds the preservation of human creativity, critical thinking and ingenuity in academic discourse.

Al-Bukhrani*et al.* (2025) examined the Adoption of AI writing tools among Academic Researchers: A Theory of Reasoned Action Approach. The study adopted cross-sectional survey design with a quantitative approach. The population of 150 researchers were used for the study purposive sampling strategy was employed to select the actual participants. Questionnaire was used employed as the instrument for data collection. Data was analysed using the frequencies, percentages, means, and standard deviations. Findings indicate the positive influence of favourable attitudes and subjective norms on intentions to use AI writing tools. It also showed that perceived barriers did not significantly impact attitudes or intentions, suggesting that in the academic context, potential benefits may outweigh perceived obstacles to AI writing tool adoption. The study concludes that strategies focusing on cultivating positive attitudes, leveraging social influence, and addressing perceived barriers could be particularly effective in promoting adoption.

Joseph*et al.* (2024) investigated Artificial Intelligence (AI) in Academic Research: A multi-group analysis of students' awareness and perceptions using gender and programme type. The study adopted cross-sectional survey design with a quantitative approach. The population 5554 comprising of university students in the focal institutions were used for the study. Data was analysed using descriptive statistics. The outcome revealed that students have high level of awareness and positive perception of AI tools in research. It also showed that the level of utilisation of AI tools in research is high. That findings further indicated that perception and awareness directly impacted on utilisation but perception mediates positively and significantly in the nexus between awareness and utilisation. The study concluded that the institutional technology base should be improved to enable students' access to free Wi-Fi so as to utilise AI tools for maximum research outcomes.

Rabbianty*et al.* (2023) investigated AI in academic writing: assessing current usage and future implications. It adopted descriptive survey research design for this study. The study involved 68 faculty members responding to closed and open-ended questions. The sampling method was therefore census technique. The instrument for data collection was questionnaire (Google Forms). Data was analysed using descriptive statistics for the demographic characteristics and thematic analysis for the open-ended responses. Findings reveal widespread adoption of AI tools among faculty members, offering efficiency, productivity, and accuracy benefits in areas like grammar checks, reference management, writing assistance, and plagiarism detection. It also showed concern regarding authorship preservation and maintaining academic work's unique character, emphasizing the need for clear guidelines. It concluded that ethical considerations play a pivotal role in integrating AI into academic writing. Also, the integration of AI in academic writing has the potential to enhance productivity and efficiency while posing challenges to authorship and the natural character of academic works

Hossain*et al.* (2024) studied exploring EFL students' AI literacy in academic writing: insights into familiarity, knowledge and ethical perceptions. It adopted descriptive exploratory approach and data was collected using structured questionnaire. A total of 427 students participated in the study. The study revealed a moderate level of AI familiarity and usage among participants, with a significant reliance on AI tools for translation and grammar proofreading. It also found out that the participants exhibited limited technical proficiency and understanding of AI's underlying mechanisms. It concluded by highlighting the necessity for a more structured and comprehensive integration of AI education in university curricula and provision of adequate support and resources to help students navigate the complexities of AI tools.

Al-Sofi (2024) explored artificial intelligence-powered tools and academic writing: to use or not to use ChatGPT. The study employed a sequential mixed-methods approach using questionnaire and interview. The population of the studies was 117 undergraduate students. Data from the questionnaire were analysed using descriptive statistic while content analysis was used for the interview. The study found out that students were generally satisfied with the effectiveness of ChatGPT in enhancing their academic writing skills. It discovered that some challenges associated with using ChatGPT, included plagiarism, overreliance, inadequate documentation, threats to academic integrity, and inaccurate information. To alleviate these challenges, effective strategies include deploying detection tools, equipping students and educators with training sessions, and revisiting academic policies and assessment methods. It concluded that ChatGPT be used responsibly as an assistant tool, rather than relying on it to generate ideas from scratch or replace the valuable guidance and feedback provided by teachers and supervisors.

Demirel (2024) investigated the use and perceptions towards AI tools for academic writing among university students. Descriptive research design was adopted for the study. A population of 72 students were involved in the study. The sampling method was therefore census technique as result of the size of the population. A combination of qualitative method and comprehensive online survey were used to collect data for the study. Data analysis was done using descriptive statistics. The findings indicated high familiarity with AI among participants, with popular tools like ChatGPT, Grammarly, and Quillbot being frequently utilized. It also revealed that AI tools are predominantly applied to support writing, brainstorming, and research, with a significant number of participants finding them timesaving and resource-accessible though they expressed concerns about AI's accuracy, ethical implications, and the potential for over-reliance. It concluded that clear guidelines and training on ethical AI use should be provides to ensure productive integration of AI into academic practices, benefiting both students and educators.

Ali *et al.* (2024), in the study the effects of artificial intelligence applications in educational settings: challenges and strategies. A total of 69 articles from a 618-article population was selected from diverse academic journals between 2018 and 2023. After a careful review of selected articles, the manuscript presents a classification structure based on five distinct dimensions: user, operational, environmental, technological, and ethical challenges. The current review recommends the use of ChatGPT as a complementary teaching-learning aid including the need to afford customized and optimized versions of the tool for the teaching fraternity. The study addresses an important knowledge gap as to how AI models enhance knowledge within educational settings. For instance, the review discusses interalia a range of AI-related effects on learning from the need for creative prompts, training on diverse datasets and genres, incorporation of human input and data confidentiality and elimination of bias. The study concludes by recommending strategic solutions to the emerging challenges identified while summarizing ways to

encourage wider adoption of ChatGPT and other AI tools within the education sector. The insights presented in this review can act as a reference for policymakers, teachers, technology experts and stakeholders, and facilitate the means for wider adoption of ChatGPT in the Education sector more generally. Moreover, the review provides an important foundation for future research.

Methodology

This study adopted a Descriptive Survey Design. A population of 109 library educators from the area of the study was taken. The population is few and manageable, so, the study employed a total enumerative sampling technique for this study. The study used a questionnaire as the only instrument for data collection. The questionnaire was divided into sections A and B. Section A dealt with the bio-data of the respondents while section B contained questions based on the research objectives of the study using a four-point Likert Scale. The instrument was subjected to face and content validation by experts in LIS and measurement and evaluation to ensure that the content was suitable to extract expected data from the respondents. The inputs of the validators were incorporated into the final document used for data collection. Data collection was done using Google Forms between January and March 2025. The data was analysed using descriptive statistics such as frequency counts, percentages, mean and standard deviations. The mean values above 2.5 were accepted while values below 2.5 were rejected.

Data Analysis

The study involved 109 library educators who completed the survey instrument between January and March 2025. Their responses were analysed using descriptive statistics (mean, standard deviation) and the acceptance benchmark of a mean score of 2.5.

What is the level of awareness of AI technologies for research among LIS educators?

Item	Mean	Standard Deviation	Decision
ChatGPT	3.56	0.60	Accepted
Gemini	3.26	0.74	Accepted
DeepSeek	2.72	0.93	Accepted
DALL-E	2.23	0.87	Rejected
Meta AI	3.62	0.59	Accepted
Grammarly	3.11	0.86	Accepted
Propensity AI	2.28	0.80	Rejected
Consensus AI	2.49	0.90	Rejected
Total	**2.90**	**0.78**	**Accepted**

High awareness by LIS educators was recorded for ChatGPT, Gemini, and DeepSeek. Low Awareness was noted for DALL-E, Propensity AI and Consensus AI. The most familiar AI from the result was ChatGPT (3.56) and the least known AI was DALL-E (2.23). In general, LIS educators can be said to be familiar with AI tools having a mean score of 2.90. This finding is in tendem with those of Demirel (2024)and Rabbianty *et al.* (2023) who indicated high familiarity with AI among participants, with popular tools like ChatGPT, Grammarly, and Quillbot.

What is the extent of use AI technologies for research among LIS educators?

Item	Mean	Standard Deviation	Decision
I use AI technologies to draft my academic writings	2.19	1.10	Rejected
I use AI technologies for generating outlines for my research	2.51	1.01	Accepted
I use AI technologies for formatting my references and citations	2.76	0.94	Accepted
I use AI technologies for summarising my or writing my abstract	3.07	0.76	Accepted
I use AI technologies for proof reading and editing my research	2.94	0.78	Accepted
Total	**2.69**	**0.91**	**Accepted**

The highest mean score 3.07 shows that most LIS educators used AI for summarising and writing abstracts, while very few use it to draft academic writings (2.19). 2.69 mean score shows that AI technologies are used to an extent by LIS educators. This shows that LIS educators most likely used AI for supporting tasks (like summarizing, editing, and citation formatting) than for full-scale draft writing, which still has low acceptance. This finding is supported by a study by Abdulah *et al*. (2024) which indicated that less than half of the respondents had employed AI technologies in academic writing. Respondents agreed that AI technologies improve the ease of research writing and enhance the quality of research output. This was in tandem with Malik *et al.* (2023), study were students acknowledged their benefits in grammar checks, plagiarism detection, language translation, and essay outlines. Joseph *et al.* (2024) also, supported this study in that students have a high level of awareness and positive perception of AI tools in research. In the current study, LIS educators were undecided regarding whether AI technologies lead to reduced critical thinking or plagiarism concerns.

Item	Mean	Standard Deviation	Decision
I use AI technologies to draft my academic writings	2.19	0.60	Rejected
I use AI technologies for generating outlines for my research	2.51	0.74	Accepted
I use AI technologies for formatting my references and citations	2.76	0.94	Accepted
I use AI technologies for summarising my or writing my abstract	3.07	0.87	Accepted
I use AI technologies for proof reading and editing my research	2.94	0.78	Accepted
Total	**2.69**	**0.78**	**Accepted**

The highest mean score 3.07 showed that most LIS educators use AI for summarising and writing abstracts, while very few used it to draft academic writings (2.19). 2.69 mean score showed that AI technologies are used to an extent by LIS educators. The findings indicated that LIS educators sometimes used AI for abstract summarizing, editing, outline generation, and citation formatting. In tandem, Hossain *et al.* (2024) discovered a moderate level of AI familiarity and usage among participants, with a significant reliance on AI tools for translation and grammar proofreading. In the current study, full academic writing using AI is less frequent, suggesting that LIS educators use AI as an assistive tool rather than a replacement for core writing.

What are the challenges associated with the use of AI technologies for research among LIS educators?

Item	Mean	Standard Deviation	Decision
AI technologies are difficult to learn and use	2.11	0.85	Rejected
AI tools are expensive to access	2.46	0.91	Rejected
There are concerns about data privacy when using AI tools.	3.06	0.74	Accepted
AI tools often produce inaccurate or unreliable results.	2.76	0.83	Accepted
AI tools require a strong internet connection to function effectively	3.08	0.77	Accepted

There is limited awareness of AI tools available for academic writing.	2.89	0.63	Accepted
AI tools may not always align with the specific requirements of academic writing guidelines	2.76	0.71	Accepted
AI tools m ake me lazy and affect my creativity	2.71	1.04	Accepted
Total	**2.72**	**0.81**	**Accepted**

The highest mean score of 3.08 showed that the Internet is more of a challenge for LIS educators than learning how to use AI, which had the lowest mean score of 2.11. The total mean score of 2.72 showed that AI has challenges for LIS educators, which must be treated. The data showed that LIS educators do not generally see AI as hard to use or too expensive, but they expressed strong concern about: Data privacy, Internet dependency, inaccuracy and reliability, alignment with academic standards, and impact on creativity. Ali *et al* (2024) was of the view of user interface being the challenge of the AI tools, which needs to have room for creative prompts, training on diverse datasets and genres, incorporation of human input and data confidentiality and elimination of bias.

Conclusion

This study examined LIS educators' perceptions of AI technologies in research writing. Findings revealed a generally high level of awareness and positive perception of AI tools, particularly for tasks such as summarizing abstracts, citation formatting, and proofreading. However, full reliance on AI for drafting academic work remains limited. While educators acknowledged the usefulness of AI in enhancing research quality and efficiency, concerns persist regarding data privacy, internet dependency, and the potential impact on creativity and academic standards. Nonetheless, the tools were not considered difficult to use or prohibitively expensive. Overall, AI technologies are increasingly being integrated into research practices among LIS educators, but their use remains cautious, suggesting the need for more structured support, training, and ethical guidelines.

Recommendations

i. Regular workshops, webinars, and hands-on training should be organized for LIS educators to deepen their understanding and confidence in using AI tools ethically and effectively.
ii. LIS programs should integrate AI literacy and digital scholarship into their curricula to prepare both educators and students for AI-enhanced academic environments.
iii. Educators should be encouraged to use AI as a complementary tool, not a substitute for creativity and critical thinking, to maintain academic rigour and originality in research.
iv. Academic institutions should formulate clear policies and guidelines for the acceptable use of AI in research and academic writing, ensuring that standards for originality, ethics, and intellectual integrity are upheld.

References

Adeleke, R. T. & Ajakaye, J. E. (2023). Personal protection of privacy in the information age. (2023). *Library Philosophy and Practice (e-journal)*. 7871.https://digitalcommons.unl.edu/libphilprac/7871

Abdulah, D. M., Zaman, B. A., Mustafa, Z. R., & Hassan, L. H. (2024). Artificial intelligence integration in academic writing. *Aro-The Scientific Journal of Koya University*, 12(2), 194-200.

Ali, O., Murray, P. A., Momin, M., Dwivedi, Y. K., & Malik, T. (2024). The effects of artificial intelligence applications in educational settings: Challenges and strategies. *Technological Forecasting and Social Change*, 199, 123076.

Al-Sofi, B. B. M. A. (2024). Artificial intelligence-powered tools and academic writing: To use or not to use ChatGPT. *Saudi Journal of Language Studies*, 4(3), 145-161.

Ashraf, S., Beinborn, M., Chikoti, C., & Gezer, D. (2024). Youth shaping the future of science, technology, and education at AI for good. *United Nations Geneva Report*. https://www.ungeneva.org/sites/default/files/2024-07/2024%20GSP%20Report.pdf#page=74, 15/02/2025

Bonk, C. J., & Wiley, D. A. (2020). Preface: Reflections on the waves of emerging learning technologies.

Educational Technology Research and Development, 68(4), 1595–1612. https://doi.org/10.1007/s11423-020-09809-x

Bergen, K. J., Johnson, P. A., de Hoop, M. V., & Beroza, G. C. (2019). Machine learning for data-driven discovery in solid Earth geoscience. *Science*, 363(6433), eaau0323.https://doi.org/10.1126/science.aau0323 PMID:30898903

Bernaerts, S., Van Daele, T., & Carlsen, C. K. (2024). User involvement in digital mental health: Approaches, potential, and the need for guidelines. *Frontiers in Digital Health*. https://www.frontiersin.org/journals/digital-health/articles/10.3389/fdgth.2024.1440660/full

Cavaliere, P., De Souza, D., Fenton, A. L., Giridharan, B., Gralla, C., Inshakova, N., ... &Zaharuk, G. (2020). *Academic misconduct and plagiarism: Case studies from universities around the world*. Rowman & Littlefield.

Cummings, S. (2024). Theoretical AI frameworks in digital practice. *Taylor & Francis*. https://www.tandfonline.com/doi/full/10.1080/0312407X.2024.2356273

Demirel, E. T. (2024). The use and perceptions towards ai tools for academic writing among university students. *Innovations in Language Teaching Journal*, 1(1), 1-20.

Duggleby Wenzel, S., Charest, M., & Pritchard-Wiart, L. (2025). Interpretive description as a qualitative research framework in speech-language pathology: A scoping review. *International Journal of Speech-Language Pathology*, 1-13.

Fasola, O. S. (2024). Awareness, perception and use of Artificial Intelligence tools by LIS educators in Nigerian Higher institutions. *Cybrarians Journal*, (72), 1-20.

Gabi, C. (2022). *Academic writing*. Altralogue Publishing.

Gustilo, L., Ong, E., & Lapinid, M. R. (2024). Algorithmically-driven writing and academic integrity: exploring educators' practices, perceptions, and policies in AI era. *International Journal for Educational Integrity*, 20(1), 3.

Henriksen, D., Mishra, P., Woo, L., & Oster, N. (2025). The Education Doctorate in the Context of Generative Artificial Intelligence: Epistemic Shifts and Challenges to Practical Wisdom. *Impacting Education: Journal on Transforming Professional Practice*, 10(1), 73-79.

Hossain, Z., Çelik, Ö., & Hınız, G. (2024). Exploring EFL students' AI literacy in academic writing: insights into familiarity, knowledge and ethical perceptions. *Journal of Theoretical Educational Science*, 18(1), 157-181.

Laher, S. (2025). Behind the scenes of scholarly success: the critical yet underappreciated role of editing and peer review. South African Journal of Psychology, 00812463251318506.

Liang, Y., You, J., Wang, R., & Han, S. (2024). AI-driven predictive analytics and data visualization. IEEE Access. https://ieeexplore.ieee.org/abstract/document/10543013/.

Luan, H., Geczy, P., Lai, H., Gobert, J., Yang, S. J., Ogata, H., ... & Tsai, C. C. (2020). Challenges and future directions of big data and artificial intelligence in education. *Frontiers in psychology*, 11, 580820.

Osuchukwu, N. P., & Wagwu, V. (2020). The Library and Information Science educator: nurturing for strategic learning experiences. *Folia Toruniensia*, 20, 165-180.

Owan, V. J., & Asuquo, M. E. (2022). "Publish or perish," "publish and perish": The Nigerian experience. In J. A. Undie, J. B. Babalola, B. A. Bello & I. N. Nwankwo (Eds), *Management of higher education systems* (pp. 986-994). University of Calabar Press.

Rabbianty, E. N., Azizah, S., & Virdyna, N. K. (2023). AI in academic writing: Assessing current usage and future implications. *INSANIA: Jurnal Pemikiran Alternatif Kependidikan*, 28(1)

Youn, C. H., Salam, A. R., & Rahman, A. A. (2025). AI-Driven Tools in Providing Feedback on Students Writing. *International Journal of Research and Innovation in Social Science*, 9(3s), 58-67.

Marketing Library and Information Services in the 5th Industrial Revolution

BY

[1]WHONG, Fidelia M. (PhD, CLN), [2]GIMBA, Grace N. (CLN),
[2]ONUNKA, Okeoma (CLN), [3]KAJANG, Victor S. (CLN)
[1]Kashim Ibrahim Library,
Ahmadu Bello University, Zaria, Nigeria
Email: / 08035927624
[2]Library and Information Services Department,
Nigerian Institute of Leather and Science Technology,
Samaru, Zaria, Nigeria
Email: gracesunny99@gmail.com /07068335767.
Email: okeonunka@gmail.com / 08032964734.
[3]Library and Information Services Department,
National Research Institute for Chemical Technology,
Basawa – Zaria, Nigeria.
Email: kajhvictor73@gmail.com / 08167248379.

Abstract

This paper examined the evolving role of marketing strategies with library and information services in the context of the 5th Industrial Revolution which has fundamentally transformed how information is accessed, organized, shared, and consumed. Libraries now faced with challenges and opportunities of integrating the 5th Industrial Revolution technologies, such as Artificial Intelligence, Blockchain, Machine Learning, Internet of Things, with human creativity and innovation into their marketing strategies to remain relevant and meet the needs of modern users. The study explored marketing library and information services in the 5th Industrial Revolution. It highlights how libraries can leverage these emerging technologies to enhance marketing library and information services delivery, improve users' engagement, increased accessibility, and social media platforms in marketing and disseminating library resources. The paper concludes with recommendations for policy-makers, library managers, and information professionals to adopt innovative marketing approaches to enhance users satisfaction and sustain the relevance of libraries in the future digital economy.

Keywords: Library and Information Services, Marketing, 5th Industrial Revolution

Introduction

In the era of the 5th Industrial Revolution (5IR), landscape of library and Information Services (LIS) has evolved significantly over the past few decades, with technological and societal needs continually shaping its studies and functionality. The 5th Industrial Revolution (5IL) makes a transformative shift in the way industries, businesses, and services operate, driven by the convergence of advanced technologies such as Artificial Intelligence (AI). Chai (2023) states that libraries are embracing those technologies to improve their services and offer new ways for users to access and interact with information. The 5th Industrial Revolution is not only characterised by the emerging technologies but also by the increasing importance of human-centric, collaborative systems, making it essential for libraries and information professional to rethink their marketing strategies.

Marketing library and information services play a crucial role in ensuring the accessibility, organisation, and dissemination of information in this digital era. Marketing library and information services involves a dynamic combination of communication strategies aimed at reaching diverse users groups, promoting engagement, and fostering community collaboration (Harrison, 2024). Libraries have historically been centres of learning, knowledge management, and community engagement. However, in the 5th Industrial Revolution, libraries and information services must adapt marketing strategies to cater to the diverse needs of users who are more accustomed to accessing information digitally. This includes leveraging big data to understand users behaviour, implementing AI-driven recommendation systems and utilising social media and other digital channels to engage with users (Morse, 2020). Marketing strategies must therefore align with the broader goals of libraries, ensuring accessibility, inclusivity and the promotion of digital literacy.

Libraries are undergoing a significant transformation due to digital disruption. Traditionally, libraries were custodians of knowledge; however, the 5IR demands libraries evolve into proactive facilitators of knowledge co-creation and emotional engagement. The integration of AI, robotics, and virtual reality (VR) allows libraries to provide personalized, immersive, and interactive services (IFLA, 2022). The integration of marketing with library and information services ensures that these institutions remain essential pillars in knowledge dissemination and community development (Mehra & Bilal, 2020). In this context, library and information services (LIS) must evolve their marketing strategies to reflect the values and capabilities of 5IR. Traditional LIS marketing focused on access, awareness, and education. In contrast, 5IR compels LIS

to adopt more personalized, socially conscious, and technologically sophisticated marketing approaches. This involves using AI for user behavior analysis while ensuring ethical data use, leveraging collaborative robots (cobots) in service delivery, and promoting sustainable digital practices (Baryshev et al., 2021). Therefore, as information are being more fragmented and personalised, libraries must navigate the complexity of managing and marketing vast amount of data and resources to ensure they remain relevant and accessible to a global audience.

Marketing Library and Information Services Strategies in the 5th Industrial Revolution

The marketing of library and information services has undergone a significant transformation with the advent of digital technologies especially in the 5th Industrial Revolution. Social media platforms, email campaigns, Search Engine Optimization (SEO), and other online marketing tools are now essential for libraries to reach out to diverse users groups and promote their services (Guthrie, 2020). These platforms enable libraries to engage with patrons in real time, understand their preference through analytics, and create targeted marketing strategies that are more aligned with users needs, reshaping the world and changing expectations of library users. Therefore, marketing library and information services in the 5IR requires a blend of advanced technologies and human-centric values. It promotes services not just as informational repositories but as active contributors to equitable knowledge ecosystems, fostering a balance between automation and empathy. The following marketing strategies have become integral to successful promotion of library and information services.

i. Digital Presence and Online Engagement

With an increasing number of users turning to digital platforms for information, maintaining a robust online presence is crucial for libraries. Digital marketing through social media, email newsletters, and website optimization enables libraries to reach users globally. Online Engagement goes beyond digital activity; it reflects a two-way, interactive relationship between libraries and users. For example, the University of Toronto Libraries leverage social media platforms and their interactive website to offer tutorials, highlight resources, and engage with students and faculty (Peterson & Wright, 2024).

ii. Personalization and Data Analytics

As data analytics becomes more accessible, libraries can gather insights into user behavior and preferences. By analyzing usage patterns, libraries can tailor their marketing campaigns and recommend resources that are most relevant to users. The use of machine learning algorithms allows libraries to offer personalized services, enhancing user satisfaction and engagement (Baker, 2023). The emphasis on human emotions in 5IR enables libraries to build deeper user relationships by designing services that resonate with individual values and emotional needs (Morrar et al., 2017).

iii. Artificial Intelligence (AI) and Chatbots for User Interaction

Artificial Intelligence (AI) powered tools, such as chatbots, are transforming the way libraries interact with users. Chatbots provide instant responses to queries, help users navigate library systems, and even assist with administrative tasks. These tools enable libraries to offer real-time support, enhancing user satisfaction while reducing the workload for staff (Li & Zhang, 2022). AI-driven algorithms enable customized content delivery, enhancing user engagement through tailored recommendations and adaptive interfaces (Al-shboul et al., 2021).

iv. Collaborative Platforms and Community Engagement

In the 5th Industrial Revolution (5IR), collaboration and community-centred values lie at the core innovative and services delivery. The 5IR emphasizes collaborative approaches to innovation. Libraries market their services through collaborative knowledge-sharing platforms such as community forums, social media, and educational networks, strengthening visibility and accessibility (Kaur & Rani, 2020). Marketing strategies that focus on promoting collaborative spaces, such as makerspaces and digital learning environments, can attract new audiences and strengthen the library's role as a community resource. For instance, the Boston Public Library has introduced innovation hubs where users can collaborate on projects, access digital tools, and engage in community-driven initiatives (Gonzales & Westbrook, 2023).

v. Content Marketing and Educational Outreach

Content marketing has emerged as a critical tool for libraries in the 5IR. By creating valuable content, such as blogs, podcasts, webinars, and online tutorials, libraries can position themselves as authoritative sources of knowledge. Educational outreach programs that emphasize lifelong learning, digital literacy, and information skills are essential in promoting the evolving role of libraries in society (Harrison, 2024).

Furthermore, digital marketing techniques have expanded the scope of libraries beyond physical location. Virtual events, online workshops, webiners, and digital resources are now marketed extensively to cater to a global audience, and libraries are increasingly becoming hubs for digital literacy and online learning (Young, 2021).

Challenges

Despite these advancements, the 5th Industrial Revolution technological innovations present numerous opportunities, they also introduce several challenges in marketing library and information services. These include:

i. **Technological Disruption and Adaptation:**
Libraries must constantly integrate emerging technologies such as AI-driven search engines, personalized information services, and virtual/augmented reality learning spaces. The rapid pace of these advancements makes it difficult for many LIS institutions to keep up (Obinyan & Udem, 2021).

ii. **Digital Inequality:**
While 5IR emphasizes inclusivity, disparities in digital access still limit the effectiveness of marketing efforts, especially in developing countries. Many users lack the digital literacy or access to fully engage with online LIS services (Iwhiwhu, Ruteyan, & Eghwubare, 2018).

iii. **Lack of Marketing Skills and Strategies:**
Library professionals often lack formal training in marketing, leading to underutilized services. Traditional promotion techniques are inadequate in the digital era where data-driven, targeted marketing is essential (Aderibigbe & Farouk, 2022).

iv. **Changing User Expectations:**
Modern users expect personalized, on-demand, and mobile-friendly services. Libraries that fail to adapt their service delivery models to these expectations risk becoming irrelevant (Nwalo & Anasi, 2020).

v. **Ethical Concern and Data Privacy**
With the growing emphasis on data-driven marketing and personalised services raises users privacy issues, impacting trust in library and information services. Concerns about data privacy regulations while still leveraging data analytics for marketing purposes (Sign & Gupta, 2024).

Conclusion

As the world transitions into the 5th Industrial Revolution, an era characterised by synergy of advanced technologies and human-centred values, libraries are no longer just repositories of information; they are dynamic, user-centric environments that leverage emerging technologies to enhance user engagement, accessibility, and value that involves the strategic use of digital tools, data analytics, and innovative technologies to engage users and provide personalized experiences. Marketing in this new era must move beyond traditional outreach to embrace interactive, data-driven, and inclusive approaches that reflect the diversity of user needs and the ethical responsibilities of information institutions. By aligning their marketing strategies with the humanistic principles of the 5IR, libraries and information services can foster stronger community connections, improve digital equity, and ensure that technological advancements serve to empower rather than alienate users. Therefore, the need for policy-makers, library managers and information professionals to leverage on the 5th Industrial Revolution emerging innovative technologies marketing approaches to enhance users satisfaction and sustain the relevance of libraries in the future digital economy as institutions with essential components of future knowledge societies and community development.

Way Forward

The 5th Industrial Revolution presents an opportunity to rethink digital presence as not just a technological function but a collaborative ecosystem where human librarians work alongside intelligent system with human values, creativity and emotional intelligence. Some of the way forward include but not limited to:

i. Adopt Human-Cantered Digital Marketing which libraries should use 5IR tools to create user-focused experiences employing AI to personalize services, chatbots for instant support, and social media analytics for targeted outreach.
ii. The libraries should regularly train library professionals in digital marketing, data analytics, and customer relationship management which will empower staff to design and implement effective strategies.
iii. There should be collaboration and partnership of librarians with technology firms and academic institutions which can help libraries access innovations they may not afford independently and promote co-created value.
iv. There are needs to bridge the digital divide and proactive outreach to underserved communities, mobile LIS services, and digital literacy programs can ensure inclusivity and expand user engagement.
v. Need for ethical consideration and data privacy in marketing library services. While the 5th Industrial Revolution marketing library and information services offer numerous advantages. It also raises ethical concerns particularly related to user privacy and data security. The collection and analysis of users data for personalised marketing, through beneficial, must be balanced with considerations for privacy rights and data protection. Libraries must adhere to strict ethical

guidelines in handling users' data, ensuring transparency and safeguarding against misuse. There is need to develop transparent policies for data use in services personalisation and marketing, enhancing users trust.

References

Al-shboul, M., Ghaleb, O., & Al-Sayyed, R. (2021). "Artificial Intelligence and Marketing: A Literature Review." *International Journal of Business and Management*, 16(3), 45–56.

Baker, T. (2023). "Data-Driven Library Services: Leveraging Machine Learning for Personalization." *Library Science Quarterly*, 45(2), 76-89.

Baryshev, A. A., Ivanov, A. V., & Petrenko, A. I. (2021). "Human-centric approaches in Industry 5.0: Ethical and technological perspectives." *Procedia Computer Science*, 190, 482–487. https://doi.org/10.1016/j.procs.2021.06.063

Blair, D. (2023). "Overcoming the Digital Divide in Libraries." *Information Accessibility Review*, 31(4), 53-67.

Choi, S. (2023). "Technological Advancements in Libraries: Adapting to the 5IR." *Journal of Library Innovation*, 39(1), 98-115.

Gillis, A., & McKnight, M. (2022). "Ethical Marketing in Library Services: Protecting Users Privacy in the Digital Era." *Information and Ethics Review,* 19(1), 88-102.

Gonzales, P., & Westbrook, L. (2023). "Collaborative Libraries: Building Community and Innovation Hubs." *Community Library Review*, 12(3), 120-135.

Guthrine, T. (2020). "Social Media and Library Marketing: A Strategic Approach." *Library Management*, 41 (4), 303-314.

Harrison, A. (2024). "Content Marketing in Libraries: Strategies for Engaging Users." *Journal of Digital Library Marketing*, 29(2), 45-58.

Harrison, L. L., & McManus, S. (2019). Libraries and the digital age: Navigating the new landscape. Oxford University Press.

IFLA. (2022). Emerging Trends in Libraries: A Global Perspective. International Federation of Library Associations and Institutions.

Kaur, K., & Rani, S. (2020). "Digital Marketing Strategies for Library Services in the Knowledge Society." *Library Philosophy and Practice*, Article 4209.

King, R. (2023). "User-Centered Design in Library Websites." *Library Technology Today*, 41(1), 10-19.

Li, Y., & Zhang, H. (2022). "AI and Chatbots: Transforming Library User Services." *Library Technology Trends*, 26(3), 34-47.

Mehra, B., & Bilal, D. (2020). Marketing Libraries: New Perspectives and Practices in a Digital world. Emerald Group Publishing.

Morrar, R., Arman, H., & Mousa, S. (2017). "The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective." *Technology Innovation Management Review*, 7(11), 12–20.

Morse, K. (2020). Big data, AI, and the Future of Libraries: Strategies for Success. Information Today, Inc.

Peterson, J., & Wright, R. (2024). "Engaging Students Through Social Media: The Role of Libraries in Higher Education." *Journal of Academic Libraries*, 35(4), 222-234.

Singh, P., & Gupta, M. (2024). "Data Privacy and Security in Library Marketing." *Journal of Information Ethics*, 17(1), 76-89.

Stevenson, S., & Walker, J. (2022). "The Challenges of Keeping Up with Technological Advances in Libraries." *Library Administration and Management*, 38(2), 56-72.

Young, M. (2021). "Virtual Library Events and Marketing in the Digital Age." *Library Trends*, 69 (2), 105-120.

Open Educational Resources in the 5th Industrial Revolution: Awareness and Utilization in two Selected Higher Institutions in Kaduna State

Yohanna, Zugwai Isah
National *Water Resources Institute Mando, Kaduna State*
calebzugwai@gmail.com
+2348084794353

Ikegwuiro, Patience Uloaku
National Water Resources Institute Mando, Kaduna State
bankike2@gmail.com
+2348032294537

Anate, Michael Gbenga
Ahmadu Bello University Zaria, Kaduna State
gbemigamichael@gmail.com
+2347035405973

Egwuibe, Martina O.
National Library of Nigeria Kaduna Branch,Nigeria
Martinaegwuibe@gmail.com
07034973996

Abstract

This study investigated the level of awareness and the extent of open educational resource (OER) utilization as a vital tool in reshaping higher education by providing accessible, cost-effective learning materials in the 5th Industrial revolution marked by the integration of advanced technologies among students of higher institution. The study employed descriptive survey design using a structured questionnaire in Google Form to gather information from 60 students using a total sampling technique. The questionnaire was distributed via WhatsApp groups affiliated with the selected higher institutions and through students email addresses. The collected data was analyzed using descriptive statistics. The findings reveal that while there is a growing awareness of OERs, specialized institutions like NWRI and AFIT still reveals low level of awareness and their actual utilization is hindered by factors such as lack of institutional support, limited digital literacy, and insufficient infrastructure. Thus students possess a comprehensive awareness of the fundamental concepts of OER, its benefits, different forms, and distinctions from other electronic information resources. The study concludes that while there is a high level of awareness of OER among students in higher education, there is a significant gap in the utilization of OER in the 5th industrial revolution among students in higher institutions. Higher institutions should increase investment in OER awareness campaigns, training, and technological infrastructure to harness the full potential of OERs in the 5th Industrial Revolution. Higher institutions should also develop policies that encourage the adoption of OERs to foster collaboration among institutions, educators, and policymakers to overcome existing challenges.

Keywords: *5th Industrial Revolution, Open Educational Resources, OER awareness, OER Utilization, Higher Institution*

INTRODUCTION

The rapid advancement of technology continues to transform education worldwide. The emergence of the 5th industrial revolution marks a new era of collaboration between humans and intelligent systems to enhance creativity, learning and accessibility. Unlike the 4th Industrial Revolution (4IR), this focused on digitization and automation. The 5th industrial revolution centers on human technology, AI, sustainability and digital inclusivity. This revolution envisions advance technologies integration across various sectors, to include education and library services to foster equitable learning environment. Open Educational Resource (OERs) is the key driver of educational transformation. UNESCO defined it as freely accessible and openly licensed teaching, learning and research materials. It enables educators and learners retain, reuse, revise, remix and redistribute content supporting the goals of the 5IR Open Educational Resources (OER) have emerged as a transformative force in higher education, promoting equitable access to quality learning materials, reducing costs, and fostering global knowledge sharing. According to Ekwueme et al. (2024), OERs promotes access to high – quality educational materials which encourages global knowledge sharing. Examples of OER includes: Open Couresware, learning modules, open textbooks, streaming videos, open access journals, online tutorials and digital learning objects. Despite the significant potential of Open Educational Resources (OERs) to reshape higher education, awareness and utilization of these resources remains uneven, particularly in developing regions. Specialized institutions such as National

Water Resources Institute (NWRI) and the Air force Institute of Technology (AFIT) in Kaduna State, Nigeria represent key contexts to examine how OER awareness and Utilization are integrated within the 5IR framework. Understanding the level of awareness and utilization can provide insight on how to leverage technology in fostering innovation, inclusiveness and sustain knowledge sharing.

This study aims to assess the awareness and utilization of Open Educational Resources in NWRI and AFIT within the 5th industrial revolution framework. The researchers seek to communicate strategies for enhancing OER integration in specialized higher institutions, ensuring that the benefits of 5IR are fully realized to dancing education and research.

Open Educational Resources

The concept of openness has evolved over time (Sushma, 2021). The "open" movement grew out of a desire to meet the demands of many technologies, groups, and communities. The ideals of "open" were embraced by open universities about a century ago to reflect "learning 'anywhere, anytime' and open entry and exit points, which were the basis of open universities and as well as its correspondence and distant learning models" which made learning just a click away with the Open Movement. The term Open Educational Resources (OER) was first used at a UNESCO conference to refer to offering free global access to high-quality educational resources. OER is defined as "digitized materials supplied freely and openly for educators, students, and self-learners to use and reuse for teaching, learning, and research". The 5R concept of OER (i.e.: Retain, Reuse, Revise, Remix and Redistribute) gives the opportunity for the course designers to modify the course as per the course objectives and requirements (Sandanayake, 2019).

UNESCO define Open Educational Resources (OER) as freely accessible teaching, learning, and research materials available in the public domain or under open licenses which plays a crucial role in bridging the digital divide and expanding educational opportunities.

In higher institutions, OER has revolutionized teaching and learning by providing customizable, up-to-date, and cost-effective resources that align with the principles of 5th Industrial Revolution (5IR). However, despite the potential benefits, awareness and utilization of Open Educational Resources (OER) remain inconsistent across academic institutions, particularly in developing regions where digital transformation is still evolving. Open Educational Resources (OER) are text, media, and other digital assets that are freely available, openly licensed, and can be used for research, teaching, learning, and assessment (UNESCO, 2020).

Examples for Open Educational Resources:

1. **Open Courseware: Open Course Ware (OCW**) is a free and open digital publication of high-quality educational materials for college and university students. These materials are structured into courses, and they frequently include materials for course preparation and evaluation, as well as topic content."
2. **Learning Modules**: "A learning module is a tool that distributes course materials in a logical, sequential order, guiding students through the subject and assessments in the order chosen by the instructor," according to Wikipedia. Instructors can add prepared text, files, online links, discussion topics, assignments, tests and quizzes, and evaluations in the near future. Students can be required to complete content if it is arranged in a certain way.
3. **Open Textbooks**: Faculty generally write open textbooks, which are then released on the web with the help of institutions or new commercial firms. This new business model allows textbooks to be accessed for free online.
4. **Streaming Videos**: Streaming video is content that is supplied over the Internet in compressed form and shown in real time by the viewer. A Web user does not have to wait for a file to download before playing it with streaming video or streaming media.
5. Instead, the media is delivered as a continuous stream of data, which is played as it arrives. A player, which is a particular programme that uncompressed and transfers video data to the computer, is required by the user.
6. **Open Access Journals**: Open access journals provide "free, immediate, online availability of research articles combined with the rights to use these articles fully in the digital environment. Open access is the needed modern update for the communication of research that fully utilizes the Internet for what it was originally built to do accelerate research.
7. **Online Tutorials**: self-study activity designed to teach a certain learning result is known as an online lesson. They are typically given through a course management system, although they can also be delivered via the Internet or on DVD. Online tutorials are divided into two categories:
8. Recorded tutorials are video or screencast recordings, typically of a subject expert presenting information and ideas or giving a demonstration. Interactive tutorials are a structured collection of navigable web pages. Individual pages can contain any combination of text, images, audio, video, self test questions and other interactive activities. Interactive tutorials can also contain screencasts.
9. **Digital Learning Objects:** Small, modular, discrete units of learning built for electronic transmission and application are known as digital learning objects. A learning object is "packed" to

include a lesson, an activity, and an assessment to promote reuse with minimal effort. The most reusable learning items will have a tangible and core learning outcome that can be applied to a wide range of courses.

Sushma (2021).

Statement of the Problem

The advent of the 5th Industrial Revolution (5IR) has ushered in a new era of human-machine collaboration, emphasizing the integration of advanced technologies with human intelligence and creativity. Open Educational Resources (OER) play a crucial role in this transformation by providing free, high-quality, and accessible educational materials to enhance learning and skill development. However, the level of awareness and utilization of OER in institutions of higher learning, particularly in specialized institutions such as the National Water Resources Institute (NWRI) and the Air Force Institute of Technology (AFIT) in Kaduna State, Nigeria,

remains unclear. Despite global efforts to promote OER as a means of making education accessible and fostering innovation, several challenges persist, including low awareness, limited digital infrastructure, inadequate staff engagement, and resistance to adopting open-access materials. If these institutions fail to leverage OER effectively, they risk falling behind in the rapidly evolving landscape of education and technological advancement.

The study seeks to investigate the level of awareness and utilization of OER in National Water Resources Institute (NWRI) and Air force Institute of Technology (AFIT), examining the barriers and facilitators influencing their adoption. Understanding these factors will provide insights into how these institutions can harness OER to align with the demands of the 5th Industrial Revolution, ultimately enhancing knowledge dissemination, research, and skill acquisition.

Objectives of the study

1. The primary objective of this study is to assess the awareness and utilization of Open Educational Resources (OER) in the National Water Resources Institute (NWRI) and the Air Force Institute of Technology (AFIT) within the context of the 5th Industrial Revolution (5IR).
2. Determine the level of awareness of OER among students at NWRI and AFIT.
3. Examine the extent of utilization of OER in learning, and research within these institutions.

   By achieving these objectives, the study will provide valuable insights into how OER can be effectively integrated into specialized higher education institutions to foster innovation, accessibility, and sustainable knowledge sharing.

Research Questions

1. What is the level of awareness of Open Educational Resources (OER) among students at NWRI and AFIT?
2. To what extent are OER utilized in learning, and research activities within these institutions?
3. What are the major challenges and barriers hindering the adoption and effective use of OER in NWRI and AFIT?

   These research questions will guide the study in exploring the role of OER in higher education and its potential to transform learning and research in specialized institutions.

Literature Review

Open Educational Resources have been recognized globally for their potential to expand learning opportunities in academic environments. Mncube and Mthethwa (2022) emphasis that OERs have widened the scope of learning in higher education by providing diverse teaching and learning materials. Dsouza (2021) found that both staff and students at St. Joseph Engineering College (SJEC), located in Mangaluru, Karnataka India exhibited high level of awareness supported by institutions efforts and library services.

Similarly, Bakrin (2024) reported that library personnel in South-West Nigerian universities had a solid understanding of OER concepts and benefits, although the available materials were limited in coverage and currency. Karitu (2022) also supports the link between awareness and utilization, showing that increased OER awareness significantly contributes to usage among postgraduate students. These studies highlights the importance of awareness campaigns and institutional support in driving OER engagements, a critical consideration in the context of institutions like NWRI and AFIT in Kaduna State.

Despite rising awareness, actual utilization of OERs remains inconsistent. Samy and Jeyshankae (2023) reported that postgraduate science students in Alagappa University Tamilnadu faced multiple barriers to effective OER utilization, including low quality, limited repositories and poor download speeds. . Sulekha, and Ram,(2022) noted that while research scientists at Kuruksheta University were aware of online resources, challenges such as inadequate customization limited their use. Nayantara (2018) highlighted that although the faculty was familiar with the concept of OERs, uncertainly about classroom implementation hindered adoption.

In Nigeria, Priya (2024) found that teachers in rural arrears struggled to integrated OERs into their teaching due to poor internet access, inadequate training and lack of practice in sourcing materials. This is supported by Joshua (2020) who noted that lack of training and perceived time consumption were major deterrents to faculty usage of OERs. These findings point to a critical need for institutional training and infrastructure support factors this study will explore within NWRI and AFIT. A recurring theme in the literature is the presence of structural and technical barriers to OER adoption. As noted by Samy and Jeyshankar(2023), issues such as inadequate technology, repository limitations and slow download speeds persist. Priya(2024) and Josua (2020) both emphasized the role of insufficient training and digital skills as limiting factors, especially in under resourced areas. Even in institutions where awareness exists, such as those examined by Bakrin (2024), the lack of regular updated and comprehensive OER collections impedes effective use.

These challenges are particularly relevant in the context of Nigerian institutions like NWRI and AFIT, where resources availability, policy support and digital infrastructure vary significantly. Exploring these factors within the framework of the 5th industrial revolution provides a valuable lens of this study.

RESEARCH METHODOLOGY

This study adopted a quantitative survey research design to examine the level of awareness and utilization of Open Educational Resources (OERs) in the context of the 5th industrial revolution among students at the Air Force Institute of Technology (AFIT) and the National Water Resources Institute (NWRI) Kaduna State, Nigeria. The target population comprised students enrolled in various programs at AFIT and NWRI .

Data were collected through a structured questionnaire designed using google forms. The questionnaire consisted of both closed – ended and likert- scale items that measured student's awareness, utilization and perceived barriers to the use of OERs.

The questionnaire link was distributed electronically through WhatsApp platforms to selected students from both institutions. This method was adopted to facilitate wider reach and participation, given the convenience and accessibility of digital communication among students. A total of fifty three (53) responses were retrieved, representing a response rate of 88.3%.

The collected data was analyzed using descriptive statistics (frequencies and percentages) to summarize the responses.

Analysis and Discussion of Result

Table 1:1 Field of Study/Discipline

Response	Frequency	Percentage
AFIT	26	49.1%
NWRI	27	50.9%
TOTAL	**53**	**88.3%**

Table 1 shows that, among 53 respondents 27 which is 50.9% came of Air force Institute of Technology (AFIT) Kaduna students and 26 made up of 49.1% are students of National Water Resources Instituted Mando Kaduna State. The overall responses are 88.3%.

Table 2: Have you heard of Open Educational Resources (OER)?

Response	Frequency	Percentage
Yes	21	39.6%
No	32	60.4%
TOTAL	**53**	100%

Table 2, Findings from the study indicates a low level of awareness of OER among students in both institutions. As shown in Table 2, 60.4% of respondents reported they had never heard of OER, while only 39.6% had heard of it. This suggests a significant awareness gap.

Table 3: I**f yes, how did you hear about OER? (Select all that apply)**

Response	Frequency	Percentage
Social Platforms	10	47.6%
Lecturers	3	14.3%
Library	8	38.1%
Total	**21**	**100%**

Regarding the sources of awareness, Table 3 reveals that 47.6% of those aware of OERs learned about them via social platforms, while 38.1% cited libraries and only 14.5% mentioned their lecturers. This shows that institutional channels such as lectures and libraries are underutilized in promoting OER awareness.

Table 4: How knowledgeable are you about OER?

Response	Frequency	Percentage
No Knowledge	32	60.4%
Low Knowledge	11	20.8%
Moderate Knowledge	10	18.9%
Very high knowledge	-	-
TOTAL	**53**	**100%**

Additionally, Table 4 shows that 90.4% of respondents had little or no knowledge about OER, further emphasizing the critical need for awareness campaigns within these specialized institutions.

Table 5: Are there institutional policies known that promote the use of OER in your institution

Response	Frequency	Percentage
Yes	13	24.5%
No	40	75.5%
TOTAL	**53**	**100%**

Table 5 shows that 75.5% of respondents are unaware of any institutional policies that promote OER usage, which implies a lack of institutional support and structure.

SECTION C: Utilization of OER in Higher Institutions

Table 6: Have you ever used OER for academic purposes?

Response	Frequency	Percentage
Yes	21	39.6%
No	32	60.4%
TOTAL	**53**	**100%**

Table 6 shows that 60.4% of respondents have never used OERs for academic purposes, which confirms that OER utilization is relatively low.

Table 7: If yes, which of the following types of OER have you used? (Select all that apply)

Response	Frequency	Percentage
Open CourseWare(OCW)	6	28.6%
OpenLearn(by the Open University)	0	-
OER Commons	2	9.5%
Coursera (Free course and Audit option)	11	52.4%
edx (Audit free courses)	0%	-
UNESCO Open Learning Platforms	0%	-
UNESCO Online Training Valuing Ware'	0%	-
WIZAPE (Integrated Water Resources Management Courses)	0%	-
Coursera (Water Resources Management Policy)	0%	-
U. S. Geological Survey (USGS) Water Resources Education	0%	-
WIZAPE (Water Resources Management and Conservation Course)	2	9.5%
TOTAL		**100%**

Among those who use OERs, Coursera (52.4%) is the most accessed platform (Table 7), followed by Open CourseWare (28.6%), and OER Commons (9.5%). This suggests students may be more familiar with branded platforms than with institutional or general OER repositories.

Table 8: How frequently do you use OER?

Response	Frequency	Percentage
Never	0	-
Rarely	9	42.9%
Sometimes	7	33.3%
Often	5	23.8%
Very often	0	0%
TOTAL	**21**	**100%**

Table 8 also indicates that 42.9% of students rarely use OERs, which aligns with the general trend of low awareness..

Table 9: What is the primary purpose of your use of OER?

Response	Frequency	Percentage
Learning	17	80.95%
Research	4	19.04%
TOTAL	**21**	**100%**

However, Table 9 shows that 80.95% of those who use OERs rely on them primarily for learning purposes, suggesting that students see value in OERs for enhancing their academic knowledge beyond the classroom

Table 10: What challenges do you encounter when accessing or using OER

Response	Frequency	Percentage
Poor connectivity	11	52.4%
Inadequate digital literacy skills	3	14.35%
Inadequate institutional support policies	6	28.6
Language limitations of available OER	-	-
I do not encounter any challenges	1	4.8%
Total	**21**	**100%**

According to Table 10, the most significant challenge faced by respondents is poor internet connectivity (52.4%), which affects access and limits usage. Furthermore, These findings highlight two key barriers:

1. Infrastructural limitations, particularly internet access, which directly affects the availability and smooth use of OERs.
2. Policy and institutional gaps, including the absence of known strategies, policies, or formal promotion efforts within the institutions.

These findings underscore the urgent need for structured awareness programs, faculty training, and institutional policies to support the integration of OERs in learning and research activities, especially within specialized institutions like NWRI and AFIT. Leveraging platforms already known to students (e.g., Coursera) may serve as a gateway to deeper OER engagement when combined with improved internet infrastructure and policy backing.

DISCUSSIONS

The study revealed a low level of awareness and utilization of Open Educational Resources (OER) among students of NWRI and AFIT, two specialized higher institutions in Kaduna State.

Despite the global shift toward digital and open learning environments encouraged by the 5th Industrial Revolution (5IR), the findings highlight a significant gap in exposure to and integration of OER within these institutions.

These results align with studies by Samy & Jeyshankar (2023) and Priya (2024), which emphasized challenges such as low digital literacy, inadequate awareness, and infrastructural limitations. The predominance of social platforms as the primary source of OER awareness further suggests that

institutional support mechanisms—like libraries and faculty-led initiatives are underutilized or ineffective in disseminating OER information. Utilization rates remain low, with over 60% of students reporting they have never used OERs for academic purposes. However, those who have engaged with OERs primarily use platforms like Coursera, indicating a preference or reliance on well-known branded educational services rather than institutional repositories. This supports Dsouza (2021), who found that structured institutional efforts increase OER usage. The absence of institutional policies (noted by 75.5% of respondents) further hampers OER integration. As Bakrin (2024) suggested, policy frameworks are crucial to legitimizing and scaling OER usage in academia. For these institutions to align with 5IR goals, especially innovation, inclusivity, and digital advancement, they need to develop comprehensive OER policies, invest in infrastructure (e.g., stable internet), and promote faculty and student training. Libraries and faculty members should lead awareness campaigns, and digital literacy programs. This study relied on self-reported data from a limited sample size and only two institutions, which may not fully represent the broader academic context in Nigeria.

Conclusion

The 5th Industrial Revolution (5IR) presents a unique opportunity for higher institutions, particularly specialized institutions like NWRI and AFIX, to leverage Open Educational Resources (OER) to enhanced learning, research, and skill development. By fostering awareness and promoting the effective utilization of OER, these institutions can bridge knowledge gaps, improve accessibility, and enhance the quality of education. With strategic collaborations, continuous capacity-building, and institutional commitment, maximum benefits of OER will be achieved by students ensuring a more inclusive and innovative educational landscape

Recommendations

The finding of this study reveals a significant gap in the awareness and utilization of Open Educational Resources (OERs) within special higher institutions with only 39.6% of respondents indicating familiarity and usage. Given the transformation of the 5th industrial revolution (5IR) marked by fusion of artificial intelligence, human – machine collaboration and personal learning. To enhance the awareness and utilization of Open Educational Resources (OERs) in institutions during the 5th industrial revolution, institutions should implement policies and institutional support which may include awareness campaigns and workshops, curriculum integration, policy and incentives, technological infrastructure with collaboration and partnerships. Implementing these recommendations, special higher institutions will be able to align with demands of 5IR while promoting equitable and sustainable quality education through OERs. Further research should include a broader range of stakeholders, including lecturers and librarians, to assess institutional readiness and develop tailored interventions for OER adoption. Exploring faculty perceptions and barriers could offer deeper insight into systemic challenges.

REFERENCES

Ahmed I. I., Mukhtar A I, Amos O O, & Adenike A O. (2020). Undergraduates' Attitude towards the Utilization of Open Educational Resources for Learning. International Journal of Technology in Education and Science. V(4) Issue 3, ISSN: 2651-5369 https://www.researchgate.net/publication/38185570.

Dsouza. F, (2023). Awareness and Use of Open Educational Resources: A study. Library Philosophy and Practice (e-journal). https://digitalcommons.unl.edu/libphilprac.

Ekwueme. B. O, Oluwaseun, Ifeoma A. A, Patricia N. O & Smart E. A. (2024).The impact of 5th industrial revolution technologies on academic libraries: improving diversity and inclusive services in open and distance learning Indonesian. Journal of Library and Information Science E-ISSN: 2747-2140, P-ISSN: 2747-2132 Volume 5. No (2) DOI: 10.22373/ijlis.v5i2.604.

Dr. Indrajeet Dutta, (2016). Open Educational Resources (OERs): Opportunities and Challenges for Indian Higher Education. Turkish Online Journal of Distance Education. ISSN 1302-6488 V(17) Number: 2 https://www.researchgate.net/publication/387488722

Liz Murugi Karitu & Grace Kimani, (2022). Assessment of Utilization of Open Education Resources by Postgraduate Students in Selected Public University Libraries in Kenya. International Journal of Current Aspects, V(6) Issue 3, PP 2242, ISSN 2707-8035.

Mncube, L. S., & Mthethwa, L. C. (2022). Potential Ethical Problems in the Creation of Open Educational Resources through Virtual Spaces in Academia. Heliyon, 8(6),

https://doi.org/10.1016/j.heliyon.2022.09623.
Mangai, G., & Ganesan, P. (2023). Researchers' Perception and Response to the Open Access Resources (OAR) in higher learning institutions of Tamil Nadu, India, and Library Management, 44, 4055. https://doi.org/10.1108/LM-02-2022-0012.
Rebecca Oluwayimika Kasumu (2023) Awareness and Use of Open Educational Resources and its Benefits to University Students. https://www.researchgate.net/publication/370419333 DOI: 10.22159 Vol 11, Issue 3, 2023, 32-35 ISSN: 2347-5528
Dr Reena Ruby, (2024), Utilization and Challenges of Higher Education Teachers towards the Open Educational Resources in Teaching. International Journal of Cultural Studies and Social Sciences.Vol-21, Issue-2, No.35, ISSN: 2347-4777.
Sandanayake, T.C. (2019). Promoting open educational resources – based blended learning. International Journal of Educational Technology in Higher Education. 16(3). Pp 1-16.
Dr. Sushma.R, (2021). Open Educational Resources. International journal of creative Research. www.ijcrt.org. V (9), Issue 8 ISSN: 2320-2882
Sirajudeen F. B & Jelili A. L (2024). Awareness and Availability of Open Educational Resources in South-West Nigerian University Libraries. Journal of Library and Information Management, Technology, Education. ISSN Online: 2814-3558 https://www.jolimate.com.
Samy, M.Muniya & Jeyshankar, R. (2023). Postgraduate Student's Open Educational Practices and Hurdles among Faculty of Science at Alagappa University during the Pandemic. International Journal of Information and Education Technology, 13(3), 526-534. https://doi.org/10.18178/ijiet.2023.13.3.1835.
Singh, S., Sulekha., & Ram, M. (2022). Awareness and Use of Open Educational Resources among the research scholars of Kurukshetra University, Haryana, India. Library Philosophy and Practice (e-journal), 6848. https://digitalcommons.unl.edu/libphilprac/6848.
Turai. U. B, Bari,S.A, Abdulaziz. A & Baballe M. A.(2025). Contributions of the 5th Industrial Revolution and How the Third and Fourth Industrial Revolutions. Global Journal of Research in Engineering & Computer Sciences ISSN: 2583-2727 (Online) V (5)| Issue 01 Journal homepage: https://gjrpublication.com/gjrecs.
UNESCO. (2021). Open educational resources. Retrieved 30 September, 2021, https://en.unesco.org/news/covid-19-crisis-unesco-call-support-learning-andknowledge-sharing-through-open-educational.

Open Educational Resources in the Fifth Industrial Revolution: A Review

Smart Eromosele Ambrose (Ph.D)
Department of Library and Information Science
Faculty of Education
National Open University of Nigeria, Abuja
sambrose@noun.edu.ng
Phone No: 08055426760

Adedoyin Oluwatosin Esan (Ph.D)
Emily Aig-Imoukhuede Library
Wellspring University Benin City, Edo State Nigeria
sayrald@yahoo.com
08069600248

Stanley Omondiale Unuabor (Ph.D)
College Library
Edo State College of Education, Edo State Nigeria
stanleyunuabor@yahoo.com
08053010454

Abstract

The Fifth Industrial Revolution (5IR) is a significant shift that amalgamates advanced technologies with human-centric values, emphasising sustainability, inclusion, and ethical innovation. This conceptual study examines the incorporation of open educational resources (OER) within the 5IR framework, highlighting their revolutionary capacity to democratize education and foster lifelong learning. The paper analyses how technologies including artificial intelligence (AI), big data, blockchain, and extended reality (XR) improve the creation, personalization, and dissemination of open educational resources (OER), based on vast literature. It highlights the collaborative role of human-machine interaction in facilitating adaptable learning settings and enhancing educational access, particularly for marginalized groups. Moreover, the paper examines the obstacles related to the deployment of Open Educational Resources (OER), encompassing quality assurance, policy deficiencies, and digital equity. The analysis determines that OER, enhanced by 5IR technologies, can provide a sustainable, inclusive, and human-centred educational environment that is contingent upon ongoing innovation, stakeholder collaboration, and supporting regulatory frameworks.

Keywords: Open Educational Resources (OER), Fifth Industrial Revolution (5IR), Emerging Technologies and Inclusive Education

INTRODUCTION

Understanding the relationship between Open Educational Resources (OER) and the Fifth Industrial Revolution (5IR) is critical in the rapidly changing field of education and technology. OER is defined as digital or otherwise available teaching, learning, and research materials in the public domain or under an open license that allows for free access, usage, adaption, and redistribution without restriction. These assets contain software, movies, audio, projects, tests, assignments, lecture notes, curricula, and textbooks. The primary goal of OER is to improve educational access, equity, and quality by allowing teachers and students to freely use and alter educational materials. These works, released under an open license, allow for free access, reuse, re-purposing, adaptation, and redistribution. (UNESCO, 2012). The Fifth Industrial Revolution (5IR) is a transformative stage in which cutting-edge technology are combined with human-centered solutions, sustainability, and social well-being. Unlike the Fourth Industrial Revolution, which prioritized digitization and automation, this one is centred on human-centric solutions. Human-machine interaction, the use of artificial intelligence for individualized experiences, and a commitment to long-term growth are among 5IR's key features. This transition promotes a more equitable and sustainable future by balancing technological advancements with human values and environmental concerns. The goal is to create a more sustainable, inclusive society. (Demir et al., 2019).

Open educational resources (OER) paired with the ideas of the Fifth Industrial Revolution (5IR) have the potential to alter education. OER can give personalized and adaptable learning possibilities by leveraging cutting-edge technology, hence boosting accessibility and inclusiveness. While resource sharing might foster sustainable practices, artificial intelligence can help to tailor material to individual needs. This agreement ensures that learning materials evolve in response to technological and social changes, while also democratizing education. The Fifth Industrial Revolution (5IR), which combines sophisticated technologies with human-centered and ecological practices, represents a significant shift in the industrial paradigm. Unlike the Fourth Industrial Revolution (4IR), which focused on automation and smart technology, the Fifth Industrial Revolution (5IR) promotes human-machine collaboration, sustainability, and ethical technological progress. It emphasises ethical technological progress, sustainability, and human-machine cooperation. This paper discusses 5IR's key qualities, its impact on education and information delivery, and the transition from 4IR to 5IR.

According to Xu et al. (2018), Industry 5.0, also known as the Fifth Industrial Revolution (5IR), aims to reconcile technological advancements with human intelligence, creativity, and values. It aims to promote cooperation rather than replacement through a synergistic connection between humans and machines. 5IR emphasises sustainability, ensuring that industrial development complements environmental responsibility and societal welfare. (Xu et al., 2018). The transition from 4IR to 5IR is a shift from pure automation to

augmented intelligence, in which people and technology work together efficiently to ensure inclusivity and technological equity. Building on 4IR, the transition from 4IR to 5IR prioritises human-machine collaboration over replacement, resulting in a more balanced approach. According to Nahavandi (2019), 5IR encourages a hybrid workforce in which artificial intelligence and automation work alongside humans to boost creativity, decision-making, and problem-solving. (Rushan et al., 2024). Green technologies, circular economies, and social responsibility are the core values of 5IR. (Nahavandi, 2019)

This paper is a conceptual and analytical opinion essay based on an extensive assessment of existing literature. The study did not use empirical data or a specified population. Instead, it relied on secondary sources to investigate the relationship between Open Educational Resources (OER) and the Fifth Industrial Revolution. Relevant research articles, policy papers and publications from google scholar, and other databases were systematically reviewed to get insights into developing trends, challenges, and opportunities for OER use within the context of 5IR. The selection of literature was driven by its relevance to the topics of educational justice, technological innovation, and sustainable development. The literature was analysed using thematic synthesis to develop informed arguments and propose solutions for increasing the role of OER in attaining inclusive and transformative education in the 5IR era. The process emphasises critical thinking, interpretation, and the integration of multiple views to back up the paper's arguments.

Objectives of the Study

The objectives of the research are:

1. To examine the evolution of Open Educational Resources (OER) from the Fourth to the Fifth Industrial Revolution.
2. To assess the impact of Open Educational Resources (OER) on the implementation of the Fifth Industrial Revolution (5IR).
3. `To examine how technological innovations are improving Open Educational Resources (OER).
4. To investigate the opportunities associated with OER in the context of the Fifth Industrial Revolution (5IR).
5. To identify the challenges associated with integrating Open Educational Resources (OER) within the framework of the Fifth Industrial Revolution (5IR).

REVIEW OF RELATED LITERATURE

The evolution of open educational resources (OER) from the fourth to the fifth industrial revolution

The Fifth Industrial Revolution (5IR) has begun due to the rapid advancement of new technology. This represents a marked departure from the Fourth Industrial Revolution (4IR). The 4IR focused on automation, artificial intelligence (AI), the Internet of Things (IoT), and machine learning, with the goal of increasing efficiency and substituting human labour with technology. However, it raised concerns about employment losses, data privacy, and sustainability (Ziatdinov et al., 2024). In contrast, the 5IR concentrates on blending human-centered values with cutting-edge technologies to build a more ethical, inviting, and sustainable digital ecosystem (Nahavandi, 2019).

In this shifting industrial environment, Open Educational Resources (OER) have evolved from digital content repositories enabled by 4IR technology to dynamic, interactive platforms powered by 5IR's ethical and inclusive frameworks. The 5IR improves OER by incorporating AI, big data, and immersive technologies to help create more personalised, accessible, and flexible learning experiences (Xu et al., 2021; Ordieres-Meré et al., 2023). The 4IR established the foundation for digitising instructional content. The 5IR builds on this by emphasising learner diversity, individual autonomy, and equitable access to knowledge.

The Fifth Industrial Revolution advocates for open access to knowledge and emphasises the importance of making education more accessible to everyone by providing free and customised learning materials. These human-centered innovations enable real-time material recommendations, learning routes that adapt to each learner's needs, and interfaces that accommodate a wide range of learning styles and demands (Beltramini, 2019). Governments and organisations should invest in things like digital literacy initiatives, affordable internet access, and AI-enhanced classroom technology to ensure that those on the margins can benefit from these new technologies. Furthermore, supportive legislation, state initiatives, and international frameworks have accelerated the global expansion of OER. The 2019 UNESCO Recommendation on Open Educational Resources was a significant step forward because it united all member countries in their commitment to sharing information (Ossiannilsson et al., 2023). Countries such as Canada, South Africa, and the United Kingdom have effectively incorporated OER into their national education programs. In Africa and Asia, more and more schools are utilizing OER to compensate for a shortage of trained teachers and instructional materials (Yalcinalp, 2010).

In resource-constrained areas such as Sub-Saharan Africa, the combination of mobile technologies and OER platforms has significantly boosted the number of formal and informal learning opportunities. This update demonstrates how the 5IR's core principles of inclusivity, human-centered AI, sustainability, and ethical technology use are incorporated into new teaching methods. In short, the transition from the 4IR to the 5IR in OER represents a larger shift in industry: from just becoming digital to developing knowledge-sharing ecosystems that are purposeful, ethical, and accessible to all. As the 5IR evolves, OER will remain a vital instrument for eliminating educational gaps and supporting lifelong learning in a technologically enabled and people-driven society.

METHODOLOGY

The study adopted a narrative review as its methodological approach. This was chosen because a narrative review effectively summarizes empirical findings on a given concept or theme and relates them to the context of the current study. Paré et al. (2015) noted that a narrative review synthesizes previously published studies on a subject of interest, with emphasis on concepts, hypotheses, study methods, or research findings.

The literature reviewed centered on the evolution of open educational resources (OER) from the fourth to the fifth industrial revolution, the impact of open educational resources (OER) on the fifth industrial revolution, leveraging emerging technologies for open educational resources (OER), synergy between OER and the fifth industrial revolution, opportunities and innovations in OER within the 5th industrial revolution, challenges in implementing OER in the 5th industrial revolution, strategies for maximizing OER in the 5th industrial revolution, and suggestions and way forward.

DISCUSSION

The impact of open educational resources (OER) on the fifth industrial revolution

Improving Access to Knowledge and Inclusion

As stated by Huang et al., (2020). Open Educational Resources (OER) serve as a mechanism to dismantle educational barriers and facilitate equitable access to knowledge. It provides complimentary, adaptable, and repurposed educational resources, with the objective of being inclusive and human-centric. Open Educational Resources (OER) have markedly enhanced educational access for individuals with disabilities, those from low-income backgrounds, and remote learners. It mitigates the digital divide by rendering knowledge accessible to various global populations. Cerna et al., (2021) state that Open Educational Resources (OER) are very advantageous for marginalized populations and assist students from various socioeconomic backgrounds, notably in rural and impoverished areas. The material is adaptable and versatile, ensuring cultural and language relevance. OER offers screen-reader-compatible text, subtitles, and adjustable fonts for students with disabilities, fostering inclusive, accessible, and egalitarian education. (Mishra, 2017)

Personalized and Adaptive Learning with AI-Driven OER

AI integration in Open Educational Resources (OER) enables personalized, flexible learning, aligning with the Fifth Industrial Revolution's emphasis on human-machine collaboration. AI-driven OER systems enhance student motivation and engagement through immersive experiences. (Zawacki-Richter et al., 2019). AI-driven Open Educational Resources (OER) platforms use machine learning algorithms to customize content based on individual student habits, preferences, and progress, enhancing engagement, retention, and performance. (Bond et al., 2021; Zhao et al., 2023). AI chatbots and virtual tutors provide immediate responses, promoting an interactive, learner-focused educational experience, supporting the inclusive and personalized educational objectives of the Fifth Industrial Revolution. (Fischer, et al., 2022).

Collaboration and Co-Creation in Open Education

Open Educational Resources (OER) play a crucial role in the Fifth Industrial Revolution (5IR) by enhancing collaboration and co-creation in education. They enable educators and learners to collaboratively create and refine instructional materials (Wiley & Hilton, 2018). The open pedagogy linked to OER encourages critical thinking, creativity, and digital literacy as students engage in resource creation (DeRosa & Jhangiani, 2019). Additionally, OER supports collaborative authorship of educational content among educators, students, and AI systems (Mhlanga, 2022). Furthermore, the collaborative essence of OER aligns with the 5IR's emphasis on shared information and human-technology collaboration (Wiley & Hilton, 2018).

Open education platforms enable educators, researchers, and students to collaboratively develop high-quality learning resources (DeRosa & Jhangiani, 2019), thereby changing students into active participants in the creation of educational content (Bozkurt et al., 2023). This interactive method fosters critical thinking, problem-solving, and lifelong learning (Ossiannilsson, 2019). The implementation of OER in MOOCs and open-access digital libraries facilitates worldwide knowledge exchange and encourages international collaboration, hence enhancing the quality of educational content.

Digital and Immersive Learning Technologies

Digital and immersive learning technologies, such as augmented reality (AR), virtual reality (VR), and mixed reality (MR), are augmenting educational opportunities beyond conventional classrooms by fostering engaging environments that enhance comprehension and critical thinking (Ordieres-Meré et al., 2023). These technologies provide hands-on teaching in disciplines such as medicine and engineering, while also aiding in the visualization of intricate scientific concepts. The 5IR educational paradigm advocates for personalized and interdisciplinary learning, integrating STEM with social sciences and humanities to enhance student readiness for future labour market requirements (Santhi & Muthuswamy, 2023)

Leveraging emerging technologies for open educational resources (OER)

Cutting-edge technologies like artificial intelligence, blockchain, and extended reality (XR) are revolutionizing the field of Open Educational Resources (OER) within the framework of the Fifth Industrial Revolution.These technologies improve the accessibility, security, and interactivity of OER, making learning experiences more engaging and sustainable. (Zawacki-Richter et al., 2019)

1. Artificial Intelligence (AI) in OER

Artificial intelligence is essential for automating content creation, enhancing resource accessibility, and facilitating personalized learning experiences. Natural language processing (NLP) approaches enable AI-driven OER systems to provide summaries, translations, and adaptive assessments, hence improving educational content accessibility for a wider audience (Fischer et al., 2022; Zhao et al., 2023). Through the analysis of learners' behaviour and performance metrics, AI systems can offer tailored educational content and furnish immediate feedback, hence facilitating differentiated instruction and accommodating varied learning requirements.

2. Blockchain for OER Certification and Attribution

Blockchain technology addresses issues of intellectual property, authorship recognition, and resource authenticity in OER. It facilitates transparent and immutable records of content modifications and contributions, ensuring that educators and learners receive appropriate acknowledgment for their efforts. Furthermore, blockchain-enabled smart contracts streamline the licensing of OER, optimizing the sharing and distribution of educational resources while maintaining transparency and fair attribution (Mishra, 2017; Mhlanga, 2022).

3. Extended Reality (XR) for Immersive Learning

Extended reality (XR), encompassing virtual reality (VR), augmented reality (AR), and mixed reality (MR), enriches open educational resources (OER) by offering immersive learning experiences that enable students to investigate historical sites, perform virtual experiments, and participate in interactive simulations. This methodology corresponds with the aims of the Fifth Industrial Revolution (5IR), which prioritizes experiential and learner-centred education. (Bond et al., 2021). The amalgamation of AI, blockchain, and XR in OER represents a transition towards personalized, inclusive, and sustainable education, equipping students for a multifaceted world and enabling them to evolve into responsible global citizens with vital critical thinking and interpersonal skills (Ordieres-Meré et al. 2023).

Synergy between OER and the fifth industrial revolution

The integration of Open Educational Resources (OER) and the Fifth Industrial Revolution (5IR) offers a transformative prospect for the future of education. OER aims to democratize knowledge access by providing freely available, openly licensed educational resources, while 5IR incorporates human-centric technologies like artificial intelligence (AI), big data analytics, and immersive media to enhance inclusivity, personalisation, and sustainability in education. They cultivate an educational ecology that corresponds with the worldwide pursuit of justice, flexibility, and environmental stewardship. (Ziatdinov et al. 2024).

Opportunities and innovations in OER within the 5th industrial revolution

Human-centered technology, personalisation, sustainability, and inclusivity in education define the 5th Industrial Revolution (5IR) (Ordieres-Meré et al., 2023). Open Educational Resources (OER) revolutionize knowledge accessibility and lifelong learning. AI, blockchain, and XR are transforming OER, enabling adaptive learning, secure accreditation, immersive experiences, and open research cooperation (Mhlanga, 2022). A human-centered strategy that blends sophisticated technologies promotes inclusivity and personalized learning in the 5th Industrial Revolution (5IR) (Ordieres-Meré et al., 2023). This paradigm change relies on Open Educational Resources (OER) to improve information accessibility and lifelong learning via AI, blockchain, and XR (Mhlanga, 2022)

AI-Driven Content Curation and Recommendation Systems

Artificial intelligence (AI) is transforming Open Educational Resources (OER) through enhanced content curation and personalized learning experiences. AI algorithms analyze students' choices and behaviors to recommend instructional resources, improving the efficiency of OER repositories (Zawacki-Richter et al., 2019; Fischer et al., 2022). Additionally, AI automates metadata tagging, facilitating easier content discovery and tools like chatbots provide guidance and support for learners (Zhao et al., 2023). AI also aids in overcoming language barriers through automated summaries and translations, making OER more accessible globally. Similarly, Esan et al., (2025) reported that postgraduate students find the quality of the systems or repositories that houses OER to be very high.

Blockchain for OER Copyright, Accreditation, and Certification

Blockchain technology enhances the management of copyright, accreditation, and certification in Open Educational Resources (OER) ecosystems by providing a decentralized and transparent framework.

It ensures that OER creators receive proper attribution and licensing through immutable records. Blockchain also protects academic credentials from fraud, making it easier for employers to verify qualifications (Mhlanga, 2022).

Extended Reality (XR) for Immersive OER Learning Experiences

Extended reality (XR), which includes virtual reality (VR), augmented reality (AR), and mixed reality (MR), is revolutionizing open educational resources (OER) by providing immersive learning experiences that boost student engagement and retention (Bond et al., 2021). XR-based OER supports experiential education, helping students understand complex concepts; for example, VR simulations allow medical students to practice surgery in a safe environment, while AR applications enhance real-world learning by overlaying digital information on physical objects (Huang et al., 2020). Furthermore, XR caters to various learning styles and fosters inclusivity, as haptic feedback in VR allows visually impaired learners to engage with

Open-Access Research and Data-Sharing for Lifelong Learning

Open education fosters lifelong learning through open-access research and data-sharing, enabling students and researchers to access advanced research at no cost, as highlighted by Mauthner and Parry (2013). Platforms like the Open Science Framework (OSF) facilitate global collaboration among researchers and educators (Zizic et al., 2022). The integration of AI in open-access repositories enhances searchability and accessibility, aiding learners in staying updated with industry advancements (Stracke et al., 2022).

Challenges in implementing OER in the 5th industrial revolution

Open Educational Resources (OER) in the Fifth Industrial Revolution (5IR) presents various challenges which include:

Infrastructure Constraints and Digital Divide

The World Economic Forum (2021) emphasises the importance of modernising digital infrastructure to guarantee fair access to educational materials, which will increase the potential of OER in the context of 5IR. The digital divide greatly impedes the deployment of open educational resources (OER) in developing nations and vulnerable areas, as sophisticated digital gadgets and dependable internet connectivity are required for OER use (Mishra, 2017).

Worries about intellectual property and licensing

Implementing Open Educational Resources (OER) presents issues in terms of preserving licence agreements and intellectual property rights, potentially leading to copyright and authorship conflicts (Wiley and Hilton, 2018). Concerns may prevent educators and institutions from adopting open educational resources (OER) (Castañeda & Selwyn, 2022). While Creative-Commons Licenses make it easier to share and reuse resources, unstandardized licensing might cause misunderstanding over modification and distribution (Stracke et al., 2022). To foster openness and collaboration, educators need clear guidelines and training on intellectual property problems.

OER Materials' Credibility and Quality

Quality management is critical for the successful acceptance and deployment of open educational resources (OER), as worries regarding the authenticity and academic rigour of internet content remain. Zawacki-Richter et al. (2019) found that some educators regard OER as inferior to traditional materials, which may limit their utilization. The absence of a centralized strategy for OER quality certification exacerbates the problem. Furthermore, Esan et al., (2024) stated that despite the awareness of benefits associated to the use of OER, the use of OER is still very low in developing countries partly because users are not satisfied with the quality of information and quality of the system that houses OER.

Policy gaps and resistance to change.

Resistance from teachers and institutions considerably impedes the adoption of Open Educational Resources (OER) in the context of the Fifth Industrial Revolution (5IR). Many educators used to traditional approaches see OER integration as time-consuming and difficult. Additionally, a lack of institutional support and training contributes to this reluctance (Wiley et al., 2022). Current educational legislation have not kept up with the rapid improvements in digital and open education, creating substantial policy gaps (Castañeda & Selwyn, 2020).

Digital Equity and Ethical Issues

The growing use of data-driven tools and AI in education raises serious concerns about privacy, bias, and digital equity. Ethical concerns about data ownership, monitoring, and algorithmic transparency arise, particularly with the use of smart systems to customise Open Educational Resources. Without sufficient controls, these technologies may exacerbate existing inequities. (Huang, 2023). Furthermore, the absence of representation of minority languages and cultures in AI training datasets may impair the cultural relevance of OER, limiting access.

Readiness of Policies and Institutions

Strong policy frameworks and institutional commitment are required for 5IR technology to be successfully integrated with OER. Meanwhile, many educational institutions lack clear policies on OER use, intellectual property rights, and artificial intelligence oversight. Institutional inertia and teachers' and administrators' limited abilities to innovate further stifle progress. (Adedoyin et al., 2024). Strategic planning, funding for digital skill development, and the formulation of rules for ethical artificial intelligence use in education will all contribute to facilitate integration.

Strategies for maximizing OER in the 5th industrial revolution

Several solutions are required to fully realized the potential of Open Educational Resources (OER) in the Fifth Industrial Revolution (5IR).

Policies for the Adoption of Open Educational Resources

The use of Open Educational Resources (OER) in a fast-changing educational landscape necessitates strong regulatory policies for effective legislative policies are critical for incorporating OER into both official and informal education. UNESCO (2020) emphasizes that such policies should encourage the use of open educational materials, establish quality certification and ensure equal access for all students. More so, Fischer et al. (2022) urge that national governments should promote the production and use of open educational resources (OER).

Digital literacy and professional development for students and teachers.

Digital literacy is essential for instructors and students to fully leverage open educational resources (OER) in the context of the Fifth Industrial Revolution (5IR). Many teachers currently lack the necessary digital literacy and understanding of open educational practices, which hampers their ability to utilize OER effectively. To address this gap, educational institutions should provide comprehensive professional development courses focused on digital skills and OER (Hodgkinson-Williams and Arinto, 2017). Esan et al., (2024) also recommended that university management should promote the usage of OER by organizing conferences, seminars and workshops to train staff and students on how to maximize the benefits.

Partnerships for the Development and Distribution of Public-Private OER

Public-private partnerships (PPPs) are essential for enhancing the creation and distribution of open educational resources (OER) in the context of the Fifth Industrial Revolution (5IR). These collaborations among governments, institutions, and companies enable the provision of high-quality OER tailored to diverse student needs (D'Antoni, 2020). Technology partnerships also improve access to digital tools that enhance OER delivery (Fischer et al., 2022). Successful collaborations have resulted in innovative OER projects that tackle educational challenges, empowering stakeholders to produce and share quality resources (OER, 2021). The corporate sector's involvement is crucial for the sustainability of OER initiatives through financial and technological support (Zawacki-Richter et al., 2022).

CONCLUSION

The integration of Open Educational Resources (OER) into the context of the 5th Industrial Revolution (5IR) offers transformative opportunities for education. OER enhances access to knowledge, supports personalized learning through innovative technologies, and fosters collaboration and co-creation among educators and learners. The democratization of knowledge through OER is crucial for building inclusive educational environments that cater to diverse learner needs. However, successful implementation requires ongoing innovation and collaboration among stakeholders. The rapid pace of technological advancement demands adaptability and responsiveness from educators and institutions. Fostering partnerships between public and private sectors can drive the sustainable development of OER, ensuring relevance and effectiveness in meeting the evolving demands of learners and the job market. To maximize the potential of OER in the 5IR, policymakers, educators, and technology developers should collaborate actively. Policymakers should prioritize the establishment of supportive frameworks and funding mechanisms for OER initiatives, while educators should engage in continuous professional development to enhance their digital literacy and pedagogical skills. Technology developers should focus on creating user-friendly platforms and tools for OER creation, sharing, and customization.

Recommendations

To fully harness the transformative potential of the Fifth Industrial Revolution (5IR) in the design, delivery, and dissemination of Open Educational Resources (OER), a strategic and inclusive approach is required. The following suggestions offer a road map for educators, policymakers, institutions, and technology developers:

1. Strengthening Technological Infrastructure

Governments and educational institutions must prioritize investments in digital infrastructure, especially in under served and remote areas. Affordable broadband access, stable electricity, and access to smart devices are foundational to enabling the use of 5IR technologies

2. Developing Human-Centered AI for Education

Educational technologies should be developed using ethical, inclusive, and human-centric AI frameworks. This includes ensuring that OER platforms respect user privacy, minimize algorithmic bias, and are culturally and linguistically adaptable. AI systems should enhance, not replace, the role of educators by acting as intelligent assistants that support personalized learning pathways.

3. Promoting Institutional Readiness and Capacity Building

There is a need for strategic leadership within educational institutions to drive the adoption and integration of 5IR technologies with OER. Continuous professional development programs for educators on digital pedagogy, AI tools, and instructional design are crucial. Institutions should also revise curricula to incorporate digital literacy and future-ready skills.

4. Encouraging Inclusive and Participatory Policy Frameworks

National and institutional policies should support open licensing, data governance, and ethical standards for the use of emerging technologies in education. These policies must be developed in consultation with diverse stakeholders, including students, educators, technologists, and marginalized communities, to ensure equitable access and representation.

5. Supporting Localized and Culturally Relevant OER Development

To make OER more relevance, the content should be locally developed or adapted to reflect regional languages, values, and learning contexts. Collaboration between educational institutions, community organizations, and local content creators can ensure that OER resources are inclusive, accessible, and contextually meaningful.

6. Fostering Global and Regional Collaboration

Cross-border collaboration can facilitate knowledge exchange, resource sharing, and the co-creation of OER materials enhanced by 5IR technologies. Initiatives like open repositories, consortia, and international OER conferences can help harmonize standards and promote innovation on a global scale.

7. Sustainability of OER in the Digital and AI-Driven World

Sustainability depends on funding, institutional support, and community engagement. Sustainable financing models, like public-private partnerships, are essential for resource availability. Fostering collaboration among institutions, educators, and learners can also enhance OER's sustainability.

REFERENCES

Adedoyin, O. B., Altinay, F., Gemikonakli, E. Altinay. Z. & Dagli.G. (2024). National Policy on Open Educational Resources for Higher Education in Nigeria: Evaluation of Institutional Compliance Rate to Infrastructure and the Connectivity Goal. *High Educ Policy*. https://doi.org/10.1057/s41307-024-00387-8

Bali, M., Caines, A., DeWaard, H., & Hogue, R. J. (2020). *Open at the margins: Critical perspectives on open education*. Pressbooks.

Beltramini, E. (2019). Life 3.0. Being human in the age of artificial intelligence, by max tegmark. *Religion and Theology*, *26*(1-2), 169-171.

Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2021). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, *18*(2), 1-30.

Castañeda, L., & Selwyn, N. (2022). The automation of education: The role of artificial intelligence and data-driven decision making in teaching and learning. *AI & Society*, *37*(1), 47-62.

Cerna, L., Mezzanotte, C., Rutigliano, A., Brussino, O., Santiago, P., Borgonovi, F., & Guthrie, C. (2021). Promoting inclusive education for diverse societies: A conceptual framework. *OECD Education Working Papers*, (260), 1-57.

Chassignol, M., Ballard, C., & Bénabent, A. (2021). Ethical AI and open educational resources: Challenges and opportunities. *International Journal of Artificial Intelligence in Education*, 31(2), 300-318. https://doi.org/10.1007/s40593-021-00225-3

D'Antoni, S. (2020). Open educational resources: Global perspectives. In E. C. B. J. G. A. H. R. L. (Eds.), The Cambridge Handbook of Open Education. 33-49. Cambridge University Press

Demir, K. A., Döven, G., & Sezen, B. (2019). Industry 5.0 and Human-Robot Co-working. *Procedia Computer Science*, 158, 688–695.

DeRosa, R., & Jhangiani, R. S. (2019). Open pedagogy: The importance of removing barriers. Open *Educational Practices*, *4*(1), 12-27.

Esan, A. O., Ifijeh, B. A., & Chanomi, P. O. (2024). Perceived usefulness and use of open educational resources among postgraduate students in federal universities in South-West, Nigeria. *Communicate: Journal of Library and Information Science*, *26*(1), 195–209. https://www.cjolis.org/index.php/cjolis/article/view/87

Esan, A. O., Ogbomo, M. O., & Ogbomo, E. F. (2025). System quality and use of open educational resources among postgraduate students in federal universities in South-West, Nigeria**.** *Record and Library Journal, 11*(1).
Fischer, C., Ray, B., & Zawacki-Richter, O. (2022). AI in education: Implications for OER. *Educational Technology & Society*, *25*(1), 45-59.
Huang, L. (2023). Ethics of artificial intelligence in education: Student privacy and data protection. *Science Insights Education Frontiers*, *16*(2), 2577-2587.
Huang, R., Spector, J. M., & Yang, J. (2020). *Educational technology beyond content: A new focus on open education*. Springer.
Mauthner, N. S., & Parry, O. (2013). Open access digital data sharing: Principles, policies and practices. *Social epistemology*, *27*(1), 47-67. https://doi.org/10.1080/02691728.2012.760663
Mhlanga, D. (2022). Digital transformation in education: relevant paradigms and theories of teaching and learning in the industry 4.0. In *Intelligent systems in digital transformation: Theory and applications* (pp. 453-470). Cham: Springer International Publishing.
Mishra, S. (2017). Open educational resources: removing barriers from within. *Distance Education*, *38*(3), 369–380. https://doi.org/10.1080/01587919.2017.1369350
Nahavandi, S. (2019). Industry 5.0-A human-centric solution. *Sustainability*, *11*(16), 4371. https://doi.org/10.3390/su11164371
Okunlaya, R. O., Syed Abdullah, N., & Alias, R. A. (2022). Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. *Library Hi Tech*, *40*(6), 1869-1892.
Ordieres-Meré, J., Gutierrez, M., & Villalba-Díez, J. (2023). Toward the industry 5.0 paradigm: Increasing value creation through the robust integration of humans and machines. *Computers in Industry*, *150*, 103947.
Ossiannilsson, E. (2019). OER and OEP for access, equity, equality, quality, inclusiveness, and empowering lifelong learning. *The International Journal of Open Educational Resources*, *1*(2).
Pare, G., Trudel, M.-C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. *Information and Management*, 52, 183-199.
Rushan Ziatdinov, Madhu Sudhan Atteraya, & Rifkat Nabiyev. (2024). The fifth industrial revolution as a transformative step towards society 5.0. *Societies*, *14*(2), 19–19. https://doi.org/10.3390/soc14020019
Santhi, A. R., & Muthuswamy, P. (2023). Industry 5.0 or industry 4.0S? Introduction to industry 4.0 and a peek into the prospective industry 5.0 technologies. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, *17*(2), 947–979. https://doi.org/10.1007/s12008-023-01217-8
Stracke, C. M., Sharma, R. C., & Bozkurt, A. (2022). Open education: From OER to OEP and the future of education. *Journal of Learning for Development, 9*(1), 35-50.
Tlili, A., Zhang, J., Papamitsiou, Z., Manske, S., Huang, R., Kinshuk, & Hoppe, H. U. (2021). Towards utilising emerging technologies to address the challenges of using open educational resources: A vision of the future. *Educational Technology Research and Development*, *69*, 515-532.
United Nations Educational, Scientific and Cultural Organization (UNESCO). (2012). Forum on the impact of open courseware for higher education in developing countries: Final report. http://unesdoc.unesco.org/images/0012/001285/128515e.pdf
Van Dijk, J. A. (2020). The digital divide. In J. D. Carpentier & K. De Marez (Eds.), The Handbook of Media and Communication Research. 186-207 Routledge.
Wiley, D., & Hilton, J. L. (2018). Defining OER-enabled pedagogy. *International Review of Research in Open and Distributed Learning, 19*(4), 133-147. https://doi.org/10.19173/irrodl.v19i4.3601
Wiley, D., McDonnell, J., & Oh, E. (2022). The OER ecosystem: Opportunities and challenges. *Open Learning: The Journal of Open, Distance and e-Learning*, *37*(1),
Xu, M., David, J. M., & Kim, S. H. (2018). The Fourth Industrial revolution: Opportunities and Challenges. *International Journal of Financial Research*, *9*(2), 90–95. https://doi.org/10.5430/ijfr.v9n2p90
Yalcinalp, S. (2010). Opening up education: The collective advancement of education through open technology, open content, and open knowledge–By Toru Liyoshi & MS Vijay Kumar. *British Journal of Educational Technology*, *41*(6), 970-971.
Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – Where are we now and where are we going? *International Journal of Educational Technology in Higher Education*, *16*(1), 1-20.
Zhao, F., Jiang, M., & Yang, Y. (2023). AI-driven learning analytics in open education. *Journal of Artificial Intelligence in Education,* 34(1), 85-104.
Ziatdinov, R., Atteraya, M. S., & Nabiyev, R. (2024). The fifth industrial revolution as a transformative step towards society 5.0. *Societies, 14*(2). https://doi.org/10.3390/soc14020019
Zizic, M. C., Mladineo, M., Gjeldum, N., & Celent, L. (2022). From industry 4.0 towards industry 5.0: A review and analysis of paradigm shift for the people, organization and technology. *Energies*, *15*(14), 5221.

Open Science: Redefining the Role of Libraries as Hubs for Knowledge Justice and Innovation in the 5th Industrial Revolution

*** Ajayi Taiwo Bosede, PhD, CLN.**
Lagos State University of Science and Technology
ajayi.t@lasustech.edu.ng
https://orcid.org/0000-0001-7337-9419

**** Ojo Joshua Onaade, PhD, CLN.**
University of Lagos
jojo@unilag.edu.ng

***** Oyeniyi Wosilat Omolara, CLN.**
Lagos State University of Science and Technology
****** Otuyalo Atinuke Modupe, CLN.**
Lagos State University of Science and Technology
Tinux2003@yahoo.com

Abstract

The 5th industrial revolution era focusses on human-centered advancements driven by the unification of artificial intelligence and machine learning. Libraries are situated to lead this transformation by promoting equitable access to information and support the innovation and open knowledge. There are extant literature on the benefit of open science but no much attention on the disparity among the underrepresented communities in accessing and contribution to scholarly communication. Libraries as the custodian of knowledge are expected to redefine their roles in this era for proper positioning in ensuring inclusion, fair use, technology, service oriented, and dismantle knowledge supremacy through open science. The study explored how libraries can transform and adapt their roles in this era by ensuring human-centered innovation and technology integration, targeting the principle of knowledge, justice and equitable participation into their operations. Bridging the gaps and guaranteeing equitable access to open science, the study aimed at exploring how open science would be empowered in the 5th IR through librarians in ensuring knowledge, justice and innovation. Qualitative research approach was used and semi-structured interviews were used as the instrument to gather data. A purposive sampling technique was used to select participants who have direct experience or expertise in open science practices, knowledge equity initiatives, and library innovation strategies. The result showed that there are benefits of open science but the disparity between the developed and under-represented can better be bridged by innovative approach of the library. It was suggested that there should be collaboration among stakeholders and supportive policies to ensure knowledge justice.

Keywords: *knowledge justice, library, open science, innovation, 5th industrial revolution, Critical race theory*

Introduction

The emergence of the Fifth Industrial Revolution (5thIR) gave way to a transformative era that is characterised by the interactive connection of advanced technologies such as artificial intelligence, biotechnology, and quantum computing with human ingenuity and ethical considerations. According to Xun, et al. (2021), the harmonious integration of diverse technological domains of 5thIR was instituted based on the assumption that 4thIR focuses less on the original principles of social fairness and sustainability but more on digitalisation and AI-driven technologies for increasing the efficiency and flexibility of production.

Open science is a movement reshaping the environment of scholarly communication and has gotten global recognition. This is the unrestricted availability of high-quality data, publications, and innovations, as well as the establishment of a strong scientific community that transcends traditional boundaries to make effective decisions. The paradigm shifts in essence advocate for unlimited access to research outputs and data in order to promote reproducibility, transparency, innovation and collaboration among disciplines (Onyebinima, et al, 2024).

Knowledge justice applies the concept of social justice in information spaces. The concept was developed to advocate for libraries to be active agents in disrupting white supremacy and promoting racial justice within information access and knowledge creation (Feldman, 2019). Knowledge justice therefore is a concept, advocating for equitable access to information, inclusive participation in knowledge creation, and the dismantling of systemic barriers that perpetuate information inequities (Cornelius-Hernandez & Clarke, 2024). Traditionally, libraries are the custodians of physical information resources however, the transformation has been adapted to by librarians. This practice could be envisioned in libraries, where users experience the same in a paperless society. This development positions libraries in promoting knowledge justice through equitable access to information for all segments of the society. The transitioning from

conventional repositories of physical media to dynamic hubs that facilitate digital access, data literacy, and participatory learning is visible both in library collections and spaces (Isiaka, et al, 2024),

Open science such as open data, open book, open journal and open publishing is expected to make scholarly communication available without restriction in research publishing ecosystem. Open science awareness has increased in the last decade and researchers are exploring this opportunity to make their work visible to the global world as the result of any research work is meant to address thematic issues in the society. However, there are limit to publication and access within certain geographical areas such as Africa, and Asia, where they are struggling to gain traction. The emergence of publishing by the British colonial administration was borne out their interest in the supply of agricultural raw materials from the region thereby setting up agricultural research stations in various cities in Africa. Also, most research result from developed world are funded, allowing authors to publish and communicate the result freely in most recognized commercial publishers' sites, most especially where they positioned themselves as facilitators of scholarly communication. Accessing open access mostly, researchers in developing world pay either through subscription or paywalls since these publishers have consolidated themselves as gatekeepers of knowledge. Universities pay heavily annually to access research produced by their faculty members. It is therefore important that knowledge needs to be reclaimed in global north regions (Sheikh & Richardson (2023); Taubert, et al (2021); Ann (2013); & Dominique, Xiya & Hloni (2021).
Result of research in developing countries are being swamped by research from developed country. Harle & Warne (2020) note that subscribing as an institution or as an individual is difficult mostly in the global north as high cost has created academic and global inequalities in education and research thereby limiting access to what they want to read. All these are making research from the global south region invisible and less regard than those from the global north. Knowledge injustice in open science most especially open access is prevalent and there should be equitable justice in accessing, publishing and communicating scholarly output.
Onyebinima, et al (2024) noted that countries outside of North America and Europe are not as prominently represented in open science. This suggests that open knowledge systems may not adequately reflect the diverse knowledge and needs of a global audience, strengthening the existing power disparities in knowledge creation and dissemination. This framework, as introduced in Egert & Allen (2017) and emphasised throughout the discussion of the book Knowledge Justice, Leung & López-McKnight (2021) provides a crucial lens for examining the social justice implications of knowledge production and distribution. It emphasises that knowledge and its creation should be seen as a good to be distributed, including all voices for whom the science will matter. This paper explores the redefined role of libraries in the 5thIR, emphasizing their critical function as enablers of open access and as catalysts for knowledge justice and innovation. By examining contemporary case studies and strategic initiatives, the study elucidate how libraries can harness emerging technologies to empower communities, bridge knowledge disparities, and cultivate an ecosystem conducive to sustainable progress.

Objectives of the Study
i. To identify the principles most critical to open science relevant to the 5thIR,
ii. To explore the benefit of open science in the 5th Industrial Revolution
iii. To identify the challenges of adopting open access in the 5th Industrial Revolution
iv. To examine the roles of libraries as hub for promoting knowledge justice in the 5thIR;
v. To identify relevant innovative approaches to open science and knowledge justice in the 5th Industrial Revolution.

Theoretical framework
Critical Race Theory (CRT) is the foundational theory underpinning *Knowledge Justice*. CRT offers essential concepts for understanding how race, racism, and power operate within information systems and institutions. The critical race theory started with the movement of collection of activists and scholars interested in studying and transforming the relationship among race, racism, and power. The movement focused on issues bothering on conventional civil rights and ethnic studies discourses take up, but places them in a broader perspective that includes economics, history, context, group- and self-interest, and even feelings and the unconscious (Ekwueme, et al, 2024).
The theory was used by Leung & López-McKnight (2021) to analyse and challenge the relationship between race, and power within library and information studies and advocating for dismantling white supremacy in order to achieve more just offers a powerful background for appraising the development of equitable and inclusive library and information practices (Egert & Allen (2017). This can be applied to critically examine existing open science practices and infrastructures, identify potential biases and inequalities that might perpetuate or exacerbate existing knowledge injustices. Furthermore, CRT's commitment to social justice and transformative action aligns with the study's aim of empowering open science and redefining the role of libraries McCoy & Rodricks (2015). Understanding these dynamics through frameworks like CRT and the concept of knowledge justice is crucial for developing truly equitable and inclusive open knowledge initiatives.

Intersection of Open Science and Knowledge Justice in the 5thIR

The convergence of open science, technological advancements, and knowledge justice principles is a fundamental area within library and information profession. Though open science and technological advancements offer prospects for broader access to information and knowledge, knowledge justice provides a critical lens to ensure these developments are equitable and address existing power imbalances within open science (Ogungbeni et al, 2016).

The principles of open science are assumed to align with the objectives of knowledge justice within the framework of the 5thIR. It is characterised by extraordinary technological advancements and societal transformations driven by the integration of digital technologies such as; artificial intelligence (AI), the Internet of Things (IoT), cloud computing, big data, robotics, biotechnology, nanotechnology, blockchain, and quantum computing, characterised the technological advancement and reinforced by the increasing importance of data and advanced communication technologies (Ajani & Oladokun, 2024; Enakrire et al, 2024).

One of the main objectives of open science is promoting access to scientific research across all fields to the advantage of scientists and society (Onyebinima, et al, 2024). This support perfectly the 5th Industrial Revolution's emphasis on inclusivity and access to information for all individuals (Enakrire, Oladokun, Ignatius, Gaitanou (2024). By eliminating obstacles to research and promoting collaborative scientific endeavors, open science can guarantee that the vast amounts of data and knowledge generated during the 5th Revolution are not locked behind paywalls or restricted by exclusive access (Ogungbeni, et al 2016; Onyebinima, et al, 2024). It was therefore suggested that the synergy between open science and knowledge justice should make result of research and knowledge freely available and break down every barriers to access especially for the marginalized communities (Feldman, 2019).

The intersection of open science, knowledge justice and 5thIR will tripod equity, fairness and inclusive knowledge landscape between global north and south, will accurately reflects the key themes and potential interactions to consider how the principles of open science and knowledge justice can be brought together within the context of the technological transformations of the 5th industrial revolution to create a more equitable and inclusive knowledge landscape. The connection of these ideas within the 5th IR suggests a need for innovative open science approaches that actively integrate diverse knowledge and challenge traditional knowledge hierarchies. These concepts are synergised where knowledge is co-created, openly shared, ethically managed, and used to empower all segments of society, not just the privileged few.

Innovative approaches to open science within 5th Revolution

In the context of the 5thIR and open science, it implies that libraries have a crucial role to play in ensuring that the advancements in open science are guided by the principles of knowledge justice, promoting equitable access and participation in the emerging knowledge ecosystem. The redefined role of libraries as active agents in this landscape is crucial for ensuring that open science in the 5th Revolution is not only technologically advanced but also contributes to a more just and equitable knowledge ecosystem for all. Power dynamics and social inequities deeply influence who can access, contribute to, and benefit from open knowledge systems. Libraries, in their evolving roles, have the potential to be key actors in challenging these imbalances and fostering a more just and participatory knowledge landscape. Based on the provided sources and our conversation history, a review of identifying and analysing innovative approaches to open science within the context of the "5th Industrial Revolution" reveals a dynamic interplay between technological advancements, the principles of knowledge justice, and the evolving role of libraries.

The intersection of open science, 5thIR, and knowledge justice presents both significant opportunities and challenges. Libraries, in their evolving roles, are uniquely positioned to navigate this intersection by embracing innovation while upholding core principles of equity and justice in the digital age. CRT inspires a move towards transformative librarianship, which involves understanding how information shapes self-awareness and community awareness, while also recognising epistemic supremacy and institutional harms faced by marginalised communities (Ogungbeni, et al 2016; Onyebinima, et al, 2024). This approach encourages libraries to become active agents in creating conditions for radical change towards racial justice (Leung & López-McKnight, 2021)

Critical race theory encourages a re-evaluation of the core tenets of open science, such as neutrality and vocational awe, arguing that these concepts can inadvertently uphold white supremacy (Ogungbeni et al, 2016; Egert & Allen, 2017). By critically examining these assumptions, libraries can move towards practices that actively address systemic racism rather than masking it under the guise of neutrality (Leung & López-McKnight, 2021). In essence, CRT provides LIS professionals with the critical tools and perspectives necessary to move beyond surface-level diversity initiatives and engage in the fundamental work of dismantling white supremacy and creating truly equitable and inclusive library and information practices (Leung & López-McKnight, 2021). It calls for a paradigm shift in how librarians understand their roles and responsibilities in shaping a more just information landscape. Libraries need to become the "dynamic, intelligent hubs developing new services and expertise that actively facilitate open science grounded in knowledge justice. This includes and start with acquiring new skills in data science, digital

curation, and technology management (Ann, 2013). Libraries can act as advocates for policies development and advocacy that support equitable open science initiatives and address the digital divide. They can also contribute to developing ethical guidelines for the use of emerging technologies in open science.
According to Ajani and Oladokun (2024), in bridging the digital divide, technological advancements have the potential to enhance accessibility and inclusivity which is the key aspects of knowledge justice, by overcoming geographical barriers and providing access to digital resources for diverse users, including those with disabilities. However, the use of advanced technologies like AI in libraries raises ethical and privacy concerns that can impact knowledge justice principles such as inclusivity, transparency, and intellectual freedom. Therefore, libraries can develop ethical guidelines to ensure these technologies are used responsibly and equitably. Libraries as a hub can build institutional repositories and open access infrastructure for open access to research and data. Innovation in this area could involve developing more user-friendly, accessible, and community-driven platforms that prioritize the needs of diverse knowledge producers and users which can foster scientific collaboration and knowledge sharing among researchers. For communities, and policymakers to advance open science and address societal challenges. Innovative approaches could involve leveraging 5thIR technologies to create virtual collaboration spaces and platforms that intentionally center marginalised voices.
To ensure equitable participation in open science within the 5thIR, libraries must actively work to enhance digital literacy and technology skills among library patrons and staff, particularly in marginalized communities, focusing on different digital literacy programs on promoting inclusive open science engagement. Training, resources, and advocacy, especially for marginalized communities who might otherwise be excluded can be facilitated. To allow users embrace and explore technologies like AI, blockchain, AR/VR, and 5th generation wireless to enhance services and accessibility while remaining mindful of ethical implications and equity. The sources afore mentioned collectively argue that the 5th Industrial Revolution presents a unique opportunity for libraries to redefine their roles. By embracing digital technologies and the principles of Open Science, libraries can become more accessible, inclusive, and collaborative hubs. By actively engaging with the concepts of Knowledge Justice and challenging systemic inequities, libraries can move beyond traditional roles to become powerful agents for social change and innovation in the 21st century. They are not just repositories of information but dynamic centers that empower individuals and communities through equitable access to and engagement with knowledge.

Challenges
Libraries need to address challenges such as limited funding and infrastructure, a shortage of skilled professionals, and the need for supportive policies to effectively promote open science and knowledge justice in a technologically advanced landscape, particularly in regions like Africa (Ann, 2013) lack of infrastructure directly impacts access to open knowledge systems, This is particularly relevant to the Global South, where infrastructure limitations and the high cost of internet bandwidth can hinder the adoption of open science practices.
Identifying and analyzing innovative approaches to open science in the 5th Revolution requires considering how the unique characteristics of this era intersect with the goals of open science and the principles of knowledge justice. The sources suggest several areas where innovation is emerging or necessary. Also, technological advancement plays a key role in open science with its innovative opportunities like internet, open access publishing platform and digital repository, (Xun, et al, 2021). However, the challenge of data security, privacy, digital infrastructure and interoperability are likely to emanate. Although the intersectional relationship gives hope to the marginalised community yet, the risk of intensifying inequalities can occur if marginalised communities lack the necessary resources, infrastructure, or digital literacy to fully participate in the system. The study of Egert & Allen (2017) does not delve into this holistically therefore calling for expert-centered approaches to inclusive knowledge ecosystem (Ogungbeni, et al 2016; Redkina 2021; Ajani & Oladokun 2024). However, the digital divide unequal access to technology and internet connectivity remains a significant obstacle to achieving knowledge justice in a technologically driven environment (Enakrire, et al, 2024).

Methodology
Qualitative research approach was used in this study to explore the role of libraries in empowering open science and promoting knowledge justice and innovation in the 5th industrial revolution. Semi-structured interviews were used as the instrument to gather data because of the explorative nature of the research and that it allows deeper probe into emerging themes while ensuring that key research objectives are systematically addressed. The Population for the study are the heads of libraries in South West Nigeria. A purposive sampling technique was used to select participants Heads of Library in academic library with twenty (20) years of existence.
A total of 10 participants who have direct experience or expertise in open science practices, policy makers and researchers were selected and interviewed. To ensure diverse insights into the variables, an interview guide was developed based on the key themes of the study; Libraries and open science facilitation, knowledge justice principles in library services, innovation roles of libraries in the 5th Industrial

Revolution and challenges and opportunities in redefining libraries' functions. The interviews were conducted via virtual platforms (WatsApp) based on participant's availability and convenience after which the responses were transcribed for analysis.

Findings

This study examines open science in the 5th revolution, and the role of libraries as hubs for knowledge justice and innovation. Thematic content analysis was done to achieve the study objectives. These findings were summarized as follows based on the questions asked during the interview.

How well do you understand the term '5th revolution' from the perspective of knowledge production and societal transformation?

This section provides a foundational understanding of the key principles driving open science in the 5thIR. Open access emerges as the most critical principle in promoting open science within the context of the 5thIR, as it directly influences research accessibility and knowledge sharing. Collaboration is consistently highlighted as crucial for fostering interdisciplinary approaches and accelerating innovation. Reproducibility and transparency are seen as foundational principles for ensuring the credibility and trustworthiness of research in the open science framework. Open data and open methods also receive significant attention, highlighting their importance in ensuring that research processes are transparent, accessible, and usable by others. Open peer review, while mentioned less frequently, remains an important principle for ensuring the quality and integrity of research in an open science environment. This finding implies that open science can foster innovation and ensure trust in research by focusing on the principles of collaboration, reproducibility, and transparency, all of which are critical to keeping pace with the rapid technological advancements in the 5thIR.

What do you see as the benefits and challenges of adopting open science practices in the 5th revolution?

Insights from the analysis revealed that the benefits of open access, particularly increased accessibility, transparency, innovation, and collaboration are central to its value in advancing research. However, the challenges, including Cultural Barriers, Data Management, and Intellectual Property issues, must be addressed for open access to reach its full potential. Libraries and institutions should focus on overcoming these challenges by providing necessary training, developing supportive policies, and ensuring adequate funding and infrastructure. The findings showed that the benefits of open access in the library include increased accessibility. Equitable access to information remains the most frequently mentioned theme. Open access provides a platform for research to be freely available, ensuring that knowledge is accessible to researchers globally. One of the participants emphasized the *importance of making research findings available on public platforms to verify and validate research results*.

The finding also showed that open access increases transparency and accountability. Open access enhances transparency in research processes, allowing for better validation and verification of findings. This also encourages greater accountability in research. Participant 3 highlighted this as a key benefit, *helping researchers ensure that their open access increases transparency*. In addition, open access accelerates innovation by making new research findings available faster to the global research community. Participants 3 and 6 emphasized: *that when research is openly shared, it enables quicker application and further innovation, especially in interdisciplinary work.* This finding is in line with the submission of Harle & Warne (2020). Improved collaboration was also identified as a major benefit. Open access enables increased collaboration among researchers, particularly across disciplines and geographical boundaries. Participants 3, 5, 7 highlighted that the global sharing of information allows researchers from various fields to collaborate more effectively and drive forward knowledge creation. Empowerment of citizen science also emerged as benefit. Participant 6 pointed out that *citizen science can thrive with open access, enabling individuals who are not professional researchers to contribute valuable data and insights to scientific research*. Open access was also perceived as improving research quality. Open access contributes to enhanced research quality by ensuring that research is available for peer review and validation.

Challenges of Open Access in the Library.

Various challenges were pointed out by the participants. Cultural resistance and institutional barriers remain significant challenges in promoting open access. Participant 3 mentioned that certain cultural and institutional norms can prevent researchers from embracing open access, as there may be reluctance to make work freely available due to traditional publishing practices or institutional policies. Effective data management and sharing are essential to support open access, but are often hindered by technical and organizational challenges. Intellectual property (IP) and copyright challenges are major obstacles to open access, as researchers and institutions may be concerned about losing control over their work. Participant 3 highlighted that many researchers are hesitant to share their work openly due to concerns about maintaining ownership and protecting intellectual property rights. Ensuring the quality of research in an open access environment was also significant challenge, particularly regarding the peer review process. Open access

requires sustainable funding models to ensure its long-term viability, and the lack of this could be a barrier to open access quality and sustainability. Another challenge: The lack of necessary skills in data management, AI, and open science principles is a barrier for institutions to fully implement open access. Participants 5 and 7 pointed out that librarians and researchers need specialized skills to manage data and ensure knowledge justice. By implication, to meet the challenges of the 5thIR, libraries must focus on upskilling their staff, supporting local initiatives, and preserving valuable knowledge. The implication of this finding is that while open access can drive forward progress, libraries must navigate these barriers, making it essential for libraries to have robust infrastructure and policies to ensure open access is truly open.

What does it mean for a library to act as a "hub for knowledge justice?

The focus under this section is understanding how libraries can facilitate equitable access to information, foster diverse perspectives, and address information inequalities. The finding revealed that libraries can become hubs for knowledge justice by prioritizing equitable access to information for all, ensuring that no group is left behind. Participant 3 explicitly stated that a library as a hub for knowledge justice means *prioritizing equitable access and addressing information inequalities*. Another role is by promoting digital literacy as essential for ensuring that individuals navigates and effectively use the digital tools available in the 5thIR. Libraries must also engage with their communities to provide relevant resources and services. Libraries also play a critical role in advocating for open access to information and ensuring that their policies support inclusive access. In addition, the finding revealed that libraries should use innovative services, such as virtual reference services, to promote knowledge justice by offering faceless interactions. This can help ensure that all individuals, regardless of their identity, can access resources without bias as suggested by Isiaka, et al, (2024). Also, the finding revealed that libraries can work in partnership with other organizations and communities to improve access to resources and services. Libraries can empower communities and individuals through training and support for local initiatives. The importance of ensuring continual training for staff to keep up with technological advancements were also identified to enable them meet the challenges of the 5thIR. This finding showed that in the 5thIR, libraries must evolve into hubs that not only provide resources but also ensure fair distribution and use of knowledge.

What innovative approaches to open science do you think are particularly relevant or necessary within the context of the 5th Revolution?

The objective of this section is to identify emerging and innovative approaches in libraries for promoting open science and knowledge justice within the context of the 5th Industrial Revolution (5thIR). Key themes emerged from the findings. First, open data and research data management are becoming essential services in libraries, especially in the context of the 5thIR. Participant 1 highlighted the need for libraries to provide services like open data and research data management. This includes supporting researchers in making data findable, accessible, interoperable, and reusable (FAIR) as mentioned by Ogungbeni et al (2016). Open data services support open science by ensuring that data is freely available for researchers and the public, facilitating collaboration and the reuse of research findings. Libraries are increasingly involved in managing and curating large datasets to ensure they are accessible and can be shared across platforms. Next, collaborations between libraries, research institutions, and community organizations were also identified as essential for advancing open science and promoting knowledge justice. Collaboration allows libraries to pool resources, share knowledge, and create innovative solutions to challenges posed by the 5thIR. By working together, libraries can leverage expertise from various fields to create inclusive open science platforms and increase accessibility. Advocacy for Knowledge Justice emerged third. Knowledge justice is about libraries ensuring fair and equitable access to information, and Participant 5 stressed that *"As information professionals, knowledge justice is about being fair in how we acquire, store, and share knowledge. It's essential that libraries foster inclusivity and equality in information access."*

Data privacy and ethical concerns emerged fourth. With the increased use of digital technologies in research and data collection, libraries must ensure that ethical standards are maintained and that user data is protected. Participant 6 noted: *"In the digital age, libraries must be vigilant about data privacy and ensure that ethical considerations guide how we collect and share information.* The need to bridge the digital divide was also emphasized as a key factor. Digital Divide is identified as a challenge to accessing knowledge and technology, particularly for underrepresented or disadvantaged populations. Libraries play a critical role in bridging the digital divide by offering access to technology and providing digital literacy training. This is essential for promoting knowledge justice and ensuring that everyone, regardless of background, can participate in the digital revolution. Participant 6 observed, *"The digital divide remains a major barrier to equal access to knowledge. Libraries must work to ensure that all users have the tools and training they need to engage with digital content."* This response corroborates Afzal et al (2023) where digital divide was identified as one of the major reasons for lack of participation in open access. Next, AI literacy, coding, robotics, and data science skills were also identified as necessary for librarians to effectively engage with the demands of the 5thIR. Participant 9 stated, *"AI literacy and coding skills are essential for future-proofing library services. Librarians need to stay ahead of technological advancements to help users engage with these tools.*

Conclusion

In conclusion, the study gave an understanding of the transformative backdrop of the 5th revolution that is marked by digital technologies and global collaboration, open science emerges as a force in knowledge justice and libraries are no longer a passive repositories of information but driving towards a forward progress. In this paradigm, libraries are repositioning themselves as dynamic hubs for knowledge justice and innovation. By embracing open access, fostering inclusive research environments, and supporting equitable knowledge sharing, libraries can dismantle traditional barriers to scientific participation and empower underrepresented communities. This redefinition not only aligns libraries with the ethical requirements of the open science movement but also ensures their continued relevance and leadership in shaping an equitable knowledge ecosystem.

Recommendations

1. There should be an active involvement and collaboration of diverse stakeholders; researchers, government, students and libraries in developing an inclusive open science initiative that will allow a robust policy that priorities equity, accessibility and transparency.
2. Institutions should invest in open science ecosystem; open repositories, data management tools, and interoperable systems that will enable libraries to support and balance open science practices more effectively.
3. Investment in capacity building for librarians is essential to effectively navigate and use open science tools and platforms.

.

Reference

Ajani, Y., & Oladokun, B. (2024). Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution. *Folia Toruniensia*, *24*, 29–51. https://doi.org/10.12775/FT.2024.002

Afzal, Arfa, Khan, Saima, Daud, Sana, Ahmed, Zahoor & Butt, Ayesha. (2023). Addressing the Digital Divide: Access and Use of Technology in Education. 3. 883-895. https://www.doi.org/10.54183/jssr.v3i2.326.

Ann, S. I. (2013). *Issues and challenges in the development of Open Access publishing and scholarly communications in Nigeria.* https://digitalscholarship.unlv.edu/aaas_pacific_conf

Cornelius-Hernandez, T., & Clarke, A. (2024). The current state of integrating equity, diversity and inclusion into knowledge mobilization: a systematic literature review. *Equality, Diversity and Inclusion: An International Journal*, ahead-of-print (ahead-of-print). https://doi.org/10.1108/EDI04-2023-0134

Dominique, V., Xiya, M. & Hloni, B. (2021). Equitable Open Access publishing: Changing the financial power dynamics in academia. *Global Health: Science and Practice 9*(4):733-736. https://doi.org/10.9745/GHSP-D-21-00145

Egert, P. R., & Allen, B. L. (2017). Knowledge Justice: An Opportunity for Counter-expertise in Security vs. Science Debates. Science as Culture, 28(3), 351–374. http://dx.doi.org/10.1080/09505431.2017.1339683

Ekwueme, Loveth Ogoegbunam, Oluwaseun, Babarotimi Opeyemi, Ajie, Ifeoma Abigail, Ofodu, Patricia Ngozi & Ambrose Smart Eromosele (2024) The impact of 5th industrial revolution technologies on academic libraries: improving diversity and inclusive services in open and distance learning. *Indonesian Journal of Library and Information Science,* 5(2)

Enakrire, Rexwhite Tega., Oladokun, Bolaji David., Ignatius, Onyema Nsirim Ajuru., Gaitanou, Panorea (2024) Paperless libraries: The trending way to go in the fifth industrial revolution. *Greece Business Information Review*, 41(4) 164–173

Feldman, Alice (2019) Knowledge justice as global justice Epistemicide, decolonising the university, and the struggle for planetary survival. https://www.taylorfrancis.com/

Ghalioungui, Jameson Paul (2022). Closing the Gap: Supporting Equity, Diversity, & Inclusivity Plans in the Modern Library" Library Philosophy and Practice (e-journal). 7485.

https://digitalcommons.unl.edu/libphilprac/7485

Harle Jon & Warne Verity (2020) Open Access: challenges and opportunities for Low- and Middle Income Countries and the potential impact of UK policy. The Report of a consultation commissioned by the Foreign, Commonwealth and Development Office in collaboration with the National Institute for Health Research and UK Research and Innovation. https://www.inasp.info

Isiaka, Abdullahi Olayinka; Soliu, Abdulfatai; Aremu, Biliamin Abiola; Bamidele, Benjamin Adebisi; SabaJibril, Saidu & Ibitoye, Adelani Rotimi, (2024). The evolving role of libraries in the fourth industrial revolution: navigating digital transformation. *Library Philosophy and Practice (e-journal)*. 8141) https://digitalcommons.unl.edu/libphilprac/8141

Leung, S. Y., & López-McKnight, J. R. (2021). Knowledge justice: Disrupting library and information studies through critical race theory. T*he International Journal of Information, Diversity, & Inclusion*, 5(4), https://jps.library.utoronto.ca/index.php/ijidi/index

McCoy, D. L., & Rodricks, D. J. (2015). Critical race theory in higher education: 20 years of theoretical and research innovations. *ASHE Higher Education Report, 41*(3), 1

Ogungbeni, John I., Obiamulu, Amaka R., Ssemambo Samuel, & Bazibu, Charles M. (2016) The roles of academic libraries in propagating open science: a qualitative literature review. *Information Development* 1–9. http://dx.doi.org/10.1177/0266666916678444

Onyebinama, Colette Ogugua., Okere, Oluchi Ojinamma., Ayo-Olafare, Funmilayo Racheal & Chima-James Ngozi (2024) Open science and academic libraries in Africa. *Library and Information Perspectives and Research*, 6(1), 249 – 261. http://doi.org/10.47524/lipr.v6i1.250

Redkina, N. S. (2021) The Library in the Information Ecosystem of Open Science. Scientific and Technical Information Processing, 48, (4), pp. 239–247 http://doi.org.10.3103/S0147688221040043

Sheikh Arslan& Richardson Joanna (2023) Open access movement in the scholarly world: Pathways for libraries in developing countries. *Journal of Information Science* 1–19 http://doi.org.10.1177/01655515231202758

Taubert N., Bruns A., Lenke C & Stone G, (2021) Waiving article processing charges for least developed countries: a keystone of a large-scale open access transformation. *Insights,* 34(1), 1–13 https://doi.org/10.1629/uksg.526

Wong, Desmond. (2022) Review of Knowledge Justice: Disrupting Library and Information Studies through Critical Race Theory, edited by Sofia Y. Leung and Jorge R. López-McKnight. Canadian *Journal of Academic Librarianship* 8: 1–4.

Xun Xu, Yuqian Lu, Birgit Vogel-Heuser, & Lihui Wang (2021) Industry 4.0 and Industry 5.0—Inception, conception and perception. 61, 530-535. https://doi.org/10.1016/j.jmsy.2021.10.006.

Preparing Librarians in Academic Libraries for the 5th Industrial Revolution in Delta State, Nigeria

Prof. Esoswo Francisca OGBOMO (CLN)
Delta State University, Abraka, Delta State, Nigeria
ORCID Profile: https://orcid.org/0000-0001-6559-5488
E-mail- esoobas@gmail.com
Phone Number: +2348038349691

Abstract

The 5th Industrial Revolution (5IR) represents a transformative phase of integrating advanced technologies with human-centric approaches, emphasising collaboration between human creativity and intelligent systems. Building on the Fourth Industrial Revolution (4IR), which revolutionised sectors like education and library services, 5IR fostered personalisation, adaptability, and efficiency. This study examined how librarians in Delta State, Nigeria, are being prepared for 5IR, achieved with five research questions which include "What is the current level of technological competency among librarians in Delta State?" "What specific training needs do librarians identify as essential for adapting to the 5th Industrial Revolution?" and "What infrastructural challenges do academic libraries face in integrating advanced technologies?". A descriptive research design, and a population of 170 librarians across 23 tertiary institutions in Delta State, including universities, polytechnics, and colleges of education. A census sampling technique was employed for data collection, ensuring a comprehensive representation. Descriptive statistics, including frequency, percentages, mean, and standard deviation, were applied to analyse the data, with a criterion mean set at 3.00. The study found that librarians in Delta State possess technological competencies slightly below the expected standard, with many categorised as "Somewhat Competent." There is a strong recognition of the need for training, particularly in digital literacy, IT skills, social media, digital marketing, and AI applications, to meet 5IR demands. Inadequate infrastructure, including poor internet connectivity and limited funding, was identified as a significant barrier to technological adoption. The study concluded that there is an urgent need for targeted training programmes to address competency gaps, particularly in digital literacy and AI. Additionally, infrastructure improvements are necessary to support technology adoption in academic libraries. Investment in enhancing connectivity, funding, and resources is essential for libraries to overcome these challenges. There is consensus among librarians on the importance of addressing these issues to effectively prepare for the demands of 5IR. This study highlights the critical need for libraries to adapt and evolve to meet the technological demands of the future and remain relevant in a rapidly changing digital landscape. It was recommended that it is essential to prioritise continuous training programmes for librarians in digital literacy, AI, data analytics, and other relevant technological areas to bridge the skills gap and efforts should be made to improve the infrastructural foundation of academic libraries, including upgrading internet connectivity, increasing funding, and providing the necessary hardware and software to support the adoption of advanced technologies.

Keywords: *Fifth Industrial Revolution (5IR), Infrastructure Challenges, Librarians, Technological Competency, Training Programmes*

Introduction

A librarian is a trained information professional responsible for the acquisition, organisation, preservation, retrieval, and dissemination of information to meet users' academic, research, and informational needs. In the past, librarians were largely seen as custodians of printed materials. However, with the evolution of information and communication technologies (ICTs), their roles have expanded significantly to include information literacy instruction, digital curation, knowledge management, and the integration of emerging technologies into library services (Aina, 2004; Issa et al., 2014; IFLA, 2022). Modern librarians are expected to possess both traditional library skills and digital competencies to function effectively in a constantly changing information landscape.

Academic libraries, as integral components of higher education institutions, are designed to support teaching, learning, and research. They provide access to a wide range of information resources, both print and digital, and serve as hubs for intellectual engagement, scholarly communication, and knowledge creation. Academic librarians, therefore, play a crucial role in empowering students, faculty, and researchers through efficient information services, innovative technologies, and user-centered practices (Popoola & Haliso, 2009; Aina, 2004).

The 5th Industrial Revolution (5IR) marks a transformative phase that integrates advanced technologies with human-centric approaches. Building on the Fourth Industrial Revolution (4IR), which revolutionised sectors like education and library services, 5IR emphasises collaboration between human creativity and intelligent systems, fostering personalisation, adaptability, and efficiency (Mattila et al., 2022). This global shift has significant implications for academic libraries, particularly in Delta State, where librarians face challenges in adapting to these transformative changes. Libraries are evolving from traditional information repositories into dynamic knowledge hubs, leveraging technologies such as

artificial intelligence (AI), machine learning, robotics, cloud computing, big data, and the Internet of Things (IoT) to enhance user experiences, optimise operations, and promote lifelong learning. However, these opportunities are accompanied by challenges, including inadequate infrastructure, limited budgets, and insufficient training programmes, which hinder progress in aligning librarians' skills with the demands of 5IR advancements (Adigun et al., 2024). Strategic investments in resources and professional development are essential for positioning librarians as key facilitators of innovation, research, and collaboration. Addressing these challenges will enable academic libraries in Delta State to solidify their roles as vital institutions in the digital age, enhancing access to information and supporting the educational ecosystem.

Statement of the Problem

The 5th Industrial Revolution (5IR), defined by integrating advanced technologies with human-centric approaches, presents significant challenges for academic libraries in Delta State, Nigeria. Emerging technologies such as artificial intelligence (AI), data analytics, and cloud computing offer vast potential for enhancing library services. However, many librarians lack the necessary skills and training to implement these innovations effectively (Akparobore et al., 2020). Although there is awareness of AI's role in improving library operations, a substantial gap exists in librarians' readiness to integrate these technologies into everyday practices. Challenges such as inadequate infrastructure, limited funding, and insufficient professional development opportunities exacerbate the situation (Tella et al., 2022). Additionally, concerns about job security, as AI systems increasingly perform roles traditionally handled by human librarians, add to the attitudinal barriers.

These technical, infrastructural, and attitudinal challenges hinder librarians' ability to fully leverage the opportunities provided by 5IR. Targeted strategies are urgently needed to build technological competencies, alleviate job security concerns, and cultivate a culture of innovation. Without such interventions, librarians risk diminished effectiveness and relevance in the rapidly advancing digital age. Addressing these issues is crucial for ensuring that academic libraries in Delta State remain indispensable in supporting education and research.

Objective of the Study

The primary objective of this study is to examine preparing librarians in academic libraries in Delta State, Nigeria, for the 5th Industrial Revolution.

Research Questions

The study addressed the following research questions.

1. What is the current level of technological competency among librarians in academic libraries in Delta State?
2. What specific training needs do librarians identify as essential for adapting to the 5th Industrial Revolution?
3. What infrastructural challenges do academic libraries face in integrating advanced technologies?
4. What factors influence the librarians' attitudes/willingness towards adopting new technologies?
5. What strategic measures can be implemented to enhance the preparedness of academic libraries for the 5th Industrial Revolution?

Literature Review

As the Fifth Industrial Revolution (5IR) unfolds—marked by a fusion of advanced technologies and human-centered approaches—academic libraries are challenged to evolve into intelligent knowledge hubs. In Delta State, Nigeria, this shift presents immense opportunities through innovations like artificial intelligence (AI), big data analytics, cloud computing, and the Internet of Things (IoT). However, successful integration requires more than technological procurement; it necessitates skilled personnel, adequate infrastructure, positive attitudes, and strategic planning (Akparobore et al., 2020; Tella et al., 2022).

Current Level of Technological Competency Among Librarians

Librarians' technological competency is a fundamental determinant of academic libraries' ability to adapt to 5IR. Competencies in areas such as AI, digital content management, data analytics, and emerging information systems are increasingly essential for library relevance and innovation (Adigun et al., 2024). However, empirical evidence reveals that many librarians in Nigeria, including Delta State, lack proficiency in these advanced domains (Sidhu et al., 2024). This deficit poses a risk to effective service delivery, as digital resources require technical skills for curation, access, and evaluation. Furthermore, technology-mediated user services like virtual reference and digital literacy instruction demand continual professional upskilling, which remains underdeveloped in many institutions.

Training Needs for Adapting to the 5IR

To bridge this competency gap, librarians have identified continuous professional development as a priority. According to Van der Walt and Badenhorst (2021), effective training should include online courses,

practical workshops, peer learning, and mentorship programs, tailored to specific technologies such as AI applications in cataloguing, virtual services, and digital content creation. Beyond technical skills, librarians require training that fosters critical thinking, creativity, and adaptability—traits vital for human-machine collaboration in the 5IR era. Targeted interventions are also needed to build librarians' confidence and mitigate anxieties associated with disruptive technologies.

Infrastructural Challenges to Technological Integration

Despite growing awareness, infrastructural limitations significantly hinder technological adoption in Delta State's academic libraries. Many institutions struggle with poor internet connectivity, erratic power supply, outdated hardware, and limited access to cloud-based platforms (Nwakaego, 2023). These infrastructural deficits delay the implementation of essential services such as automated library systems, digital repositories, and real-time user support systems. Moreover, limited institutional funding restricts the procurement of modern technologies and the maintenance of existing infrastructure (Akparobore et al., 2020). This highlights the need for both governmental intervention and institutional reforms that prioritize digital infrastructure.

Factors Influencing Librarians' Attitudes and Willingness to Adopt Technology

Librarians' attitudes toward technological change play a critical role in adoption and implementation success. While some embrace the transition with enthusiasm, others exhibit resistance due to fear of job displacement, low self-efficacy, or lack of institutional support (Nasir & Tyagi, 2024). Studies emphasize that a supportive environment—characterized by inclusive leadership, peer support, and open communication—positively influences librarians' willingness to adopt new technologies (Van der Walt & Badenhorst, 2021). Additionally, perceptions of usefulness, ease of use, and relevance to users' needs significantly shape attitudes (Sidhu et al., 2024). Therefore, interventions must address both technical and emotional concerns to foster a culture of innovation.

Strategic Measures to Enhance Preparedness for the 5IR

The integration of 5IR in academic libraries demands strategic, coordinated responses. Comprehensive strategies should include:

- Infrastructure development through government-private sector partnerships (Singh & Thomas, 2021),
- Professional training frameworks embedded in institutional policy, and
- Funding mechanisms that prioritize technological advancement and innovation (Owoeye & Ibitoye, 2021).

Furthermore, libraries must embrace user-centered innovation by implementing AI-powered tools such as personalized recommendations, automated cataloguing, and smart reference services, all of which enhance user experience and operational efficiency (Gul & Khan, 2021). Leadership within academic institutions also plays a vital role in championing change, motivating staff, and aligning library goals with technological trends (Okunoye et al., 2020). Notably, successful models from South African academic libraries underscore the importance of deliberate planning and investment in achieving technological transformation (Dube, 2022).

Methodology

This study employed a descriptive research design. The population of the study is 170 librarians in 23 tertiary institutions in Delta State, eleven universities both public and private, and six polytechnics and colleges of education respectively. The census sampling technique, also known as total enumeration, was adopted for this study as it involves collecting data from every member of the population of interest, ensuring a comprehensive and accurate representation (Babbie, 2016). Questionnaire served as the research instrument for data collection. Descriptive statistics, including frequency and percentages, were used to analyse the questionnaire response rate, while statistical mean and standard deviation were employed to answer the research questions, with a criterion mean set at 3.00.

Results

This section presents the results in line with the bio-data information of the respondents and the research questions.

Table 1: Questionnaire Response Rate

Copies of the Questionnaire Administered	Copies of the Questionnaire Returned	Percentage of Questionnaire Returned
170	168	99%

One hundred and seventy (170) copies of the questionnaire were distributed and 168(99%) copies were returned. The response rate of 99% is considered adequate for the study because the standard and acceptable response rate for most studies including humanities, social and management sciences, health sciences and particularly education is 60% and above (Sataloff & Vontela, 2021).

Table 1: Gender of the Respondents

Gender	Frequency	Percent (%)
Male	53	31.5
Female	115	68.5
Total	168	100.0

Table 2 shows the sex of the librarians. There are 115(68.5%) female librarians and 53(31.5%) males. It can be concluded from the finding that there are more female than male librarians who participated in the study.

Table 3: Highest Educational Qualification of the Respondents

Bachelor's Degree	129	76.8
Master's Degree	34	20.2
Doctorate (Ph.D.)	5	3.0
Total	168	100.0

Out of the 168 respondents, the majority, 129 individuals (76.8%), hold a Bachelor's Degree as their highest educational qualification. A smaller proportion, 34 respondents (20.2%), have attained a Master's Degree, while only 5 respondents (3.0%) possess a Doctorate (Ph.D.). This distribution indicates that the respondents predominantly have undergraduate-level qualifications, with fewer individuals achieving postgraduate or doctoral levels of education.

Table 4: Years of Experience of the Respondents

Years of Experience	Frequency	Percent (%)
Less than 1 year	80	47.6
1-3 years	48	28.6
4-6 years	5	3.0
7-10 years	5	3.0
More than 10 years	30	17.8
Total	168	100.0

Among the 168 respondents, the largest group, 80 individuals (47.6%), have less than 1 year of experience. 48 respondents (28.6%) have between 1 and 3 years of experience. A small proportion, 5 respondents (3.0%), fall into 4–6 years and 7–10 years of experience, respectively. Additionally, 30 respondents (17.8%) have more than 10 years of experience. This distribution reveals that nearly half of the respondents are relatively new to their roles, with less than one year of experience, while a smaller percentage has accumulated significant experience of over a decade.

Research Question 1: What is the current level of technological competency among librarians in academic libraries in Delta State?

Table 5: Technological Competency of the Librarians

S/N	Technological Competency Scale	Extremely Competent	Very Competent	Competent	Somewhat Competent	Not Competent	□	Std.
1	Use of computer software (e.g., MS Office, library management software)	16	20	112	20	0	3.19	0.77
2	Use of digital resources (e.g., online databases, e-books, e - journals)	0	34	96	38	0	2.98	0.66
3	Use of artificial intelligence (AI) in library services (e.g., chatbots, automated cataloguing)	16	32	54	48	18	2.88	1.13
4	Data analytics for library management (e.g., usage statistics, user behaviour analysis)	11	36	41	36	44	2.61	1.26
5	Using social media for library promotion and communication	48	0	102	0	18	3.36	1.21
6	Managing digital archives and repositories (e.g., institutional repositories, digital preservation)	16	16	16	103	17	2.47	1.10
Aggregate Mean							2.91	1.02
Criterion Mean							3.00	

The aggregate mean of 2.91 is slightly below the criterion mean of 3.00, indicating that, on average, the librarians' technological competencies fall just short of the expected standard of "Competent." A score of 3.00 represents the threshold for being fully "Competent." Since the aggregate mean is less than this value, it suggests that the librarians are generally closer to being "Somewhat Competent" than fully "Competent" in their technological skills. This comparison reveals that while some areas of technological competency are closer to the desired level, there is an overall need for improvement to meet or exceed the expected standard.

Research Question 2: What specific training needs do librarians identify as essential for adapting to the 5th Industrial Revolution?

Table 6: Librarians' Training Needs for Adapting to the 5th Industrial Revolution (5IR)

S/N	Training Needs Scale	Extremely Essential	Very Essential	Essential	Somewhat Essential	Not Essential	□	Std. Dev.
1	Digital literacy and information technology skills (e.g., software, online tools, and digital platforms).	36	32	84	0	16	3.41	1.13

2	Artificial Intelligence (AI) and machine learning applications in library services (e.g., chatbots, automated cataloguing).	40	32	32	48	16	3.19	1.34
3	Big data analytics and usage for library management (e.g., usage statistics, user behaviour analysis).	34	16	56	32	30	2.95	1.35
4	Digital scholarship and research data management (e.g., digital archives, open-access publishing).	34	24	32	46	32	2.89	1.41
5	Social media and digital marketing for library promotion (e.g., social media platforms, online communication).	32	32	69	19	16	3.27	1.18
6	Cloud computing and library data management (e.g., cloud storage, cloud-based library tools).	40	32	32	32	32	3.10	1.45
Aggregate Mean							3.13	1.31
Criterion Mean							3.00	

The aggregate mean of 3.13 is above the criterion mean of 3.00, indicating that, on average, librarians perceive the listed training needs as more than "Essential" and closer to "Very Essential." This result highlights a strong recognition among librarians of the importance of acquiring these skills to adapt to the demands of the 5IR. The comparison between the aggregate mean and criterion mean shows that librarians generally recognise the importance of training for adapting to the 5IR. Training in digital literacy and IT skills, social media and digital marketing, and AI applications are particularly emphasized as critical. However, areas such as big data analytics and digital scholarship fall slightly below the overall standard, suggesting they are considered less urgent but still necessary.

Research Question 3: What infrastructural challenges do academic libraries face in integrating advanced technologies?

Table 7: Infrastructural Challenges Faced by Academic Libraries in Integrating Advanced Technologies

S/N	Infrastructural Challenges	Severe Challenge	Significant Challenge	Moderate Challenge	Minor Challenge	No Challenge	□	Std. Dev.
1	Inadequate funding for acquiring and maintaining technology (e.g., hardware, software, and staff training).	52	84	16	16	0	4.02	0.89

2	Poor internet connectivity, affecting access to cloud -based services and online resources.	34	118	16	0	0	4.11	0.54
3	Insufficient staff training on new technologies, resulting in resistance or lack of readiness to adopt advanced tools.	38	98	32	0	0	4.04	0.65
4	Inconsistent or unreliable power supply affecting technology usage in the library.	36	100	32	0	0	4.02	0.64
5	Lack of technological infrastructure (e.g., computers, servers, or mobile devices) for library staff and users	20	116	32			3.81	0.63
6	Challenges in managing or storing large volumes of digital content (e.g., e-books, e-journals, research data).	36	84	32	16	0	3.83	0.87
Aggregate Mean							3.97	0.70
Criterion Mean							3.00	

The aggregate mean of 3.97 is significantly higher than the criterion mean of 3.00, indicating that librarians perceive infrastructural challenges as severe to significant overall. This reflects the substantial barriers academic libraries face in adopting advanced technologies. The comparison between the aggregate mean and criterion mean shows that infrastructural challenges are a major impediment to integrating advanced technologies in academic libraries. The most severe challenges are poor internet connectivity, inadequate funding, and insufficient staff training, while issues such as technological infrastructure limitations and managing digital content are also notable but slightly less critical. Addressing these challenges is essential for successful technological integration.

Research Question 4: What factors influence the librarians' attitudes/willingness towards adopting new technologies?

Table 8: Factors Influencing Librarians' Attitudes and Willingness to Adopt New Technologies

S/N	Factors Influencing Librarians' Attitudes and Willingness to Adopt New Technologies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	□	Std.
1	I am confident in my technological competency and comfortable using new technologies in my work.	100	52	16	0	0	4.50	0.67

2	I am more willing to adopt new technologies if there is institutional support (e.g., funding, resources, training) available.	113	55	0	0	0	4.69	0.46
3	I believe that leadership in my library plays a key role in motivating the adoption of new technologies.	84	84	0	0	0	4.50	0.50
4	I am more willing to adopt new technologies if they are perceived as easy to use and enhance my work efficiency.	48	84	0	16	16	4.29	0.45
5	I believe that the cost of implementing new technologies is a significant barrier to adoption in my library.	52	68	0	16	32	3.55	1.49
6	I am more willing to adopt new technologies when there are clear professional development opportunities and training available.	72	64	0	16	16	3.99	1.29
Aggregate Mean							4.25	0.81
Criterion Mean							3.00	

The aggregate mean of 4.25 is significantly higher than the criterion mean of 3.00, indicating that librarians generally agree or strongly agree with the identified factors influencing their attitudes and willingness to adopt new technologies. This suggests a positive disposition toward technology adoption when favourable conditions are present. The aggregate mean suggests a predominantly positive attitude toward adopting new technologies, contingent upon key influencing factors. Institutional support, leadership motivation, and confidence in technological competency are the most critical enablers. While concerns about costs are noted, they are less influential than factors such as training and ease of use. Addressing these key motivators and barriers can foster a more conducive environment for technology adoption in libraries.

Research Question 5: What strategic measures can be implemented to enhance the preparedness of academic libraries for the 5th Industrial Revolution?

Table 9: Strategic Measures to Enhance the Preparedness of Academic Libraries for the 5IR

S/N	Strategic Measures to Enhance 5IR	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	□	Std. Dev.
1	Investing in high -speed internet, AI, and cloud computing.	88	48	16	0	16	4.14	1.21
2	The integration of AI-powered systems and big data technologies.	68	84	0	0	16	4.12	1.12
3	Continuous professional development programmes focused on emerging technologies (e.g., AI, cloud computing, data analytics).	51	101	0	0	16	4.02	1.08
4	Cybersecurity to protect sensitive user data.	104	32	16	0	16	4.05	1.53

5	Collaborations with technology providers, universities, and research institutions for advancing technological integration in academic libraries.	102	50	0	0	16	4.32	1.17
6	Adopting of AI -powered reference services is important for improving user experience and information access.	85	67	0	0	16	4.22	1.15
Aggregate Mean							4.14	1.21
Criterion Mean							3.00	

The aggregate mean of 4.14 exceeds the criterion mean of 3.00, signifying that respondents generally agree or strongly agree with the strategic measures identified. This highlights the importance of these strategies in preparing academic libraries for the demands of the 5IR. The findings revealed a strong consensus on the strategic measures required to prepare academic libraries for the 5IR. The highest-rated measure is collaboration with technology providers and academic institutions, followed by the adoption of AI-powered reference services. Investing in infrastructure, integrating advanced systems, and offering continuous professional development are also deemed essential. Emphasising these strategies can significantly enhance the readiness of academic libraries to embrace the opportunities of the 5IR.

Discussion of Findings

The finding indicated that the technological competencies of librarians in Delta State, Nigeria, are slightly below the expected standard. While some possess near-desired skills, many remain closer to the "Somewhat Competent" category. This aligns with the broader context of the 5th Industrial Revolution (5IR), where academic libraries face pressure to integrate technologies like AI, big data, and cloud computing. However, infrastructural challenges, gaps in expertise, and fear of job displacement hinder full adoption, reflecting Sidhu et al. (2024), which emphasized the critical role of librarians in adapting to new technologies.

Librarians in Delta State strongly recognised the need for training to meet 5IR demands. They view these training needs as "Very Essential," particularly in digital literacy, IT skills, social media, digital marketing, and AI applications. This awareness is supported by Akparobore et al. (2020) and Tella et al. (2022), who highlighted that while AI, big data, and cloud computing can greatly enhance library services, gaps in technological skills and infrastructure slow progress. Many librarians still lack proficiency in critical areas like AI and data analytics.

Infrastructural challenges are perceived as significant by librarians in Delta State. This suggests substantial barriers to adopting advanced technologies, consistent with findings from Akparobore et al. (2020), Tella et al. (2022), and Sidhu et al. (2024), which noted that poor internet connectivity and limited funding are major obstacles in Nigerian libraries.

Librarians showed a generally positive attitude and willingness toward technology adoption, provided the right conditions are in place. This optimism aligns with Akparobore et al. (2020), who recognized the transformative potential of AI, big data, cloud computing, and IoT in enhancing library services during the 5IR.

There is consensus among respondents on the importance of strategic measures to prepare academic libraries for 5IR. The findings emphasise the urgency for libraries in Delta State to adapt, addressing technological competency gaps, inadequate infrastructure, and limited funding, as outlined by Adigun et al. (2024).

Conclusion

The findings showed that librarians in Delta State, Nigeria, face challenges in meeting the demands of the 5th Industrial Revolution (5IR), especially in technological skills, infrastructure, and training. While some librarians have technological competencies, many fall short, underscoring the need for further development. Infrastructural issues, like poor internet and limited funding, hinder the adoption of technologies like AI and big data. Despite these challenges, librarians are open to technology adoption if proper training and infrastructure are provided.

Recommendations

The following recommendations are hereby made:

1. It is essential to prioritise continuous training programmes for librarians in digital literacy, AI, data analytics, and other relevant technological areas to bridge the skills gap.

2. Efforts should be made to improve the infrastructural foundation of academic libraries, including upgrading internet connectivity, increasing funding, and providing the necessary hardware and software to support the adoption of advanced technologies.
3. Libraries should collaborate with technology providers and educational institutions to secure affordable and effective technological tools and resources, ensuring the integration of AI, big data, and cloud computing into library services.
4. There is a need for awareness campaigns to emphasise the importance of technology adoption for enhancing library services and the role of librarians in this transformation. This will help mitigate resistance and foster a more proactive attitude towards change.
5. The government should provide policies that support the integration of advanced technologies in academic libraries, including financial support for infrastructure development and training initiatives.

References

Adigun, G.O., Ajani, Y.A., & Enakrire, R.T. (2024). The Intelligent Libraries: Innovation for a Sustainable Knowledge System in the Fifth (5th) Industrial Revolution. Libri, 74(3),211-223. https://doi.org/10.1515/libri-2023-0111

Aina, L. O. (2004). Library and information science text for Africa. Third World Information Services.

Akparobore, D. O., Omosekejimi, A. F., & Nweke, A. C. (2020). Librarians' awareness, positive attitude, and ICT skills: A panacea for effective service delivery in the Fourth Industrial Revolution (4th IR) era in academic libraries in Southern Nigeria. Library Progress International, 40(2), 184-194. https://doi.org/10.5958/2320-317X.2020.00021.5

Babbie, E. (2016). The practice of social research (14th ed.). Cengage Learning.

Dube, M. (2022). The impact of artificial intelligence on library management in South Africa: An empirical study. Library Management, 43(4), 285-296. https://doi.org/10.1108/LM-06-2021-0271

Gul, S., & Khan, M. (2021). AI-powered reference services in academic libraries: A user-centered approach to enhancing user experience. Information Services & Use, 41(1), 57-68. https://doi.org/10.3233/ISU-200085

International Federation of Library Associations and Institutions (IFLA). (2022). IFLA guidelines for continuing professional development: Principles and best practices. https://www.ifla.org

Issa, A. O., Amusan, B., & Daura, U. D. (2014). Information science and librarianship. Ilorin: Department of Library and Information Science, University of Ilorin.

Mattila, V., Gauri, P., Dwivedi, P., & Dadhich, D. (2022). The Fifth Industrial Revolution: Enlightenment of 5ire towards Industry 5.0. International Journal of Creative Research Thoughts (IJCRT), 10(8), 173-180. www.ijcrt.org

Nasir, M., & Tyagi, P.K. (2024). Transforming academic libraries for the future: Adapting to changing times. Conference: International Conference on Recent Trends in Academic Libraries Systems and Services At: Manav Rachna International Institute of Research and Studies, Faridabad. Pp. 1-10. https://www.researchgate.net/publication/382298331_Transforming_Academic_Libraries_for_the_Future_Adapting_to_Changing_Times

Nwakaego, O.F. (2023). linked data technology and linked open data in academic libraries in Nigeria: Level of integration, challenges and potential solution. International Journal of Intelligent Information Systems, 12(2), 31-38. https://doi.org/. 10.11648/j.ijiis.20231202.12

Okunoye, A. R., Ibidapo, O. A., & Olojede, A. M. (2020). Strategic leadership in academic libraries: Embracing technological innovation in the 5th industrial revolution. Library Management, 41(5), 313-327. https://doi.org/10.1108/LM-10-2019-0332

Owoeye, J. O., & Ibitoye, S. O. (2021). Challenges of adopting emerging technologies in Nigerian academic libraries: Infrastructure and funding constraints. African Journal of Library, Archives and Information Science, 31(2), 105-118. https://doi.org/10.4314/ajlais.v31i2.6

Popoola, S. O., & Haliso, Y. (2009). Use of library information resources and services as predictors of the teaching effectiveness of social scientists in Nigerian universities. African Journal of Library, Archives and Information Science, 19(1), 65–77.

Sidhu, G.S., Sayem, A.A., Taslima, N., Anwar, A.S., Chowdhury, F., & Rowshon, M. (2024). AI and workforce development: A comparative analysis of skill gaps and training needs in emerging economies. IJBMS, 4(8), 12-28. https://doi.org/10.55640/ijbms-04-08-03

Singh, R., & Thomas, J. (2021). Collaboration and partnerships in academic libraries: Staying ahead in the 5th industrial revolution. Journal of Library Technology, 55(2), 132-144. https://doi.org/10.1108/JLT-08-2020-0050

Tella, A., Okojie, V., Abdullahi, F., & Ajani, Y.A. (2022). The future of libraries in Nigeria during the Fourth Industrial Revolution. Portal: Libraries and the Academy, 22, 547 - 558. https://preprint.press.jhu.edu/portal/sites/default/files/tella.pdf

Van der Walt, T., & Badenhorst, P. (2021). Developing technological competencies in librarians: The role of training programmes. Journal of Library and Information Science, 19(2), 55-72. https://doi.org/1

Prospect of Artificial Intelligence (AI) on Library and Information Service Delivery in Academic Libraries

By
Maxwell, Ezinne Charity PhD (CLN)
Department of Library & Information Technology
School of Management Technology
Federal University of Technology, Ikot Abasi
P.M.B. 1055, Akwa Ibom State
Email: maxwell.charity@gmail.com/
charitymax@futia.edu.ng
Phone No: 08066017390
&
Omoniyi, Olayinka Martins
University Library
Federal University, Lokoja, Kogi State
Email: yinka.omoniyi@fulokoja.edu.ng
Phone No:08126138695

Abstract
Libraries are increasingly embracing the technology of artificial intelligence (AI), which assists in easy access to information. The study examined the prospects of artificial intelligence in service delivery in academic libraries in Nigeria. Four key research questions guided the study: to identify library and information service delivery provided in academic libraries; to explore AI technologies that can be used for service delivery in libraries; to determine the potential significance of AI adoption to library service delivery in academic libraries; and to identify the impediments associated with AI adoption to library service delivery in academic libraries. Employing a systematic review design, the study analysed and synthesised findings from 40 peer-reviewed journal articles published between 2020 and 2025 using four reputable electronic databases such as Google Scholar, Research Gate, Science Direct and Taylor and Francis. Keywords were used to search for relevant literature, and results were categorised based on the objectives. The paper generates insights into the type of library and information service delivery provided by academic libraries, including indexing and abstracting services, reference services, user education, research assistance, virtual references, online reservations, and digital repositories. Artificial intelligence, such as chatbots and virtual assistance, was employed for service delivery in academic libraries to enhance reference services, answer questions, increase user satisfaction and save time for users. Natural language processing and machine learning approaches enhance search capabilities, and AI-assisted catalogues help reduce the cataloguers' stress and time. The potential significance of AI revealed that using AI would be a welcome development towards enhancing better user experience, improved resource discovery, increased efficiency, enhanced research support, and improved accessibility, among others. Further highlights on the major impediments reveal insufficient finance, high cost of establishing an AI system, lack of technical skills, fear of job loss, unreliable power supply and lack of policy on AI. The recommendations suggest a framework document for AI policy, provision of digital infrastructure facilities, human capital development and generation of data for AI application training, and adequate financial support for the effective implementation of AI technology in libraries.

Keywords: academic libraries, artificial intelligence, AI technologies, library services, digital transformation, information services delivery.

Introduction

The mission of any library is service delivery, which is to provide timely, accurate and relevant information resources to support academic, research, cultural enrichment and support to our endeavours. The role of libraries has long been recognised as an invaluable community resource, providing access to knowledge and information. However, in today's digital age, the role of libraries goes beyond simply housing books, offering quiet study spaces and providing digital content via digital platforms that transform academic activities, research, healthcare, and businesses. ICT refers to the convergence of computing, telecommunications, and broadcasting technologies to facilitate the creation, storage, processing and exchange of information. The rapid advancement of ICT has transformed various aspects of modern life and has contributed significantly to effective service and goods delivery in today's world. The emergency of Information and Communication Technology (ICT) has changed how we live, work and communicate (UNESCO:2020). Information and Communication Technology (ICT) and Artificial Intelligence (AI) are closely linked as they complement and enable each other to improve society.

Libraries have evolved tremendously since computer access became widely available, and the rate of change has accelerated. Libraries serve as the backbone of educational institutions, providing access to knowledge and essential information for academic pursuits. Academic libraries are crucial for educational establishments because they give lecturers and students access to knowledge and information. The primary objectives of the library include collection and preservation, information dissemination, research support, education and literacy, and support for lifelong learning. These objectives have not changed, but the means

of achieving these objectives have changed with the emergence of ICT and other means of accessing written and recorded knowledge in libraries. This technological era has made knowledge creation, generation, processing, organisation, analysis, storage, transfer, distribution, dissemination, retrieval and delivery easy and more available using digital devices. Libraries have adopted, and in some cases facilitated, new technology and procedures that have improved their ability to fulfil their basic mission, providing customers with access to as much material as possible to acquire knowledge and enjoy reading.

Artificial intelligence (AI) is one of the most promising technologies that has helped industries and businesses, including libraries, to actualise their goals in this era; AI is an enhancing tool in this disruptive era to automate processes, provide personalised services, and improve user experiences. These advantages are made possible because of its potential significance, capacity to carry out tasks more effectively and efficiently, and virtual assistants provided 24/7, Adeyemi et al. (2025), Donkor & Afrane (2023). Similarly, Oniovoghai et al. (2023) noted that AI can analyse patrons' search history, borrowing patterns and course enrolment to suggest relevant resources, promoting discovery and engagement with library materials.

The nature of academic libraries in the fifth industrial revolution will be significantly impacted by artificial intelligence and advanced computer technology, presenting quality differences in various fields, including information delivery services. Many nations of the world have embraced and practically integrated AI technologies in their operations and functions; scholars like Tella (2020), Chandrashekara (2024) and Yusuf et al. (2025) gave credence to this assertion that integrating AI into library and information service delivery will transform the way libraries manage and provide access to information. The present article explores the future of artificial intelligence in libraries and information service delivery in academic libraries. By harnessing the power of artificial intelligence (AI), libraries can enhance user experiences, personalise services, and ensure equitable access to information for all purposes.

Library and information service refers to the provision of organised access to information resources, such as books, journals, journals, databases, and other materials, to support the informational needs of users. The primary goal of library and information services is to provide accurate, relevant and timely information to support learning, research and personal development. The components of library and information service collection development, cataloguing and classification, reference and information services, circulation and access, and technical services. Library and information services benefit users in the following ways: they support learning and research, promote information literacy, and support entrepreneurship, innovation and development. It plays a crucial role in supporting the informational needs of users and fostering community engagement.

Library and information service delivery refers to the libraries' provision of information services and resources to users. Services include references, information retrieval research assistance, instruction and education. The resources are physical collections, digital collections and online resources. The delivery methods are in-person services, remote services, and outreach services. Any service delivery aims to meet user needs, support research and learning, promote information literacy and contribute to users' successes.

Statement of the Problem

With the vast information expulsion in the world today, there is a significant need for individuals, organisations and society to require a new strategy, tools and skills to manage information effectively and make sense of the vast amounts of data available with speed. Artificial intelligence, with its ability to analyse a large number of data and make intelligent predictions, has the potential to revolutionise how libraries operate and serve their communities. Integrating Artificial Intelligence (AI) into Library and Information Science (LIS) services has significantly transformed how libraries manage and provide access to information. AI has the potential to impact operations such as cataloguing, information retrieval, user services, and data analysis to enhance library operations and improve information access for diverse user communities. Mulimani (2024). Adopting artificial intelligence for effective library services in academic libraries in Nigeria is setting a new level of efficient and effective library service delivery, Yusuf et al. (2022). Academic libraries are the hub and the backbone of any educational system set to study learning, teaching and quality research at all levels. Therefore, academic libraries are expected to have and hold all that will facilitate effective and efficient service delivery to their community of users. There is limited study on systematic literature review on the future of artificial intelligence (AI) in libraries and information service delivery in academic libraries. Molokwu, & Izuakolam (2020) investigated the use of innovative tools for library instruction and Services in Federal Universities in South-South Nigeria. The finding revealed that the inadequate provision of innovative tools affects patronage and the adequate delivery of library instruction and service to patrons in their different geopolitical locations. Against this backdrop, this study examines the prospect of artificial intelligence (AI) in library and information service delivery in academic libraries to bridge the knowledge gap.

Research Questions

The study seeks to provide answers to the following questions:

1. What type of library and information service delivery do academic libraries provide?
2. How can artificial intelligence (AI) technologies be used for library and information service delivery in academic libraries?
3. What are the potential significance of AI adoption in information service delivery in academic libraries?

4 What impediments are associated with AI adoption to information service delivery in academic libraries?

Objectives of the Study

The study's main objective is to examine the future of artificial intelligence in libraries and information service delivery in academic libraries.

The specific objectives are to:

1. Identify the type of library and information service delivery provided in academic libraries,
2. Explore AI technologies that can be used for library and information service delivery in academic libraries.
3. To find out the potential significance of AI adoption in information service delivery in academic libraries,
4. Identify the impediments associated with AI adoption to information service delivery in academic libraries.

Literature Review

This section presents a review of related literature. The review is presented as follows:

Concept of Artificial Intelligence (AI)

Artificial intelligence (AI) is a technology that enables computers and machines to simulate human learning, comprehension, problem-solving, decision-making, creativity and autonomy, and can understand and respond to human language. Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. Examples of AI applications include expert systems, natural language processing (NLP), speech recognition and machine vision.

Artificial intelligence is a branch of computer science concerned with the invention of computers capable of human-like mental processes such as learning, reasoning and self-correction. Artificial intelligence is the technology that enables robots to plan, learn, reason, solve problems, move, and, to some extent, be creative. AI integration has resulted in revolutionary changes that have improved the efficacy and efficiency of service delivery, including academic library services. Artificial intelligence (AI) use in libraries is one of the most revolutionary technological developments libraries can adopt. Adopting AI in the library setting can enhance services and give patrons access to reliable information, which can spur growth and development in this era of information. Akinyemi (2023) revealed that the way information is gathered and processed in this era is constantly changing with the help of numerous AI applications.

These tasks cover natural language understanding, pattern recognition, experiential learning, complex problem-solving, and decision-making. Several subfields of artificial intelligence, most notably machine learning, focus on techniques enabling systems to learn from data and improve performance over time without direct programming. Natural language processing is a primary domain that helps machines to understand and interact with human language (Russell & Norvig, 2020). Artificial intelligence can be classified into two primary categories: limited artificial intelligence and general artificial intelligence. Narrow artificial intelligence, or weak artificial intelligence, is engineered to perform a narrow function, such as voice assistance or recommendation systems. General artificial intelligence, or strong artificial intelligence, aspires to execute any intellectual job achievable by a person; nevertheless, this level of artificial intelligence remains predominantly theoretical (Frenk et al., 2020).

Furthermore, AI systems can evaluate historical search queries and interactions to recommend pertinent resources or new titles, cataloguing and metadata administration, etc. Artificial intelligence can streamline the cataloguing process by producing metadata and categorising materials precisely (Dwivedi et al., 2021). Natural language processing methods extract and systematise information from documents, diminishing the manual labour needed for cataloguing (Oyeniran & Olajide, 2019). Artificial intelligence methods can enhance the uniformity and quality of metadata within digital collections (Sahabi & Otobo, 2022). Artificial intelligence-powered virtual assistants and chatbots provide real-time support to library patrons. These tools manage standard inquiries, assist users in accessing library materials, and offer information regarding library services (Smith, 2024).

Methodology

This study invested the prospect of artificial intelligence in library and information service delivery in academic libraries in Nigeria. Four key objectives guided the study: to identify library and information service delivery provided in academic libraries; to explore AI technologies that can be used for service delivery in libraries; to determine the potential significance of AI adoption to library service delivery in academic libraries; and to identify the impediments associated with AI adoption to library service delivery in academic libraries. Employing a systematic review design, the study analysed and synthesised findings from 40 peer-reviewed journal articles published between 2020 and 2025 using four reputable electronic databases such as Google Scholar, Research Gate, Science Direct and Taylor and Francis. Keywords such as "artificial intelligence", "AI technologies and library service delivery", "AI adoption", AI potential significance", and AI impediments in library service delivery" were used during the search. The data from the literature were analysed using thematic analysis**.**

Findings of the study

This section presents the findings of this study in line with the themes of the objectives as follows:

The Type of Library and Information Service Delivery Provided in Academic Libraries.

Academic libraries provide various types of library and information services to support the teaching, learning and research needs of their users and the research requirements of their scholarly communities, such as indexing and abstracting services, reference services and user education (Njume & Tazitabong, 2024). Online services and research assistance are the types of library and information service delivery provided by academic libraries for library users revealed by (Okwoli et al., 2023). Technological developments, especially the integration of ICT and the Internet and Artificial Intelligence (AI), have changed how these services are delivered to improve accessibility, efficiency, and user satisfaction. Recent research underlines the vital importance of information and communication technology (ICT) in enhancing service delivery in academic libraries, Osaloruka, Okpokwasili & Adindu (2024). Using management, processing, and communication of information resources, AI aids libraries in providing services, including Online Public Access Catalogs (OPAC), virtual references, online reservations, and digital repositories. By facilitating quick and relevant access to information vital for academic performance, the intentional use of ICT has improved the quality of librarians' service delivery. Insufficient infrastructure and power supply still impact service quality in specific Nigerian academic libraries, highlighting the need for strategic investments and training (Ogungbade, 2024). Library and information service delivery provided in academic libraries includes but is not limited to Reference Services, Readers services, Circulation Services, E-library/E-resources services, and Technical Services. Library and information service delivery encompass activities that create, preserve, and disseminate knowledge, skills, and artefacts that characterise emerging technologies, such as the Internet and email, within library and information centres. The provision of library and information services is essential to libraries, and it encompasses the methods and activities that libraries employ to provide information services and resources to users to augment user engagement and productivity. Uganneya (2011) asserts that the delivery of library and information services comprises a series of mechanisms whose interactions dictate the effectiveness of these services. He affirms that library and information services consist of a unique array of activities that collectively and individually facilitate the development and dissemination of information resources, establishing the framework through which management formulates and executes policies to impact library service processes.

The emergency of ICTs in information service delivery has revolutionised how librarians provide services to users. Librarians today facilitate continuous access to information resources within and beyond the library confines (Enakrire & Oladokun, 2023). Alabi and Sani (2021) asserted that librarians are at the forefront of delivering information services to their communities to support teaching, learning, and research requirements. According to Ebiwole in Alabi and Sani (2021), libraries provide information services that encompass referral services (RS), Current Awareness Services (CAS), Selective Dissemination of Information (SDI), Internet Services (IS), Interlibrary Loan Services (ILLS), Reference Services (RS), and Circulation Services (CS).

How can artificial intelligence (AI) technologies be used for library and information service delivery in academic libraries?

Artificial intelligence-powered chatbots and virtual assistants have the tools to enhance academic library reference services. These systems provide 24-hour assistance to library customers by guiding them through library resources and addressing regularly asked questions (Asemi et al., 2021). For example, the University of Oklahoma Libraries implemented "Bizzy," a chatbot that responds to frequently asked questions, freeing librarians to handle more challenging research queries (Hervieux & Wheatley, 2021). Comparably, the Monash University Library's chatbot "Pixel" has shown considerable increases in user satisfaction and response times (Lund & Wang, 2023). A study by Cox et al. (2021) revealed that artificial intelligence chatbots can efficiently answer roughly 70–80% of frequent reference questions, dramatically reducing user waiting times. Machine learning helps these systems get more accurate as they process increasing interactions. Artificial intelligence systems have revolutionised user search of library resources. Natural language processing (NLP) and machine learning approaches enhance search capabilities, enabling more practical and straightforward information retrieval (Zhan & Widén, 2022). These systems analyse user activity, search trends, and content links to generate more pertinent search results. Studies by Frederick (2021) suggest that AI-enhanced discovery systems can 25–35% increase resource utilisation when compared to traditional search interfaces. Customised to scholarly resources, these systems offer personalised recommendations based on user profiles, search history, and academic interests, much as commercial platforms like Amazon or Netflix (Lund & Wang, 2023).

Artificial intelligence applications in technical services have substantially improved metadata-producing efficiency and classification capacity. Machine learning algorithms can also be used by OCLC's Project Passage, which uses artificial intelligence to automatically generate descriptive information for digital collections, improve cataloguing processes, automatically extract metadata from digital documents, material classification, and subject heading suggestions (Santamaria & Groenendyk 2021). Studies by Santamaria and Groenendyk (2021) reveal that AI-assisted cataloguing can cut processing times by

30–40% even when metadata quality is maintained or improved. This efficiency allows libraries to manage ever-fast-expanding collections and distribute human knowledge to more difficult cataloguing tasks.

Artificial intelligence technologies improve the user experience in academic libraries mostly by customising, accessibility, and convenience. Personalised recommendation systems enable increased resource discovery and use by suggesting relevant tools depending on user interests and behaviour patterns (Asemi et al., 2021). Research by Hervieux and Wheatley (2021) suggests that tailored recommendations can enable undergraduate students to make up to 40% more use of resources. AI-powered translating services and text-to-speech tools increase accessibility for a spectrum of user groups, including international students and those with disabilities (Santamaria & Groenendyk, 2021). These technologies help libraries to serve more diverse scholarly audiences while enabling their promise of fair access. Libraries can release staff workers for more high-value projects by automating routine tasks with artificial intelligence. Libraries using artificial intelligence for ordinary operations exhibit 15–25% increases in staff time accessible for direct user assistance and specialised services, according to research by Wilkinson et al. (2022). This efficiency is particularly crucial considering libraries' financial constraints and staffing limits.

AI technology also provides 24-hour service availability free of corresponding labour cost hikes. Virtual reference systems driven by artificial intelligence can guarantee constant service availability, which is especially important for enabling remote learning and multinational students across time zones (Cox et al., 2021). Artificial intelligence analytics deepens knowledge of collection use, user behaviour, and efficient service for libraries. These insights support evidence-based strategic planning, service development, and resource allocation decisions (Frederick, 2021). Libraries using artificial intelligence analytics report improved targeting of outreach initiatives and congruence between collections and curriculum needs (Zhan & Widén, 2022).

The potential significance of AI adoption in library and information service delivery in academic libraries

Commenting on the significant potential of artificial intelligence to the progress of academic libraries, artificial intelligence has been identified as a technology that has revolutionised the processes and services of the library in recent times with the objective of improved search and discovery of materials, personalised services, digitalisation and preservation of library materials and supporting inclusiveness in the accessibility of library resources (Halburagi, Suryakanth & Mukarambi, 2023). Memela (2023) describes it as the new hope for academic libraries for the provision of automated services to users, as it is one of the technologies that has risen to play a significant role in the upcoming fifth industrial revolution. According to a study by Ogwo et al. (2023), artificial intelligence can increase productivity, improve customer satisfaction through personalised service, make information more easily available and accessible, and facilitate collaboration and knowledge sharing. In the same vein, Olayode (2023) reveals that AI technology has the potential to simplify library functions, enhancing efficiency and improving quality service delivery. Omame & Alex-Nmecha (2020) reveal that AI adoption in library operations will result in error-free operations, working round the clock without getting tired as a human, freeing the library staff from tedious tasks, giving them room and time to do more demanding jobs, speed, efficiency and effectiveness are all the potentials of AI that would improve service delivery in libraries. Yusuf et al. (2022) identified the potential significance of AI adoption to library and information service delivery in academic libraries as having a new level of efficient and effective library service delivery, enhanced user experience, improved resource discovery and ability to take complex work. To attest to these findings, Moustapha & Yusufu's (2023) study revealed increased efficiency, enhanced research support, improved accessibility and data-driven decision-making as the potential significance of adopting artificial intelligence in academic libraries. Igbo et al, (2024). From the foregoing, adopting AI in academic libraries can transform library and information service delivery, enabling libraries to support their users' research, teaching and learning needs. Asim et al. (2023), in a study, identified that the key developments, benefits, challenges, and future implications of AI in LIS services have the potential to enhance library operations and improve information access for diverse user communities but have their challenges in developing countries such as Nigeria it includes financial uncertainty, job loss, low degree of awareness and adoption, and technological defects, among others. Moustapha & Yusufu (2023).

Omolabake (2024) revealed that AI facilitates intelligent search and retrieval, enabling patrons to quickly and easily find relevant information and helping librarians identify patterns and trends in informing collection development and library services. Oyetola et al. (2023) and Owolabi et al. (2022) indicated the recognised benefits as enhanced efficiency, increased productivity, improved customer services, informed decision-making, personalised experience and reduced risks and errors.

Impediment associated with AI adoption to information services delivery in academic libraries.

The adaptation of librarians to integrate AI in libraries is a multifaceted process shaped by numerous elements, including anxiety related to technology advancements and the degree of readiness to accept these transformations. Oladokun et al. (2023) examined the anxieties that librarians may encounter and the strategies that enhance their readiness for AI integration. The authors additionally asserted that librarians demonstrate technophobia, an aversion to new technology, which may be intensified by apprehensions of

job displacement caused by AI automation. Librarians are concerned that AI may supplant their functions in assisting and curating materials. Nonetheless, research indicates that AI can augment librarians' expertise rather than supplant it. It can mitigate this apprehension by equipping librarians to comprehend the interdependent relationship between AI and their responsibilities (Orr & Niegaard, 2020).

Moreover, resistance to change is a prevalent human response when confronted with technological transformations. Librarians are concerned that the integration of AI may disrupt existing workflows and necessitate acquiring new skills (Kvenild & Calkins, 2017). Professional growth chances and thorough training courses help librarians to move smoothly into AI-enhanced surroundings. Lund and Wang (2023) found that librarians without technological literacy may find it challenging to embrace AI solutions since ignorance about AI technologies fuels a dread of the future. Consequently, training programs offering fundamental technology literacy and practical expertise with AI tools can mitigate this apprehension. Although librarians may take pride in delivering personalised, human-centric services, the advent of AI could be viewed as a decrease in the human element in user interactions. Lee and Shim (2017) contended that librarians must recognise that AI may augment their capacity to deliver personalised suggestions and insights, improving the user experience.

Artificial intelligence adoption (AI) in academic libraries creates numerous obstacles that prevent its complete integration into the information services offering. These difficulties cover financial, technical, and cultural aspects and are several, particularly in underdeveloped nations like Nigeria and South Africa (Zondi et al., 2024); high expenses related to acquiring and sustaining artificial intelligence technology and limited financing for AI initiatives were significant limits for libraries to attend to its capacity of making required infrastructure and tool investments (Shahzad et al., 2024). Marinclin et al., 2024). Effective deployment and maintenance of AI systems suffer from a lack of knowledge and technical abilities among library staff members (Mupaikwa, 2024). Particularly in areas with underdeveloped digital ecosystems, poor network connectivity and insufficient technological infrastructure restrict AI adoption even more (Akinola, 2023). A cultural obstacle to adoption is created by opposition to change among library employees and worries about artificial intelligence replacing human roles (Giwa et al., 2024). The design of procedures and adaptation to AI-driven technologies might disturb established library operations and cause resistance to adopting AI technologies (Abba, 2025). Data security and user confidence question privacy issues and ethical consequences of artificial intelligence use in libraries (Akinola, 2023). Debatable is the possible influence of artificial intelligence on the human element in library services and critical thinking, influencing adoption and integration (Marinclin et al., 2024). Tella (2020) identifies institutional inadequacies, a lack of necessary facilities and policies and a lack of innovative library managers. Odeyemi ( ) noted financial constraints, the high cost of implementing an AI system, incomplete automation, emerging skill gaps, absence of technical skills, fear of job loss, lack of adequate infrastructure and unreliable/erratic power supply. Omame & Alex-Nmecha (2020) observed that high system development, maintenance costs, and limited availability of AI experts among library automation vendors are part of the challenges facing the full adoption of AI in library information service delivery in Nigeria seems to be a mirage.

Conclusion

It is concluded that artificial intelligence will continue to ease library and information services delivery in academic libraries in Nigeria. The comprehensive review conducted in this article has highlighted the types of library and information services provided in academic libraries and the diverse ways AI technologies are employed in libraries, including indexing and abstracting services, reference services, and user education. Online services and research assistance for library users. Others were Online Public Access, virtual references, online reservations, digital repositories, referral services (RS), Current Awareness Services (CAS), Selective Dissemination of Information (SDI) and internet Services such as email (IS), Inter-Library Loan Services (ILLS) and Circulation Services, (CS). The key challenges include insufficient infrastructure, power supply, and lack of skilled professionals.

Looking at artificial intelligence technologies (AIT) that can be used for service delivery in academic libraries, the findings of the study affirm that AI technologies can be used in academic libraries for library and information service delivery as powered chatbots and natural language processing, virtual assistants, robot, AI-based assisted cataloguing, bibliography assistants, AI generative, AI discovery, AI digital literacy resources. AI Research Assistant, AI-based LibGuide, barcode, RFIDs and AI automated routine tasks. In this area, one of the key challenges is the need for sustainable funding and improved staffing to meet targets and goals. Libraries using artificial intelligence technologies have improved their target of achieving outreach initiatives and congruence between collections and users' information needs; adopting AI technologies will enhance library professionals and librarians to focus on more complex activities like research support and community engagement. Chandrashekara, & Mulimani (2024)

Considering the potential significance of AI adoption to the delivery of library and information service in academic libraries, the study reveals improved search and discovery of materials, personalised services, digitalisation, and preservation of library materials, as well as supporting inclusiveness in the

accessibility of library resources as the new hope for academic libraries for providing automated services to users. AI adoption is one of the technologies that have risen to play a significant role in the upcoming fifth industrial revolution. The findings indicate a potential increase in productivity and customer satisfaction through personalised service, making information more easily available and accessible and facilitating collaboration and knowledge sharing. In the same vein, Olayode (2023) reveals that AI technology has the potential to simplify library functions, enhance efficiency and improve quality service delivery. Omame & Alex-Nmecha (2020) reveal that AI adoption in library operations results in error-free operations, working round the clock without getting tired as a human, freeing the library staff from tedious tasks, giving room and time to handle more demanding jobs, speed, efficiency, and effectiveness are all the potential significant of AI adoption. It has the following to offer: enhanced user experience, improved resource discovery, increased efficiency, enhanced research support, improved accessibility, and data-driven decision–making.

AI technologies to library and information service delivery reveal through a systematic literature review the impediments as follows: lack of technological infrastructure, including insufficient high-speed networks and integrated systems; technophobia nature of some librarians, especially the older librarians who are library managers now towards the adaptation of AI-driven tool for fear of job loss, high cost of establishing an AI system, lack of skilled experts in AI system, poor internet connectivity. Lack of a clear AI policy and strategic plan for implementation by government and institutions, unrealistic/ erratic power supply, institutional inadequacies, and financial constraints, emerging skill gaps were the factors that hindered AI adoption in library service delivery academic libraries in Nigeria. Based on the outcomes, this study has been able to emphasise the prospect of AI in library and information services delivery in academic libraries in Nigeria with some suggestions as follows: to have a framework document for AI policy, provision of digital infrastructure facilities, human capital development and generation of data for training in AI applications, and provision of adequate financial support for effective implementation of AI technology in libraries.

Limitations of the Study

The study on the prospect of artificial intelligence in library and information service delivery in academic libraries in Nigeria from 2020 to 2025 has several limitations. One of the significant limitations is the reliance on a systematic review design, which is inherently dependent on the availability and accessibility of the existing literature; this approach limits the study's ability to capture real-time feedback from respondents in the field. Although the study used major academic databases, there is some possibility that some relevant studies on this topic are unpublished studies, and institutional reports may not be indexed or included in the databases used for the review. This limitation may reduce the study outcome's comprehensiveness. More so, there is a limitation of the period that the study covered from 2020 to 2025; some earlier foundational studies could have provided a historical perspective or context that has been omitted. Additionally, the study did not involve primary data collection, such as interviews or survey research design with practising professionals in the academic libraries or their users; as such, the analysis may lack empirical depth regarding the lived experiences, perceptions and practical challenges faced by academic librarians who interact directly with library users thereby creating an absence of user- centred or practitioner-focused perspectives may limit the study's ability to capture complex barriers, acceptance patterns or real-world outcomes of artificial intelligence adoption and integration into library and information service delivery in academic libraries in Nigeria.

Recommendations

Based on the findings, the following recommendations are proffered:

1. The study recommends diversifying service offerings to include reference services and information literacy and embracing technology to enhance service delivery, such as online catalogues, digital repositories and virtual reference services.
2. Need to implement the use of chatbots and virtual assistants 24/7 support for users to develop a personalised AI-powered recommendation system that suggests relevant resources, articles and books based on search history and interest and an AI digital service that can answer complex research questions and provide personalised support.
3. Need to enhance user experiences through awareness creation and staff training and development to improve operational efficiency.
4. A framework document for AI policy, provision of digital infrastructure facilities, human capital development and generation of data for training in AI applications, and adequate financial support for effective implementation of AI technology in libraries.

References

Abba, T. (2025). Use of Artificial Intelligence Technologies in Rendering Library Services: An Empirical Evidence from University Libraries in Africa. SciSpace - Paper. https://doi.org/10.4314/ajlais.v34i1.2

Adeyeye, S.O & Oladokun, B.D, Taofeek, A (2023). Application of emerging technologies for research support in Nigerian academic libraries: trends, problems and prospects, IASSIST Quarterly 47 (3-4) 1-8. https://doi.org/10.29173/iq1069 .

Adeyemi I, Sanni R, Shittu R, Shiru M, and Shittu F (2025). Perceived influence of Innovation

Management and Library Service Delivery in selected Kwara State, Nigeria academic libraries. International Information &Library Review 1-20. https://doi.org/10.1080/10572317.2025.2453807
Adetayo, A. (2023).Artificial intelligence chatbots in academic libraries: The rise of ChatGPT. Library Hi Tech News, 40 (3) 18-21. https://doi.org/10.1108/lhtn-2023-0007
Adjei, E. (2024). Artificial intelligence and academic libraries: Challenges and opportunities for service delivery. Library Hi Tech News, 41(1), 12–18. https://doi.org/10.1108/LHTN-01-2024-0001
Agbo, A. D. (2015). Application of ICT facilities in special libraries: impetus for effective information service and organisational growth. International journal of research. 2(1), 155–165.
Akinola, S. A. (2023). Capabilities and Apparent Implications of Artificial Intelligence (AI) Adoption in Nigerian Academic Libraries. University Library at a New Stage of Social Communications Development, 8, 283–289. https://doi.org/10.15802/unilib/2023_293813
Akinyemi, Omolabake E. (2024). Enhancing academic library services delivery using artificial intelligence (AI). Library Philosophy and Practice (e-journal)8042. https://digitalcommons.unl.edu/libphilprac/8042
Akpukpu, A. O. V., & Osawele, R. E. (2025). Adoption of artificial intelligence by librarians for effective service delivery in academic libraries in Edo State. Communicate: Journal of Library and Information Science, 26(2), 182–190. Retrieved from https://www.cjolis.org/index.php/cjolis/article/view/124
Alabi, C. O. & Sani, J. O. (2021). Librarians and Information service delivery in Kogi state, Nigeria, during the COVID-19 pandemic. Journal of Applied Information Science and Technology 14 (1) 107-117. Retrieved from https://www.jaistonline.org/14vol1/12.pdf
Asemi, A., Ko, A., & Nowkarizi, M. (2021). Intelligent libraries: A review on expert systems, artificial intelligence, and robot. Library Hi Tech, 39(2), 412-434. https://doi.org/10.1108/LHT-02-2020-0038
Chandrashekara, G.S and Mallikarjun Mulimani (2024). The Impact of Artificial Intelligence on Library and Information Science (LIS) Services International Journal of Innovative Practice and Applied Research (IJIPAR), 14(5), 50-56.
Cox, A. M., Pinfield, S., & Rutter, S. (2021). Academic libraries' stance toward the future: A review of strategic plans. Journal of Academic Librarianship, 47(3), 102319. https://doi.org/10.1016/j.acalib.2021.102319
Davenport, T. H., & Ronanki, R. (2018). Artificial Intelligence for the Real World. Harvard Business Review, 96(1), 108–116.
Dwivedi, Y. K., et al. (2021). Artificial Intelligence (AI): Multidisciplinary Perspectives on Emerging challenges, opportunities, and Agenda for Research, Practice and Policy. International Journal of Information Management, 57(101994). https://doi.org/10.1016/j.ijinfomgt.2019.08.002
Emezie N. A. & Nwaohiri N. M. (2013) 21st Century Librarians and Effective Information Service Delivery. Journal of Information and Knowledge Management, 4(1), 30–43.
Frederick, D. E. (2021). Libraries, data and the fourth industrial revolution (4IR). Library Hi Tech News, 38(1), 1–11. https://doi.org/10.1108/LHTN-08-2020-0078
Frenk, J., et al. (2020). Health Professionals for a New Century: Transforming Education to Strengthen Health Systems in an Interdependent World. The Lancet, 376(9756), 1923–1958.
Giwa, A. O., A. A. Ogundana, & O. S. Ozonuwe. (2024). Awareness and adoption of artificial intelligence towards information management in selected academic libraries in Southwestern Nigeria. Library and Information Perspectives and Research, 6(2), 81–94. https://doi.org/10.47524/lipr.v6i2.82
Halburagi, S & Mukarambi, P (2023). Use of artificial intelligence (AI) Technology future in the library. International Journal of Research in Library Science. (IJRLS)9(2) : 14-19 Doi:10.26761/IJRLS.9.2.2023.1642.
Hervieux, S., & Wheatley, A. (2021). Perceptions of artificial intelligence applications in the academic library. The Journal of Academic Librarianship, 47(1), 102184. https://doi.org/10.1016/j.acalib.2020.102184
Huang et al. (2023). Artificial intelligence in academic libraries strategy in the United Kingdom and Mainland China. The Journal of Academic Librarianship. 49: 102772.
Igbo, U, Nwabuisi, T I,Jidere, U.I & Ugwu, F.N (2024).Adopting artificial intelligence in academic library services in Nigeria: requirements & challenges. Nigerbiblios: 34(1) 1-18 retrieved from https://nigerbiblios.nin.gov.ng/index.php/nigerbiblios/article/view/145
Jansen, B. J., Spink, A., & Bateman, J. (2020). The Role of Predictive Analytics in Libraries: Trends and Applications. Library Management, 41(7), 475-490.
Lawal , U et al (2025). The role of robots in libraries: essential skills and knowledge for librarians in the era of industrial 5.0. Unpublished paper prepared for presentation at NLA 63rd Conference Edo State July.
Lund, B. D., & Wang, T. (2023). Artificial intelligence in libraries: A systematic literature review and analysis. The Journal of Academic Librarianship, 49(1), 102622. https://doi.org/10.1016/j.acalib.2022.102622
Marinclin ,A, Idlbek, R., & Miroslav P. (2024). Application of Artificial Intelligence in Academic Libraries. Bsniaca, 29, 221–238. https://doi.org/10.37083/bosn.2024.29.221
Memela, M. (2023). Artificial intelligence (AI) enlightens academic libraries on the phenomenon. Journal of Information Processing, 2 (3) 1-10. https://doi.org/10.13140/RG.2.32481.89443.
Mensa C. F, Udoh I.U & Osiebe P.O (2023). Systematic analysis of the adoption of innovative Technologies in providing electronic information services in Akwa-Ibom state, Nigeria public universities. Centre for Digital Philosophy, philipapers.org, digitalcomms.un/.edu Philipaper.org
Moustapha, A. A & Ibrahim O. Yusufu (2023). Adoption of artificial intelligence to Improve library service delivery in academic libraries in Kwara State, Nigeria. Library Philosophy and Practice (e-journal) 7915. https://digitalcommons.unl.edu/libphilprac/7915
Mupaikwa, E. (2024). The Application of Artificial Intelligence and Machine Learning in Academic Libraries. Advances in Information Quality and Management, 1–18. https://doi.org/10.4018/978-1-6684-7366-5.ch041

Nzang D, & Awandia, J.T(2024). Information service delivery and its impact on student's academic Achievement in tertiary institution libraries within the Buea Municipality. Greener Journal of Social Sciences.14(2) 117-128
Odeyemi, S. (2019). Robots in Nigerian academic libraries: investigating infrastructural readiness and potential for library services. Paper presented at IFLA Information Technology Satellite Meeting held on 21-22 August at the Technical University of Applied Sciences Wildau, Germany.
Ogungbade, A. A. (2024). Work design, ICT use and service delivery of librarians in private universities in Oyo State, Nigeria. Contemporary Journal of Library and Information Science, 7(1). https://www.cjolis.org/index.php/cjolis/article/view/128/110
Ogwo, U, Ibegbubulem, F & Nwachukwu, V (2023). Applications and perceived impact of artificial in academic libraries in Nigeria. Library Philosophy & Practice (e-journal) 7907. https://digitalcommons.unl.edu/libphiprac/7907
Oladokun, B.D et al (2023). Emergency technologies: implications for Nigerian academic libraries. Library Hi Tech News 40(6) 15-18
Olayode, M.M. (2022). Role of technological innovations and the adoption of artificial intelligence in contemporary library service delivery. Retrieved from https://nioaim.org/wp-content/uploads/2022/06/Role-of-Technological-innovations-and-adoption of artificial, pdf
Omame, I.M & Alex-Nmecha, J.C (2020). Artificial intelligence in libraries in Osuigwe, N (ed), Managing and adapting Library Information Services for Future Users, IGI Globa, pp 120-144, doi:10.4018/978-1-7998-1116-9.ch008
Orubebe, E. E., Nwagwu, W. E., & Ofili, A.(2024). Artificial intelligence adoption in Nigerian academic libraries: Challenges and prospects. Library Philosophy and Practice (e-journal),1-20.
Orubebe, et al (2024). Adoption and utilisation of artificial intelligence in academic libraries: challenges and opportunities in developed and developing nations. International Journal of Knowledge Content Development & Technology.1-13 1(11)
Oyetola, S., Bolaji, D., Maxwell, C & Akor, S. (2023). Artificial intelligence in the library: Potential implications to library and information services in 21st-century Nigeria. SSRN Electronic Journal. DOI:10.2139/ssm.4396138
Osaloruka, R. N. Okpokwasili, N. P. & Adindu L. (2024) Enhancement and Application of Generative Artificial Intelligence Tools in Collection Development in Libraries in Nigeria. International Journal of Innovative Information Systems & Technology Research 12(3):57-66. DOI: 10.5281/zenodo.13623826.
Owolabi, et al (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. Library Management 43 (3-4) 296-305.
Owolabi, K.A, Adeleke, F.N, Ajayi, T.A & Adesina, O (2020). Awareness and perception of the artificial intelligence in managing university libraries in Nigeria, Journal of Interlibrary Loan, Document Delivery and Electronic Reserve, 29 nos 1-2 pp13-28.
Pence, E. Harry (2022). Future of artificial intelligence in libraries. The Reference Librarian 63 (1) 1-11 https://DOI:10.1080/02763877.2022.2140741
Russell, S. J., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.
Sahabi, M. K., & Otobo, E. E. (2022). Academic Library and Challenges of Service Delivery in Nigerian Universities in the Digital Era. Information Impact: Journal of Information and Knowledge Management, 12(2), 51–61. https://doi.org/10.4314/iijikm.v12i2.4
Santamaria, M., & Groenendyk, M. (2021). AI and academic libraries: A literature review. Journal of Academic Librarianship, 47(5), 102346. https://doi.org/10.1016/j.acalib.2021.102346
Shahzad, K., Khan, S. A., & Iqbal, A. (2024). Effects of artificial intelligence on university libraries: an SLR of cite score and IF journals' articles from 2018 to 2023. Global Knowledge, Memory and Communication. https://doi.org/10.1108/gkmc-12-2023-0498
Smith, S. (2024). The Pivotal Role of Academic Librarians in Digital Learning The Pivotal Role of Academic Librarians in Digital Learning, by Melissa N. Mallon, Libraries Unlimited, 2017, 170pp., $50.00, ISBN: 978-1-4408-5218-3. Journal of Electronic Resources in Medical Libraries, 21(1), 50–51. https://doi.org/10.1080/15424065.2024.2319259
Tella, A (2020). Robots are coming to the libraries: Are librarians ready to accommodate them? Library Hi Tech News 37: 13-7 https://doi.org/10.1108/LHTN-05-2020-0047
Uganneya, S. A. (2011). Information service provision and user satisfaction in Agriculture Research Libraries in Nigeria. Unpublished Ph.D. Thesis, University of Nigeria Nsukka. P. 225
Ukaegbu, Bernadette C.N,& Okwu E, (2022). Utilisation of emerging technologies for improved Service delivery in public university libraries in Rivers State, Nigeria. Ghana library journal 21(2) 190-198
Wilkinson, Z. T., Lewis, D. W., & Sawyer, S. (2022). A survey of artificial intelligence implementations in academic libraries. Information Technology and Libraries, 41(1), 1–21. https://doi.org/10.6017/ital.v41i1.13513
Yusuf, T I, O A Adebayo, L A, Bello & J. O Kayode (2022). Adoption of Artificial Intelligence for Effective Library Service Delivery in Academic Libraries in Nigeria. Library Philosophy and Practice (e-journal). 6804. https://digitalcommons.unl.edu/libphilprac/6804
Zhan, M., & Widén, G. (2022). Understanding big data in librarianship. Journal of Librarianship and Information Science, 54(1), 96-108. https://doi.org/10.1177/0961000620955249
Zondi,N.P et al. (2024). A review of artificial intelligence implementation in academic library services. South African Journal of Libraries and Information Science. https://doi.org/10.7553/90-2-2399

Readiness and Competencies of Librarians for Embracing the 5th Industrial Revolution in Nigeria

Ngozi Perpetua Osuchukwu
Department of Library and Information Science
Nnamdi Azikiwe University Awka
np.osuchukwu@unizik.edu.ng

&

Victor Wagwu
Dame Patience Goodluck Jonathan Automated Library,
Ignatius Ajuru University of Education Rumuorlumeni, Port-Harcourt, Rivers State, Nigeria

Abstract

Every professional updates and upgrades himself to be relevant with the changing era. This study investigated the knowledge and the readiness of embracing of the 5th industrial revolution by librarians in Nigeria. It examined the competencies built, the national and international agencies they benefited from and the challenges in embracing the 5IR in the new era. This was a survey research design that used online survey in data collection. The online survey was posted in the librarians' platforms. 67 respondents attended to the survey. It was discovered that 52% of the librarians are ready for 5IR, 50.7% agreed on having knowledge of 5IR, 47.7% revealed that they have high extent on the competencies on (ChatGPT, QuickChat, Grammarly, etc) and the use of cloud computing (Google Apps, dropbox, etc) while 50.7% rated low extent on the use of analytical tools (SPSS, Excel, python etc). 77.6% rated that they benefited from training organized by Nigerian Library Association (NLA) and its sections, majorly. The discovery also had it that 55.2% strongly agreed that non provision of new technologies causes challenge with inadequate skills, 52.2% internet connectivity among others. The data were analyzed using SSPS with simple frequencies and percentages. The results were presented in Tables and figures. The study recommended more adoption and adaptation, more training from other sectors and provision of the needed infrastructures. The implication is that if the competencies are not sustained and the needed infrastructures are provided, librarians' inspiration may be reduced and this will affect information services.

Keywords: *5th industrial revolution, information services, librarians, professional*

Introduction

It is no doubt that the world changes and adapts to new technologies. These changes are evidently seen in the phases of technologies over time. The new technologies of the twenty first century come with steady but expansive movement that takes the world like a storm. That includes the 5th Industrial revolution which also erupts in the library and information services. In the words of Ekwueme, Oluwaseun, Ajie, Ofodu & Ambrose (2024) the 5th Industrial Revolution (5IR) marks a transformative period where information resources and services transition into a technologically driven format accessible, anytime, anywhere through ICT devices. This explains the critical need to embrace the digital world with the new technologies in rendering the smart services of the global trend.

This rapid development brings to the fore the point of readiness of librarians in taking the leap into the transformative world of 5IR. It should be noted that Murata Manufacturing company (2023) defined 5th industrial revolution as "sustainability," "human-centeredness," and "concern for the environment" in addition to transformation of the industrial structure through the utilization of Artificial Intelligence (AI), Internet of Things (IoT), big data, etc., which was debated in the Fourth Industrial Revolution. Besides, Nwobu, Dumbri, Lbia & Oladokun (2024) characterized 5IR as the integration of digital technologies, artificial intelligence, and the Internet of Things. It makes sense therefore that professionals in different sectors follow up to establish their relevance, products and services within the trends of 5th industrial revolution.

What this means is that library and information science (LIS) professionals must step out to gear up with the new skills in the changing era. They must be competent with AI and Robotics which have been adopted in the library and information sector. Thus, as new technologies are evolving, it makes sense that emphasis is made on more capacity building of the librarians to match the global trens and best practices. These include the smart machines, human centredness, cognitive intelligence, machine-level efficiency, AI, quantum computing, bio-engineering, augmented reality and virtual reality, robotics, advanced materials, etc (World Economic Forum, 2025). These may sound high but that is where the world is, right now. The readiness and the competencies are meant to be linked for greater services.

It is of utmost importance that librarians learn the technical know-how in using the new technologies in 5IR (Ghosh, Mukherjee, Narsalay, Basu, Sengupta, Chakraborty & Prasad, 2024). In other words, the facilities and the expertise on information services of content creation, dissemination, sharing, collaboration and networking must be re-learned. But there seems to be challenges working against the competencies and the

readiness of the Nigerian librarians. The issues of efficient infrastructures, erratic power supply, building digital contents, exposure to regular training have been identified (Tella, Bamidele, Olaniyi & Yusuf, 2023). This makes it clear to understand the critical need of ensuring total acceptance of the 5IR by the Nigerian librarians. Thus, this paper investigated the readiness of embracing the 5th industrial revolution by information professionals in Nigeria.

Statement of the problem

The concept of 5th industrial revolution has waged on online coming with its relevance and changes in the information spaces. The libraries and librarians are significant parts of the 5IR and the global information sector where relevant information with digital, AI, robotics, IoT, collaborative services, data and library management are seamless. However, observations and experiences in the library and information sectors seem to indicate that librarians are not ready to embrace the 5IR. It is also not very clear the extent of their competencies and the facilitators of their training. Perhaps, 5IR still sounds like a rocket science to some professionals. There is need for LIS professionals to level up to the 5th industrial revolution which is being brandished as the global trends. The world is watching. This study, therefore, sought to explore how ready the librarians are in embracing the 5th industrial revolution in the information realm of services.

Objectives of the study

The general objectives of this study was to investigate the readiness of embracing the 5th industrial revolution by information professionals in Nigeria. Specifically, it is to

1. Confirm the knowledge of 5IR by librarians in Nigeria
2. Ascertain the readiness of the librarians in embracing 5IR in Nigeria
3. Determine the extent of competencies acquired by librarians in embracing 5IR in Nigeria
4. Identify the national and international agencies that support the training of librarians in readiness for 5IR
5. Find out the challenges of adapting to 5th industrial revolution by librarians in Nigeria.

Research questions

The following research questions were used for the study

1. What is the extent of knowledge of 5IR by librarians in Nigeria?
2. To what extent are librarians ready to embrace the 5th Industrial revolution in Nigeria?
3. What is the extent of librarians' competencies in embracing the 5IR in Nigeria?
4. What are the national and international agencies that support the training of librarians in readiness for 5IR?
5. What are the challenges that militate against 5th industrial revolution by librarians in Nigeria

Literature review

The 5th industrial revolution comes in a new package to fill the gaps of the 4th industrial revolution and create moere knowledge of the new concept. This must be the reason the World Economic Forum (2025) asserted that technology convergence across industries is accelerating innovation, particularly in AI, biotech and sustainability, pushing us closer to the fifth industrial revolution. The new terms seem to be making the head heavy but that is the feeling of new technology until it is mastered and controlled. It is not an understatement to note that the library sector understands the importance of change while the librarians have the full knowledge of the technicalities with the trend in order to remain relevant. Hence the 5IR coming with the transformation and revolution of ways of organizing, accessing, managing and sharing information is not out of order (Nwobu et al, 2024). This logic must be viewed critically.

The description of 5IR included Ziatdinov, Atteraya & Nabiyev (2024) explanation that the Fifth Industrial Revolution is a Transformative Step towards Society 5.0. by examining how Society 5.0 affects various aspects of human society (e.g., advances in healthcare and improved life expectancy; business, the economy, growth, and industry; education and skills; privacy and cybersecurity; smart cities; labour and the workforce). Indeed, these are not far from the services of the libraries and information centers. The librarians have been offering these services but this time, it needs high powered services with the relevant technologies, collaboration, data scientists to integrate new knowledge of the societies and the people therein (Ibinaiye & Jiyane, 2021).

The readiness to adopt these are the nuances this paper is investigating. The readiness and willingness of the information professionals to embrace the 5th IR will assure all the answers in amplifying the information services of the now and the future. Evidences showed that librarians' readiness have been investigated. Nwobu et al, (2024) emphasized the need for librarians' readiness in the 5IR for global services. Another study on readiness of librarians in adapting to the 4IR by Anunobi, Obiamalu and Obuezie (2021) revealed that LIS professionals are ready in view of their exposure to all the necessary training required to engage in 4th IR technologies. The above 50% responses indicated the readiness of the professionals to engage in big data, graphics, multimedia, and robotics. Although this is 4IR, it has some semblances with the 5IR.

Again, from what Ziatdinov, Atteraya & Nabiyev (2024) noted, the expected technological advancement in 5th IR addresses complex global challenges, economic development with sustainable environmental impact, workforce transformation and more collaborative work with humans and machines, global connectivity with 5G networks and IoT, smart cities, and infrastructure advancement. This displays the necessary areas and connections the librarians should focus on in the digital spaces to improve services and inclusive library services. Information professional must be ready to adopt and adapt to accommodate the changing needs and the environment.

Studies have shown that some librarians have knowledge and the necessary skills to operate the 5IR in library services. This was confirmed by Ekwueme et al (2024) who reported in their findings that librarians exhibit collaborative and digital skills essential for working with both people and machines in delivering library services to learners. The fact is that, it is one who knows that can apply the knowledge and the skills. Believably, if the librarians are well equipped, the indication is that their competencies will be displayed showing their skills as teaches, enablers, facilitators in all their service provision (Myers & Rivero, 2020). Thus library professionals were assessed on their extent of use of digital information resources and services for accessing the global practices, digital asset management platforms, and online research tools, information and digital literacy (Adamu et al, 2024; Tella et al. 2023; Affum & Dwomoh, 2023). This shows the essence of accepting the new era with the training for the professionals in information services.

Importantly, librarians need training and capacity building. There are evidences of institutions, agencies, government, and individual, organizations both local and international that support the capacity building of the librarians. For instance, Ogbomo, Ebhonu & Etagbedavwe (2023) noted that the Admiralty University of Nigeria (ADUN) Library trained its librarians on Koha Integrated Library Management System (ILMS) implementation focusing on planning, acquisition and how the software is used. This enhanced the librarians' skills and improved the library services. Again, IFLA (2025) has continued to create opportunities to re-imagine how libraries and librarianship can benefit from the Fifth Industrial Revolution and serve communities by enhancing information access, empowering engagement with these tools, and acting as advocates for information literacy in a world faced with the challenges of AI-powered misinformation. These activities are implemented every year through many IFLA Sectors and Regions. AfLIA (2023) has been providing training and knowledge based courses for LIS Educators, Librarians, Archivists, Museum professionals, Students to equip them with the new trends in standing out in their roles as information professional. Besides, professional driven workshops and conferences have been organized by Nigerian Library Association (NLA) at chapter levels and sections, living up to the one of the missions of NLA which includes provide professional development opportunities for librarians (NLA 2025). All these help librarians to level up in their services.

But then, amidst all these efforts, issues have continued to emerge with 5IR technologies. These include erratic power supply, inadequate skills of the librarians (Ekwueme et al, 2024). There is also the challenge of accommodating the new changes (Apriliyanti & Ilham, 2022). Studies also pointed out fake news, proliferation of digital content (Nwobu et al, 2024), information overload, distinguishing between fact and fiction (Alojaiman, 2023) as some of the challenges to tackle in the 5IR era. These challenges affect the seamless information services. It is therefore, important they are tackled.

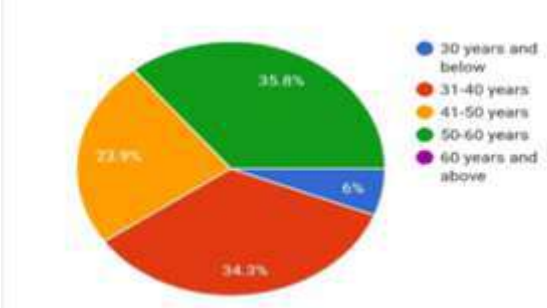
Methodology

A survey research design was adopted for this study. The librarians from the different Whatsaap platforms formed the population. A self-structured online survey was sent to the librarians' Whatsaap platform where they were requested to fill it. The survey was ledft for one week to enable respondents fill it. Six seven responses were recieved. The survey was made up of two sections. Section A was demographic data while Section B was made up of research questions. The respondents were asked to tick their preferences. The responses were: Strongly agree, Agree, Disagree and Strongly disagree. There were also: Very High Extent, High Extent, Low Extent and Very Low Extent. The responses below 50% were adjudged to be negative while responses above 50% are positive. The data was analyzed using simple frequencies and percentages. The results were presented in charts and figures.

Results

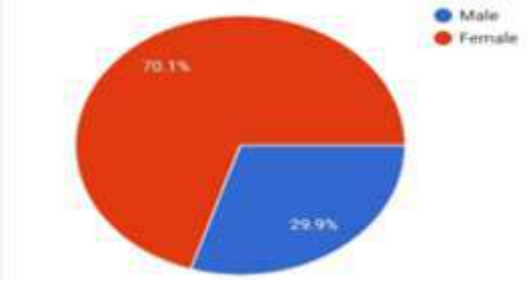
Demographic data of librarians in Nigeria

Chart 1: Age range of the respondents



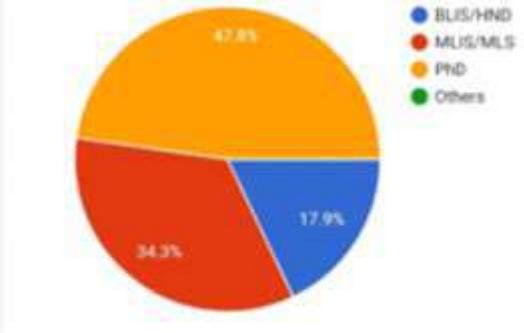
The age range showed that respondents from 50-60 years constituted 54.8%, while age 31-40 was 34.3%, 41-50 was 23.9% and 30years below was 6%. There was no respondent from 60 years and above. This shows an inclusive age range of the respondents with 41 60 years topping the list.

Chart 2: Gender distribution of the respondents



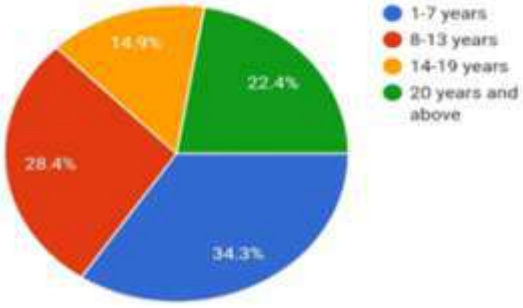
The Chart discloses that female respondents ranked 70.1% while male was 29.9%. This shows that there were more number of women who responded to this survey than men

Chart 3: Educational qualifications of the respondents



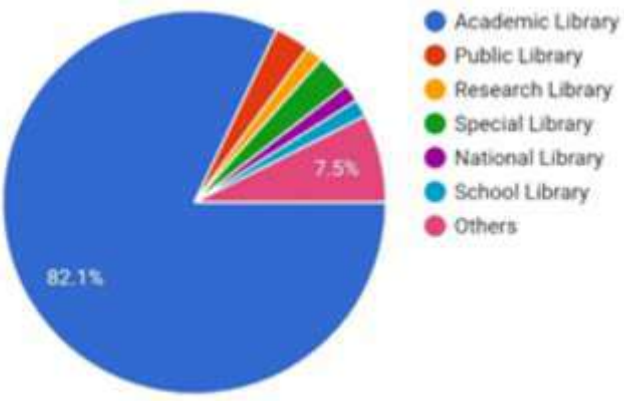
This chart shows that there were more respondents with PhD at 47.8%, while respondents with MLIS/MLS had 34.3% and BLIS/HND 17.9%. It shows that PhD holders in LIS responded more in this survey.

Chart 4: Years of Experience



Here, the chart displays the respondents between 1-7 years' experience with 54.3%, 8-13 years 28.4%, 20 years and above 22.4% and 14-19 years 14.9%. The ages of experiences were represented.

Chart 5: Types of library



It is shown here that respondents from academic library topped the chart with 82.1% while public, research, special, National and School libraries gathered 7.5% among them. This shows that majority of the respondents were from academic library

Research question 1: What is the extent of knowledge of 5IR by librarians in Nigeria?

Table 1: Knowledge of the concept of 5IR in information services

Items	Strongly Agree		Agree		Disagree		Strongly disagree	
	F	%	F	%	F	%	F	%
It is the use of automated tools and services for information	32	47.7	34	50.7	1	1	0	0
It is the use of AI and robotics	26	38.8	34	50.7	6	8.9	1	0.1
It is the knowledge of smart technologies and powered information services	36	53.7	28	41.7	2	2.9	1	0.1
It is about human centredness and concern for environment	21	31.3	21	31.3	23	34.3	2	2.9
It is about Internet of things (IoT)	30	44.7	33	49.2	3	4.4	1	0.1
I do not know what 5IR is	6	8.9	7	10.4	31	46.2	22	32.8

The Table above showed that 50.7% of the respondents agreed that it is the use of automated tools and services for information and the use of AI and robotics, respectively, while 47.7% and 38.8% strongly agreed on the same items, respectively. 8.9% disagreed. Again 53.7% strongly agreed that it is the knowledge of smart technologies and powered information services and 41.7% agreed on the same concept. 2.9% disagreed. 31.3% rated strongly agreed and agreed respectively that it is about human centredness and concern for environment while 34.3% disagreed. On the knowledge base that it is about Internet of things (IoT) 44.7% rated strongly agreed and 49.2% agreed. 4.4% disagreed. that 30 33 3 1 The item that stated, I do not know what 5IR is ranked 46.2% disagreed and 32.8% strongly disagreed. Only few 8.9% and 10.4% admitted that they do not what 5IR is, respectively. This shows that the respondents have knowledge of 5IR in Nigeria.

Research question 2: To what extent are librarians ready to embrace the 5th Industrial revolution in Nigeria?

Table 2: The readiness of the librarians in embracing the 5IR

Items	F	%
I am fully ready to use the 5th IR tools and facilities	34	52
I am somehow ready to adopt the 5th IR	19	28
I am not ready to adopt the 5IR	7	10
I do not know what 5IR means	7	10
Total	**67**	**100**

The Table showed that 52% rated that they are fully ready to use the 5th IR tools and facilities, 28% rated somehow ready, 10% stated not ready and another 10% rated that they do not know what 5IR means. This shows that the respondents are ready.

Research question 3: What is the extent of librarians' competencies in embracing the 5IR in Nigeria?

Table 3: the extent of competencies acquired by librarians in embracing 5IR in Nigeria

Items	Very High Extent		High Extent		Low Extent		Very Low Extent	
	F	%	F	%	F	%	F	%
Competencies in digital literacy and tools (ChatGPT, QuickChat, Grammarly, etc)	22	32.8	32	47.7	12	17.9	1	0.1
Use of cloud computing (Google Apps, dropbox, etc)	17	25.3	32	47.7	17	25.3	1	0.1
Use of cloud computing (Google Apps, dropbox, etc)	17	25.3	32	47.7	16	23.8	2	2.9
Use of analytical tools (SPSS, Excel, python etc)	9	13.4	20	29.8	34	50.7	4	5.9
Use of AI in information services	21	31.3	28	41.7	16	23.8	2	2.9
Use of library management systems	18	26.8	34	50.7	14	20.8	1	0.1
Use of collaborative and online learning platforms	22	32.8	34	50.7	10	14.9	1	0.1
Creation and use of digital content	20	29.8	30	44.7	16	23.8	1	0.1
Use of database and metadata management	16	23.8	35	52.2	14	20.8	2	2.9

The Table shows that 32.8% rated very high extent that they have competencies in digital literacy and tools (ChatGPT, QuickChat, Grammarly, etc) while 47.7% also rated high extent on it but 17.9% ranked low extent. 25.3% rated very high extent on the use of cloud computing (Google Apps, dropbox, etc) and 47.7% rated high extent. 25.3 rated low extent on it. On the competence of use of analytical tools (SPSS, Excel, python etc) 50.75 rated low extent while13.4% rated very high extent and 29.8% high extent. 31.3% rated very high extent on the use of AI in information services,, 41.7% high extent and 23.8% low extent. 50.7% has high extent of use of library management systems, 26.8% very high extent, 20.85 low extent. On the competencies on use of collaborative and online learning platforms 50.7% high extent, 32.85 very high extent, 14.9% low extent. On creation and use of digital content 44,7% high extent, 29.8% very high extent and 23.8% low extent. Also Use of database and metadata management 52.2% high extent, 23.8% very high extent and 20.8% low extent.

Research question 4: What are the national and international agencies that support the training of librarians in readiness for 5IR?

Figure 1: The national and international agencies that support the training of librarians in conforming to the new era.

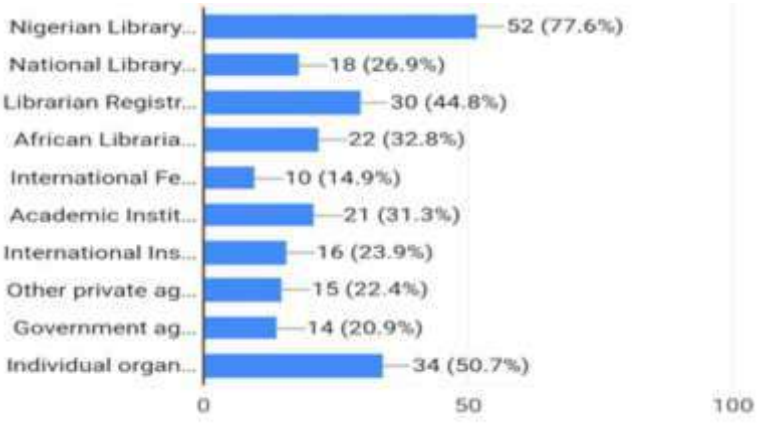


Figure 2 shows that Nigerian Library Association (comprising State Chapters, Sectors and National) is the institution that support librarians' capacity building in conforming with the new era at 77.6% and Individual organizers 50.7%. Others are Librarian Registration Council 44.8%, AfLIA 32.8%, Academic institutions 31.3%, National Library of Nigeria 26.9%, International Institutions 23.9%, Other Private Agencies 22.4%, Government agencies 20.9% and IFLA 14.9%. This shows that NLA organizes the most capacity building for Nigerian Librarians.

Research question 5: What are the challenges that militate against 5th industrial revolution by librarians in Nigeria

Table 4: Challenges of adapting to 5th industrial revolution

Items	Strongly Agree		Agree		Disagree		Strongly Disagree	
	F	%	F	%	F	%	F	%
Non provision of new technologies to work with	37	55.2	25	37.3	5	7.4	-	-
Inadequate skill for the new technologies	25	57.3	34	50.7	8	11.9	-	-
Inadequate power supply	37	55.2	22	32.8	8	11.9	-	-
Issues with internet connectivity	35	52.2	28	41.7	4	5.9	-	-
Inadequate planning for staff up skilling	32	47.7	31	46.2	3	4.4	-	-
Inability to maintain the available tools and facilities	30	44.7	33	49.2	4	5.9	-	-
Mode of training affects effective learning	28	41.7	32	47.7	7	10.4	-	-
Work load interfering with the new learning	25	37.3	30	44.7	12	17.9	-	-
Funds for procurement and training	38	56.7	28	41.7	1	0.1	-	-
Lack of personal smart devices to train with	27	40.2	22	32.8	15	22.3	3	4.4
Non provision of WiFi to join online training and work with	26	38.8	30	44.7	10	14.9	1	0.1

The Table above shows that 55.2% strongly agreed and 37.3% also agreed that non provision of new technologies to work with causes challenge while 7.9% disagreed. On the inadequate skill for the new technologies, 57.3% and 50.7% strongly agreed and agreed, respectively while 11.9% disagreed. 52.2% and 32.87% strongly agreed and agreed, respectively on the inadequate power supply while 11.9 disagreed. 52.2% and 41.7% strongly agreed and agreed, respectively on the issues with internet connectivity while 5.9 disagreed. 47.7 and 46.2% strongly agreed and agreed, respectively that inadequate planning for staff up skilling causes challenge while 4.4 disagreed. 44.7% and 49.2% rated strongly agreed and agreed, respectively on the inability to maintain the available tools and facilities while 5.9% disagreed. 47.7% was rated strongly agree while 10.4% rated disagree that mode of training affects effective learning. 37.3% rated strongly agree, 44.7% agree while 17.95 disagree that work load interfering with the new learning. 56.7% strongly agree, 41.7% agree and 0.1% disagreed that funds for procurement and training is a challenge. For lack of personal smart devices to train 40.2% strongly agree, 32.8% agree while 4.4% diasgree. On non provision of Wi-Fi 38.8% strongly agree, 44.7% agree and 14.9% disagree. All these are challenges that were rated as contradiction to 5IR in Nigeria.

Discussion of findings

The result has shown that the demographic information of the librarians cover both male and female with experiences that cut across from one to over twenty years and ages from below thirty to sixty years. The librarians also represent the whole library sectors. It shows inclusive participation of the respondents although what stands out is the population of the academic librarians that topped the list with great margin. The indication is that those in the academic sector seem to be updating their skills more. Perhaps those in the public and other libraries did not fill this survey. However, there is every need for all librarians to keep updating their skills, especially in the era of 5th industrial revolution to remain relevant (Nwobu et al, 2024; Tella, et al. 2023).

The responses that the librarians have knowledge of 5IR is encouraging showing they are following the trends. It also indicates that the readiness in embracing 5IR is a smooth transition to the new era as well as the willingness to adapt and deliver services. This assertion matches the study on readiness of librarians which Anunobi, Obiamalu and Obuezie (2021) carried out but on in adapting to the 4IR. It indicates that the same professionals are ready to flow with the change as it comes.

The responses on the competencies rhyme with the confirmation of Ekwueme et al (2024) on their findings which indicated that librarians exhibited collaborative and digital skills essential for working with both people and machines in delivering library services to learners. This was also aligned with Adamu et al, (2024) studies. In others words, the 5IR is already adopted waiting to be implemented.

The Nigerian librarians admitted that they benefited so much from Nigerian Library association on building their capacities. This is heartwarming and gives kudos to the NLA for organizing several training through the State Chapter, libraries and the sections in developing their members, professionally. It implies that NLA lives up to their mission statement which includes provision of professional development opportunities for librarians (NLA 2025).

However, the disclosure that several challenges affect the adoption of 5IR shows the limitations of information service delivery in Nigeria. Perhaps, the management of libraries and information centers in Nigeria have not really put information in the rightful perspective. This fact has been confirmed over several studies that challenges of erratic power, proliferation of digital content, of accommodation of the new changes among others affect the adoption of the new technologies (Ekwueme et al, 2024; Nwobu et al, 2024 & Apriliyanti & Ilham, 2022). It is clear that the needful should be done by the library management and stakeholders to sustain competencies and responsive information deliveries.

Conclusion

The world is changing with new technologies so is knowledge and information generation. This study has shown the need for every professional to learn and adapt to the changes. The 5IR is already here with us. It does not beg to be accepted or implemented. It is here for those who wishes to move on with the changes. Therefore, this study concluded that the Nigerian librarians are ready to embrace the 5IR. Their competences have been raised to a high level for relevant services. They gained these competencies through the NLA organized capacity buildings and other institutions. They have challenges of erratic power, digital upgrade and skill, infrastructure among others.

Recommendations

The study recommended that:

1. More awareness and inspiration for librarians to fully embrace the 5IR. This will create the sustenance needed for the growth of the profession
2. There should be more capacity building. Learning never ends. New tools and technologies need to be stepped up regularly for adaptation and adoption.
3. The NLA effort in building the capacities of the librarians is good. Other institutions and agencies are called upon to take up the promotion and training of more professionals in the information sphere.
4. The challenges of erratic power, WIFI, provision of infrastructure should be addressed quickly so as not to create a gap in delivering services of the 5IR in the new technological era.

References

Adamu, J., Mohammed, Z., Daudu, H., Umar, L., & Mu'azu, M. (2024). Availability and use of digital information resources and services for access and use by postgraduate students in university libraries in Kaduna State. *Lokoja Journal of Information Science Research,* 2 (2), 11-33. https://doi.org/10.5281/zenodo.14784051

AfLIA (2023). Webinar: Future-proofing African LIS schools in an era of smart technologies: challenges and opportunities. Retrieved on 12th May 2025 from https://web.aflia.net/webinar-future-proofing-african-lis-schools-in-an-era-of-smart-technologies-challenges-and-opportunities/

Affum, M. Q. & Dwomoh, O. K. (2023). Investigating the potential impact of artificial intelligence in librarianship. *Library Philosophy and Practice*. Published online July 2023:1-12. Retrieved on 12th May 2025 from https://www.proquest.com/scholarly-journals/investigating-potential-impact-artificial/docview/2858729033/se-2

Alojaiman, B. (2023). Technological Modernizations in the Industry 5.0 Era: A Descriptive Analysis and Future Research Directions. Processes, 11(5), 1318

Anunobi, C., Obiamalu, A. & Obuezie, A. (2021). LIS professional awareness, understanding and readiness for the 4th IR Library and information services engagement. Paper presented at the AfLIA conference on 25th May, 2021 https://web.aflia.net/2021-conference-schedule/

Apriliyanti, M. & Ilham, M. (2022). Challenges of the industrial revolution era 1.0 to 5.0 : University Digital Library in Indonesia. *Library Philosophy and Practice (e-journal)*. 6994. https://digitalcommons.unl.edu/libphilprac/6994

Ekwueme, L., Oluwaseun, B., Ajie, I., Ofodu, P., & Ambrose, S. (2024). Empowering librarians

in the fifth industrial revolution: navigating skills, challenges, and strategies for effective library services in open and distance learning. *Lokoja Journal of Information Science Research*, 2(1), 79-94. https://doi.org/10.5281/

Ghosh, S., Mukherjee, A., Narsalay, R. M., Basu, A., Sengupta, V., Chakraborty, A. & Prasad, M. (2024). Decoding the fifth industrial revolution: Marching towards a resilient, sustainable and human-centric future, 1-32. Retrieved on 6th May 2025 from https://www.pwc.in/assets/pdfs/decoding-the-fifth-industrial-revolution-v1.pdf

Ibinaiye, I. D. & Jiyane, G. V. (2021). The prospect of 5th industrial revolution and academic library services: Exploring the role of data science in the post pandemic period. Paper presented at the 4th International Conference on Information Technology in Education and Development, 87-99. Retrieved from https://event.academiainformationtechnology.org/proceedings/14.pdf

IFLA (2025). Artificial Intelligence and the Future of Libraries and Librarianship. Retrieved on 12th May 2025 from https://www.ifla.org/events/artificial-intelligence-and-the-future-of-libraries-and-librarianship/

Murata Manufacturing Company (2023). What is the "fifth industrial revolution," which will deepen the integration between people and technology? Retrieved on 4th May 2025 from https://article.murata.com/en-global/article/what-is-the-fifth-industrial-revolution

Myers, J. P., & Rivero, K. (2020). Challenging preservice teachers' understandings of globalization: Critical knowledge for global citizenship education. *The Journal of Social Studies Research,* 44(4), 383-396.

NLA (2025). What is the mission of the Nigerian Library Association? Retrieved on 12th May 2025 from https://nla.org.ng/

Nwobu, B. K., Dumbiri, R., Ibia, M. J., & Oladokun, B. D. (2024). Libraries in the fifth industrial revolution: Skills and knowledge required in preparing librarians for an uncertain future. In U. C. Udofot et al. (Eds.), Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria. (3 – 13). Port Harcourt: Chadick Printing Press

Ogbomo, M., Ebhonu, S., & Etagbedavwe, E. (2023). Koha Integrated Library System (ILS) Implementation:The Experience of Admiralty University of Nigeria, Library, Ibusa. *Lokoja Journal of Information Science Research,* 1(1), 80-94. https://doi.org/10.5281/

Tella, A., Bamidele, S. S., Olaniyi, O. T. & Yusuf Ayodeji Ajani (2023). Library and information science graduate skills needed in the fourth industrial revolution: A Nigerian. *Information Services for a Sustainable Society: Current Developments in an Era of Information Disorder,* 183, 342.

World Economic Forum (2025). Technology convergence is leading the way for the fifth industrial revolution. Retrieved on 5th May 2025 from https://www.weforum.org/stories/2025/01/technology-convergence-is-leading-the-way-for-accelerated-innovation-in-emerging-technology-areas/

Ziatdinov, R., Atteraya, M. S., & Nabiyev, R. (2024). The fifth industrial revolution as a transformative step towards society 5.0. *Societies,* 14 (2), 19. https://doi.org/10.3390/soc14020019

Regenerating Africa's Research and Scholarly Publishing Through A Systematic Review: What Does the Future Holds for 5IR?

Famuyiwa, Shola Temitope
Famuyiwa.st@unilorin.edu.ng, sholasmart0@gmail.com
Department of Library and Information Science,
University of Ilorin, Nigeria
&
Tella, Adeyinka
tella.a@unilorin.edu.ng
https://orcid.org/0000-0002-5382-4471
Department of Library and Information Science,
University of Ilorin, Nigeria.
Department of Information Science, University of South Africa

Abstract

The study explores the current state of research and scholarly publishing in Africa, examining major challenges and proposing strategies for revitalization. Despite the continent's growing research output, African scholarship faces significant barriers, including ***limited funding, inadequate infrastructure, predatory publishing, and restricted global visibility****. The study employed a* ***systematic literature review*** *and synthesizes findings from peer-reviewed journal articles, policy documents, and institutional reports. The findings reveal that while African research productivity is increasing,* ***issues related to funding, publishing standards, and access to high-impact journals continue to hinder progress****. Additionally,* ***open-access models and emerging digital technologies*** *offer promising solutions but require* ***sustained investment and policy support*** *to be effective. The study also identifies the* ***negative impact of predatory publishing on research integrity and academic progression****, emphasizing the need for stronger regulatory frameworks. The originality and value of this study lie in its* ***holistic approach*** *to identifying and addressing the systemic barriers to scholarly publishing in Africa. Through the proposition of* ***policy recommendations, institutional collaborations, and capacity-building initiatives,*** *the study provides* ***a roadmap for enhancing research quality, accessibility, and impact.*** *Regenerating or revitalizing Africa's research and scholarly publishing requires a* ***multi-stakeholder approach,*** *integrating* ***sustainable funding mechanisms, ethical publishing standards, and digital transformations.*** *Strengthening* ***academic networks, mentorship programs, and regulatory frameworks*** *will be critical in ensuring African research is globally recognized, ethically produced, and effectively disseminated. This study contributes to ongoing discourse on the future of scholarly publishing in Africa, advocating for strategic interventions that align with global best practices while prioritizing* ***Africa-led knowledge production****.*

Keywords: *Regenerating, Revitalising, Africa's research, Scholarly Publishing, Systematic Review, Africa.*

Introduction

Over the past few decades, there have been substantial changes to the research and scholarly publication landscape in Africa. The continent has seen notable improvements in research production, open-access publishing, and regional cooperation, despite ongoing issues like insufficient financing, restricted access to high-impact journals, infrastructure deficiencies, and systemic disparities. But it's becoming more and more clear that a regenerative strategy is required, one that not only tackles these issues but also encourages creative and long-lasting solutions. According to Muwanga-Zake and Kibukamusoke (2024), the ability to use technology advancements, create strong regulatory frameworks, and fortify institutional capacities in order to guarantee a vibrant and globally competitive knowledge ecosystem will determine the future of African research and scholarly publishing. The historical fight for influence and visibility lies at the core of Africa's publishing and research scene (Zell, 2025). Due to underrepresentation on editorial boards, biases in international publishing institutions, and limited access to high-impact journals, African intellectuals have struggled for decades to achieve international reputation. As a result, a large portion of the research conducted on the continent is either unpublished or only widely disseminated through local and regional channels (Kasprowicz et al., 2020; Eticha et al., 2024). With programs like the African Journals Online (AJOL) and other university-led repositories striving to increase the visibility of African research, this has spurred a growing trend towards open-access publishing. Notwithstanding these initiatives, issues with predatory publication, quality control procedures, and the long-term viability of open-access models.

Technology integration is a key component of rebuilding Africa's research ecosystem. Africa has a chance to benefit from the digital technologies, blockchain technology, and artificial intelligence that are revolutionizing the publishing sector worldwide (Gitobu & Ogetonto, 2024). Blockchain technology offers opportunities for guaranteeing transparency, authenticity, and confidence in the peer-review process, while AI-driven research discovery tools can improve the discoverability and accessibility of African scholarship (Odeyemi et al., 2924). The current inadequacies in the distribution of knowledge could be filled by digitizing research results and enhancing digital infrastructure (Hussain et al., 2024). To guarantee fair participation in the digital intellectual environment, however, issues with data sovereignty, digital literacy, and internet access inequalities continue to be significant barriers that need to be overcome.

For African research and scholarly publishing to flourish in the future, cooperation and collaborations are essential. The potential of regional and international alliances to promote infrastructure development, capacity building, and information exchange has already been shown. Cross-border research collaboration has been made possible in large part by platforms like the Partnership for African Social and Governance Research (PASGR) and the African Research Universities Alliance (ARUA) (PASGR, 2023; ARUA, 2022). For African scholars to have access to international funding possibilities, mentorship, and top-notch publishing venues, these networks must be strengthened. Furthermore, it is impossible to overestimate the contribution that African governments and policymakers provide to research by means of enhanced funding, policy changes, and investments in research infrastructure (Science for African Foundation, 2023). In order to promote long-term transformation and lessen dependency on outside donors, sustainable funding methods will be essential.

The decolonization of knowledge production is a crucial component in the revitalization of Africa's academic publishing scene. Western paradigms and approaches have historically influenced African research, raising issues of epistemic injustice and the marginalization of local knowledge systems (Omodan, 2023). In the future, there will be a greater demand for research methodology, local contexts, and African views. According to Gobena et al. (2023), this change calls for a reassessment of research funding priorities, publication standards, and curricula in order to guarantee that knowledge production is inclusive and representative of Africa's varied intellectual traditions. There are many opportunities for study and scholarly publishing in Africa in the future, but there are also challenges. The legitimacy of academic publication on the continent is seriously threatened by the growth of predatory journals, the drive to publish for career development, and the difficulties with peer review integrity (Richtig et al., 2018; Martinino et al., 2024; Nguyen & Tuamsuk, 2024). A multi-stakeholder strategy is needed to address these problems, with researchers, organizations, publishers, and legislators collaborating to create strong quality control procedures and ethical publishing norms. Accordingly, the emergence of digital repositories, preprint servers, and community-driven peer-review platforms present interesting options that could democratize knowledge generation while upholding strict academic norms (Avissar-Whiting et al., 2024).

The ability of the continent to overcome these obstacles and seize growth possibilities will ultimately determine the future of African research and scholarly publishing (Grinin & Korotayev, 2023). Both the enduring obstacles and the revolutionary possibilities that lie ahead are revealed by a thorough analysis of the existing situation. Africa can establish itself as a powerful player in the world's knowledge creation by encouraging innovation, bolstering its research infrastructure, encouraging equitable publication practices, and adopting laws that put accessibility and integrity of research first. The continent's ability to overcome its historical constraints and forge a new path that guarantees its researchers are not just contributors but also leaders in influencing the global research agenda will be determined in the upcoming years.

Statement of the Problem

Systemic issues with research and scholarly publishing in Africa prevent the continent from fully engaging in the creation of knowledge worldwide. Insufficient funding, restricted access to high-impact journals, infrastructure deficiencies, and a persistent underrepresentation in international publishing networks are just a few of the major obstacles that African scholars still face despite the consistent rise in research output (Mienye et al., 2024; Mouton, 2020; Beaudry et al., 2024; Mthembu & Ocholla, 2024; Ocholla et al., 2024). These limitations increase reliance on Western academic institutions and publishing firms for information by preventing African research from being widely disseminated and made visible. Access to African research results is one of the most urgent problems. Due to expensive article processing charges (APCs) and strict acceptance criteria that frequently favor research from the Global North, many African researchers find it difficult to publish in international journals (Nabyonga-Orem et al., 2020; Nabyonga-Orem et al., 2024). Africa is thus further marginalized in international academic debate since a large portion of its knowledge is still published in local or regional journals with little exposure and influence. Furthermore, the quality and credibility of research are seriously threatened by the growth of predatory journals, which take advantage of the pressure on African scholars to publish (Salehi et al., 2024; Hamzah et al., 2024). Moreover, the issue is made worse by disjointed research policies and inadequate institutional support.

The digital infrastructure and strong peer-review processes required to uphold high publishing standards are lacking in many African colleges and research institutes (Krugman et al., 2025; Okechukwu et al., 2024). Many African journals are forced to rely on outside donors due to the lack of sustainable funding methods for scholarly publishing, which raises questions over their long-term viability and editorial independence (Maboya & McKay, 2019).

Africa's publishing and research environment will remain behind if these fundamental problems are not addressed. To ensure the longevity and worldwide relevance of African scholarship, a revolutionary strategy that incorporates technology advancements, legislative changes, and cooperative publishing models is essential.

Objectives of the Study

The broad objective of the study is to Africa's research and scholarly publishing through a systematic review and consider what the future holds. The specific objectives of the study are to:

1. examine the current state of research and scholarly publishing in Africa.
2. Identify the factors that impact quality of African research outputs.
3. determine the role of innovations in transforming scholarly communication and knowledge dissemination in Africa.
4. investigate the prevalence and impact of predatory publishing on research integrity and the academic progression of African scholars.
5. identify strategies for regenerating Africa's research and scholarly publishing

Literature review

Overview of Scholarly Publishing

The process of formally disseminating academic research is known as scholarly publishing, and it mostly involves peer-reviewed journals, monographs, conference proceedings, and digital repositories (Tella & Onyancha, 2020). It acts as the foundation for the spread of information, guaranteeing that research results are thoroughly assessed, verified, and made available to both the academic community and the general public. Subscription-based journal formats, which are frequently under the authority of large publishing companies, have historically dominated scholarly publishing. This has limited access to research results, especially in low-income areas (Trueblood et al., 2035).

The open-access movement, which promotes publicly accessible research publications to improve accessibility and international knowledge exchange, has gained traction in recent years (Severin et al., 2018). Academic work is becoming more widely accessible because to digital developments like institutional repositories, preprint servers, and open-access journals, especially for researchers in the Global South (Kankam et al., 2024). However, issues with predatory journals, publishing fees, and the prevalence of Western-based indexing services which frequently marginalize non-Western and African scholarship remain concerns (Ma et al., 2023; Beall, 2017). Predatory publication, in which exploitative journals publish research without thorough peer assessment, likewise jeopardizes the credibility of scientific publishing (Shrestha, 2021). This damages the credibility of research and impedes academic advancement, especially for researchers in their early careers. Strong institutional regulations, more financing for African-led publishing platforms, and a stronger focus on ethical publishing practices are all necessary to address these issues (Kadikilo et al., 2024). The advancement of knowledge is greatly aided by scholarly publishing, yet its efficacy is nevertheless threatened by unethical activities, financial limitations, and access issues. Adopting open-access methods, bolstering publishing infrastructure, and encouraging international partnerships are essential to the future of scholarly publishing in Africa in order to increase the exposure and impact of research.

The Current State of Research and Scholarly Publishing in Africa

Africa has seen tremendous expansion in research and academic publishing in recent decades, but structural obstacles still prevent the continent from fully engaging in the global knowledge economy. According to estimates, less than 2% of all scientific publications worldwide are from African researchers, making up a very small portion of the world's overall research output (Ger et al., 2024). This modest contribution is mostly attributable to a lack of strong publishing frameworks that facilitate the diffusion of information, insufficient funding for research, and infrastructure deficiencies.

The predominance of local and regional publications, many of which have trouble getting adequate indexing in worldwide databases, is one of the characteristics that distinguish scholarly publishing in Africa. Many African journals still lack impact factors, which makes them less appealing to academics seeking international reputation, even if programs like African Journals Online (AJOL) have increased visibility (Krugman et al., 2025). Furthermore, African scholarship is further marginalized and becomes dependent on foreign publication platforms due to the dominance of Western-based journals as the preferred outlets for high-impact research. African scholars have additional difficulties due to language constraints and epistemic bias. Knowledge exchange among diverse linguistic communities is limited by the preference for English in scholarly communication, which excludes scholars who do not speak the language (Ocholla et al, 2024). Furthermore, Western perspectives have historically influenced African knowledge creation, frequently marginalizing local knowledge systems (Woldegiorgis, 2025). The structural constraints of international academic publishing nevertheless provide challenges to the growing movement to decolonize African research and advance locally relevant approaches. There are encouraging advancements in Africa's research landscape in spite of these obstacles. The necessity of funding research infrastructure, capacity building, and international partnerships is becoming more widely acknowledged by governments and academic institutions. The emergence of open-access journals, digital publishing platforms, and regional research networks provide African scholars with new avenues for expanding the reach of their work. However, broad legislative changes, funding for higher education, and tighter editorial and peer-review standards to improve research quality are all necessary to create a competitive and sustainable research ecosystem.

Factors that Impact Quality of African Research Outputs

The visibility, accessibility, and caliber of African research outputs are significantly impacted by the availability of research funding, the robustness of institutional infrastructure, and the existence of

supportive policy frameworks. Research in Africa has historically been chronically underfunded, and many universities depend on international grants and donor financing to continue their academic endeavors (Omodan, 2023). Most African nations still have inadequate national research budgets, which restricts researchers' ability to carry out extensive, high-impact research.

Infrastructure also plays a pivotal role in scholarly publishing. Many African universities lack access to modern digital libraries, research databases, and high-speed internet, creating significant barriers to knowledge acquisition and dissemination (Mamabolo & Durodolu, 2023). Limited access to indexing services and citation databases further restricts the global reach of African research, making it difficult for scholars to gain international recognition. Policy frameworks governing research and publishing in Africa are often fragmented and inconsistent. The African Union's Science, Technology, and Innovation Strategy for Africa (STISA-2024) emphasizes the importance of research-driven development, calling for increased investment in research infrastructure and policy harmonization across the continent (UN, 2024). Sustainable progress, however, will require long-term financial commitments and collaborative efforts between governments, universities, and international research bodies.

The Role of Innovations in Transforming Scholarly Communication and Knowledge Dissemination in Africa

Africa's scholarly publishing scene is changing due to open-access publishing and digital technologies, which present new avenues for accessibility and information sharing. Scholars can now share their work without the financial restrictions that come with traditional paywalled journals thanks to open-access platforms like AJOL and institutional repositories, which have greatly expanded the availability of African research outputs (Mwambari et al., 2024; Ezema & Okafor, 2016). Scholarly communication is also changing as a result of digital technologies like blockchain, big data analytics, and artificial intelligence (AI). Blockchain technology offers possible answers for guaranteeing transparency and confidence in the peer-review process, while AI-powered research discovery tools improve access to pertinent studies (Odeyemi et al., 2024). African scholars now have additional publication options that don't jeopardize research integrity because to the growth of digital repositories and preprint servers. There are still difficulties in spite of these developments. Concerns about data sovereignty, inconsistent internet connectivity, and gaps in digital literacy prevent Africa from fully utilizing open-access and digital advancements (Sun et al., 2024). African institutions must prioritize the development of digital infrastructure and promote laws that facilitate open-access information exchange if they are to fully realize the potential of these technologies.

The Prevalence and Impact of Predatory Publishing on Research Integrity and the Academic Progression of African Scholars

In African academia, predatory publication has grown in concern as it jeopardizes the reputation of scholarly outputs and the integrity of research. The pressure on academics to publish for career development has led to the proliferation of these exploitative journals, which charge authors fees without offering rigorous peer review or editorial oversight (da Silva et al., 2019; Beall, 2017). Predatory publication has a significant effect on African academics. Because credible indexing systems do not recognize their work, researchers that unintentionally publish in these journals frequently struggle with academic legitimacy (Odeyemi et al., 2024). Additionally, predatory journals' lack of quality control leads to the spread of dubious or inadequately vetted material, compromising the integrity of Africa's knowledge ecosystem as a whole.

Increased awareness campaigns, journal certification programs, and the advancement of ethical publishing norms are some of the measures used to counteract predatory publishing. In order to encourage researchers to publish in respectable, peer-reviewed journals, universities and funding organizations are also enforcing more stringent publication selection requirements (Frandsen et al., 2024). To improve institutional policies and offer instruction on spotting and avoiding predatory publishers, more work must be done. Addressing the problem of predatory publishing will be essential to maintaining the legitimacy and influence of academic work generated on the continent in the long run as African research and scholarly publishing continue to develop. To protect the integrity of African scholarship, it will be crucial to promote legitimate open-access projects, encourage ethical publication practices, and fortify peer-review mechanisms.

Strategies for Regenerating Africa's Research and Scholarly Publishing

Africa's research and scholarly publishing need to be revitalized through a multifaceted strategy that includes technical breakthroughs, policy changes, and institutional reforms. The creation of strong national and regional research strategies that give academic institutions' infrastructure and finance top priority is one crucial tactic (Ebekozien et al., 2023). Sustainable finances must be set aside by governments and academic institutions to support research, guaranteeing that researchers have access to the tools and guidance they need.

Enhancing peer-review and editorial standards in African publications is another crucial tactic. Global reputation and credibility can be increased by promoting partnerships between domestic and foreign publications (Ocholla et al., 2024). As it guarantees a larger distribution of knowledge and raises the awareness of research, the promotion of open-access publication and digital repositories is equally crucial

(Bamidele et al., 2023; Ebekozien et al., 2023; Ajibade & Muchaonyerwa, 2023). Last but not least, efforts to increase capacity such as mentorship programs, international collaborations, and researcher training will contribute to raising the caliber of research outputs and filling in knowledge gaps in the worldwide academic community.

Methodology

The literature that has already been written about the difficulties, possibilities, and chances for research and academic publishing in Africa is critically examined in this study using a systematic review methodology. A thorough grasp of trends, gaps, and tactical responses in Africa's scholarly publishing landscape is made possible by the systematic review method's capacity to offer an organized, transparent, and repeatable synthesis of pertinent works (Owens, 2021).

Design of the Research: The study uses a systematic review approach to analyze published literature, policy papers, institutional reports, and pertinent case studies as part of its qualitative research design. To guarantee rigor and dependability in data collection, screening, and synthesis, the systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria (Shaheen et al., 2023).

Data Sources and Search Strategy: The study used academic databases such as Scopus, Web of Science, Google Scholar, African Journals Online (AJOL), and PubMed to guarantee thorough coverage of pertinent material. Institutional repositories including UNESCO, the African Union, universities, and research councils around Africa were also used to gather data. Additionally, information was obtained from policy papers, including reports from national research funding bodies, the Association of African Universities (AAU), and the African Academy of Sciences (AAS). Last but not least, some information was taken from grey literature, such as institutional white papers, working papers, and conference proceedings. A combination of Boolean operators and keywords related to the research theme is used to filter results. Search terms include: *Scholarly publishing in Africa; Research infrastructure in Africa; Open-access publishing in Africa; Impact of funding on African research; Predatory publishing in Africa' and Academic publishing challenges in Africa.*

Inclusion and Exclusion Criteria: The study uses the following criteria to make sure the reviewed material is high-quality and pertinent. Peer-reviewed books, policy papers, and articles published in the recent 15 years (2010–2025) meet the inclusion criteria. In addition to literature addressing innovations, open-access publication, and digital revolution in African academic communication, these studies concentrate on African research ecosystems, scholarly publishing, and policy frameworks. Exclusion criteria include studies that have nothing to do with the research and publication environment in Africa, papers that are not available in full-text or that are not published in English or French, and blogs or opinion articles that don't contribute empirically or theoretically.

Data Extraction and Analysis: To group findings into major themes, a thematic analysis is carried out. The following categories are used to summarize the extracted data: i. research and scholarly publishing challenges; ii. the impact of funding, infrastructure, and policy frameworks; iii. the role of digital innovations and open-access; iv. the prevalence and repercussions of predatory publishing; and v. strategies for reviving research and scholarly publishing in Africa. The chosen literature and coding methodology are cross-checked by an independent researcher as part of a peer-review validation procedure to guarantee objectivity.

Ethical Considerations

The study does not directly include human participants because it is based on secondary data. However, ethical considerations include making sure that a variety of viewpoints from various African regions are fairly represented, avoiding plagiarism, and properly attributing sources. This report provides a thorough and fact-based evaluation of Africa's research and scholarly publication environment using a systematic review methodology. The knowledge acquired will be used to inform strategic actions and policy suggestions meant to boost academic knowledge output across the continent.

Findings of the Study

Based on the systematic review conducted, the study provides the following major findings on each of the research objectives.

1. The Current State of Research and Scholarly Publishing in Africa

According to the study, the research and academic publishing industry in Africa is still in its infancy but is developing, with notable differences between nations and institutions. Lack of financing, poor research infrastructure, and restricted access to scholarly publication platforms are problems faced by many African universities and research institutions. Despite an increase, Africa's share of the world's research output is still less than 2%, and most of its research articles are published in international journals rather than local ones. African scholars frequently encounter high publication costs, little exposure for African journals, and lack of indexing in major academic databases, according to the study. Nonetheless, access and exposure are being enhanced by regional programs such as the African Open Science Platform (AOSP) and the African Journals Online (AJOL).

2. Factors that Impact the Quality of African Research Outputs

According to the report, the quality of African research is significantly impacted by a number of problems, including a lack of money, a weak research infrastructure, gaps in policy, and insufficient peer-review procedures. High-quality research is limited in many African colleges due to a lack of mentorship programs, research grants, and contemporary labs. Additionally, there are still few incentives for academic staff to conduct serious research due to the institution's lax publication and research rules. Although there is a growing amount of collaboration with foreign research institutes, African researchers frequently encounter obstacles such as restricted research training options, journal paywalls, and access to state-of-the-art technology. The study also reveals that the difficulties in doing high-impact research are exacerbated by political unpredictability, brain drain, and language limitations.

3. The Role of Innovations in Transforming Scholarly Communication and Knowledge Dissemination in Africa

According to the findings in this study, blockchain technology, digital repositories, open-access publishing, and artificial intelligence are all transforming academic communication in Africa. The availability of African research outputs has increased thanks to open-access platforms like AJOL, SciELO South Africa, and university digital repositories. Researchers are working together and exchanging discoveries more efficiently because to emerging breakthroughs including data-sharing platforms, digital preservation methods, and AI-powered research discovery tools. Additionally, blockchain technology is being investigated for authorship verification and study integrity. Greater knowledge distribution, particularly among early-career researchers, has been made possible by the use of digital publication platforms and mobile-friendly research portals. Low levels of digital literacy, inadequate internet infrastructure, and copyright issues, according to the survey, continue to be significant obstacles to making the most of these advancements.

4. The Prevalence and Impact of Predatory Publishing on Research Integrity and the Academic Progression of African Scholars

Due to publish-or-perish demands and a lack of knowledge about predatory publishing methods, many early-career researchers and scholars from underfunded universities fall victim to fake publications, indicating that predatory publishing is becoming a bigger problem in Africa. According to the report, because of high rejection rates from respectable journals, high manuscript processing charges (APCs), and insufficient mentorship on journal selection, African researchers frequently publish in subpar or fraudulent journals. Academic promotions are impacted, research integrity is compromised, and African scholarship's reputation is harmed by this practice. The study also shows that predatory publications frequently don't have strict peer review, which allows low-quality research and false material to spread. Some institutions and academic bodies, such as the African Academy of Sciences (AAS) and university ethics committees, are working to educate researchers on predatory publishing and establish quality control measures.

5. Strategies for Regenerating Africa's Research and Scholarly Publishing

The study identifies several key strategies for revitalizing Africa's research and scholarly publishing sector:

Enhancing policy and governance frameworks: More robust institutional policies on research ethics, publication incentives, and journal accreditation can increase the credibility and impact of scholarly publishing.

Developing research training and mentorship: Research fellowships, capacity-building programs, and mentorship initiatives can assist early-career researchers in publishing high-quality research.

Increasing open-access and digital repositories: Expanding institutional repositories, open-access journals, and collaborative knowledge-sharing platforms can increase the visibility of African research.

Combating predatory publishing: African scholars can steer clear of predatory journals by increasing awareness, creating blacklists and whitelists of journals, and incorporating article selection training into postgraduate education.

Leveraging innovation and technology: Africa's scholarly publishing ecosystem can be strengthened by utilizing digital preservation platforms, blockchain-based authorship verification, and AI-powered research tools.

According to the study's findings, open-access initiatives and technological advancements present promising answers to the major financial, infrastructural, policy framework, and predatory publishing issues that African research and scholarly publication face. Reviving Africa's research landscape and guaranteeing increased exposure, integrity, and accessibility of African scholarship in the international research community require a multi-stakeholder approach involving governments, institutions, international organizations, and researchers.

Discussion of Findings

The study's findings are consistent with previous studies on the potential and problems facing the research and scholarly publishing scene in Africa. The level of research production, the elements that affect the quality of research, the significance of technological advancements, the danger of predatory publication, and methods for revitalizing the industry are some of the major themes that come to light.

The Current State of Research and Scholarly Publishing in Africa

Despite its vast population and expanding academic institutions, Africa continues to be underrepresented in global research outputs, contributing fewer than 2% of the world's scholarly publications, according to the study (Ger et al., 2024). Low research funding, inadequate infrastructure, and a propensity for publishing in international journals rather than local ones have all been blamed for the low exposure of African research (Kariuki et al., 2025). According to a study by Asubiaro and Onaolapo (2023), the majority of African scholars aim to publish in prestigious Western publications in order to advance their careers and gain international reputation. This technique, however, restricts the expansion of native African publication platforms and reduces the accessibility of local research for practitioners and policymakers.

Factors That Impact the Quality of African Research Outputs

According to the study, research quality in Africa is greatly impacted by a lack of financing, poor mentorship, gaps in legislation, and infrastructure issues. According to Mhlongo et al. (2023), African scholars are unable to produce high-impact research because they lack access to modern libraries, cutting-edge labs, and research collaboration networks. Further encouraging flimsy research outputs is the fact that career promotions and university rankings in Africa are frequently determined by the quantity of publications rather than their quality (Tijssen & Kraemer-Mbula, 2018). According to the report, the continent's research capability is further diminished by brain drain, which occurs when bright African academics leave for better-funded universities in the Global North (Tijssen & Kraemer-Mbula, 2018).

The Role of Innovations in Transforming Scholarly Communication and Knowledge Dissemination in Africa

According to the report, the main technologies transforming the academic communication scene in Africa include open-access publishing, digital repositories, blockchain technology, and artificial intelligence. African research outputs are now more visible and accessible because to open-access programs like SciELO South Africa and African Journals Online (AJOL) (Odeyemi et al., 2023). Additionally, open data exchange and cooperation among African academics have been greatly aided by the African Open Science Platform (AOSP) (Okafor et al., 2022). Long-standing problems with research accessibility and legitimacy are being addressed by new digital innovations like blockchain for authorship authentication and AI-powered study discovery systems (Aldoseri et al., 2024). However, challenges remain, particularly in digital literacy, weak internet infrastructure, and concerns about copyright and intellectual property rights (Adetunji & Okuonghae, 2022).

The Prevalence and Impact of Predatory Publishing on African Scholarship

The study's key finding is the pervasiveness of predatory publishing in Africa, which is consistent with research by Mouton and Valentine (2017) showing that predatory journals disproportionately target developing nations, including Africa. These bogus journals take advantage of African researchers who face obstacles such as the publish-or-perish culture, inadequate mentorship, and the expensive cost of publication in recognized journals (Mouton & Valentine, 2017). African research integrity is severely impacted by predatory publishing, which exacerbates the spread of subpar research, undermines academic credibility, and damages institutional reputations (Aboyade et al., 2024). Several initiatives, such as Think. Check. Submit. and Cabell's blacklist, are helping scholars identify legitimate journals, but awareness remains low among early-career researchers in Africa (Schira & Hurst, 2024).

Strategies for Regenerating Africa's Research and Scholarly Publishing

According to the survey, the most important tactics for revitalizing Africa's research ecosystem are enhanced mentorship, digital innovation, regulatory reform, and more money for research. To increase African research output, Akindele et al.'s (2024) study highlights the necessity of government-backed funding programs, long-term research grants, and collaborations with foreign organizations. African research will be more visible and accessible if institutional repositories are strengthened and open-access programs are expanded (Raju et al., 2015). Furthermore, early-career researchers can benefit from mentorship networks, training seminars, and capacity-building initiatives to help them navigate the challenges of academic publishing (Ng'oda et al., 2024). Last but not least, utilizing blockchain, artificial intelligence, and digital archiving technologies would guarantee increased accountability, transparency, and long-term preservation of African research outputs (Olabanji et al., 2024).

The results of the study confirm that the research and academic publication environment in Africa is undergoing a period of transformation, with both promising potential and major obstacles. Predatory publishing practices, a lack of funding, and inadequate infrastructure continue to be major barriers, but technological advancements and legislative changes present promising avenues for change. To guarantee that African research achieves international recognition, integrity, and long-term sustainability, cooperation between governments, academic institutions, funding agencies, and international research networks is crucial.

Conclusion

The potential and difficulties pertaining to the research and academic publication environment in Africa have been investigated in this study. The results demonstrate that African research output is still

underrepresented in the world, mostly as a result of a lack of money, inadequate infrastructure, a lack of policies, and the predominance of Western publication methods. The continent suffers from low research visibility, limited access to high-quality publishing routes, and a weak culture of information transmission, despite a burgeoning academic community.
The pervasive impact of predatory publication, which jeopardizes the integrity and legitimacy of African study, is one of the main problems noted. Many academics, especially those in their early careers, are lured to exploitative journals by the high cost of publishing, the pressure to publish, and the lack of proper supervision. Stricter institutional regulations, increased awareness, and the encouragement of trustworthy open-access platforms are all necessary to address this. The report also emphasizes how open-access publishing, digital technologies, and artificial intelligence have the power to revolutionize scholarly communication. Platforms like the African Open Science Platform (AOSP) and African Journals Online (AJOL) are already making a big difference in improving the accessibility and exposure of research. Furthermore, emerging developments like AI-driven discovery tools and blockchain for research authentication provide up new possibilities for enhancing the creation and sharing of knowledge.
A multi-stakeholder strategy combining governments, academic institutions, financial agencies, and technological partners is crucial to reviving Africa's research and scholarly publication. For African research to continue growing and become globally competitive, it will be essential to invest in mentorship programs, financing sources, research capacity-building, and sustainable digital infrastructures. Through the tackling of these issues and seizing new chances, Africa may establish itself as a major contributor to the creation and sharing of knowledge worldwide.

Policy Recommendations, Institutional Collaborations, and Capacity-Building Initiatives for Regenerating Africa's Research and Scholarly Publishing
A comprehensive strategy including institutional alliances, policy reforms, and capacity-building programs is necessary to address the issues pertaining to research and scholarly publishing in Africa. These tactics will support a competitive and sustainable research environment while addressing financing constraints, research exposure, predatory publishing, and knowledge accessibility.

1. Policy Recommendations
To improve the research ecosystem in Africa, policymakers and academic institutions must enact specific regulations. Among the main suggestions are, but are not restricted to:
the requirement for more funds for research. In accordance with international best practices, governments and funding organizations ought to devote a larger portion of GDP to research and development (R&D). In light of this, competitive funds for early-career researchers ought to be established.
It becomes imperative that national open access policies be developed. Open-access publishing should be urgently mandated by governments to guarantee that African research is publicly accessible, increasing its impact and visibility.

The speed at which publishing standards are regulated. To prevent predatory publishing and promote ethical research practices, national and regional academic authorities should set up quality assurance procedures. Many local journal outlets floated people, just as there are international predatory publications. These people created themselves; they are the journal managers, the chief editors, the reviewers, and everything else. Such actions have damaged the reputation of scholarly publishing by turning it into a profitable endeavor. Regulation is required for all of these. Regulation of the proliferation of academic publications is also necessary.
Digital technology integration should be taken into account. To improve research distribution, authentication, and archiving, policies should encourage the use of AI, blockchain, and digital repositories. The protection of intellectual property rights (IPR) should also be a priority. Clear legal frameworks that guarantee equitable recognition and prohibit exploitation are necessary to safeguard the intellectual property of African academics.
The development of multilingual publishing is also necessary. Policies supporting academic publications in native African languages should be in place to reduce accessibility barriers and promote the sharing of local knowledge.

2. Institutional Collaborations
Reviving Africa's research and publishing ecosystem requires cooperation between academic institutions, research centers, and foreign partners. Some strategies are:
Regional Research Consortia: To pool resources, knowledge, and infrastructure for extensive research projects, African universities ought to establish research consortia. CODESRIA (Council for the Development of Social Science Research in Africa) and the African Research Universities Alliance (ARUA) are two examples.
Public-Private Partnerships (PPPs): To create cutting-edge knowledge-sharing platforms, research grants, and digital infrastructures, universities should collaborate with funding organizations, publishing houses, and technology companies.

International Partnerships: Forming international alliances with organizations like the World Bank, UNESCO, and the European Research Council can make it easier to obtain funds, training, and high-impact publishing channels.
Library and Information Science Networks: Developing academic library networks can improve digital preservation of African research, repository development, and knowledge exchange.
University Press Strengthening: There are now a lot of new universities being founded. In order to lessen their need on Western-based journals and establish more locally controlled scholarly publishing outlets, these new universities should start university presses, and the older ones should start or revive their publishing arms.

3. Capacity-Building Initiatives
Continuous training and mentoring programs are necessary to empower African researchers, librarians, and journal editors in order to create a sustainable research and publication ecosystem. Initiatives to increase capacity should consist of:
Training programs in research should be given careful consideration. Universities and other research organizations must to provide graduate training in research technique, academic writing, and ethical publication, as well as workshops and short courses.
Peer review networks and mentoring ought to be prioritized and implemented. Early-career researchers should receive mentoring from senior scholars on how to choose credible journals, navigate the publishing process, and enhance the quality of their manuscripts. Models can be found in African academic networks such as AfriSIG (African School on Internet Governance).
It is now essential to integrate AI and digital literacy. To improve scholarly communication, academics can benefit from training in digital archiving, big data analytics, and artificial intelligence. We should think about setting up grant-writing assistance centers at our educational institutions. To assist researchers in obtaining outside financing, universities ought to set up grant-writing assistance offices. This will improve competitiveness and make research funding opportunities more accessible.
Training in journal management must also be taken into account. African academic journals can gain more credibility by providing editors and publishers with training on peer review procedures, plagiarism detection, and journal indexing.
Reviving Africa's research and academic publishing industry will depend on putting these policy proposals into practice, developing solid institutional partnerships, and allocating funds for capacity-building. Africa can improve its academic institutions, raise the profile of its research, and make a significant contribution to the creation of knowledge worldwide by implementing ethical publication practices, sustainable funding sources, and digital advances.

Implications of the Study for Research, Society, and Practice
This study on regenerating Africa's research and scholarly publishing has significant implications for research, society, and practice.

Implications for Research
In order to improve knowledge generation, the report emphasizes the necessity of more financing, infrastructure, and capacity-building investments in African research. It emphasizes how critical it is to support African-led publishing platforms so that research findings are broadly available and not limited to publications under Western control. Additionally, combating predatory publishing will raise African scholarship's stature. According to the findings, scholarly communication can be revolutionized by open-access models, AI-powered research instruments, and digital repositories, increasing the visibility and influence of African research on the international scene.

Implications for Society
Addressing societal issues like health crises, climate change, and economic development requires a strong research ecosystem. When African researchers have more opportunities to publish and share their work, local knowledge can drive innovation, inform policymaking, and support sustainable development initiatives. Additionally, encouraging multilingual scholarly communication can help close the gap between academic knowledge and societal needs by making research findings more accessible to practitioners, policymakers, and the general public.

Implications for Practice
The study emphasizes the value of mentorship programs, ethical publication norms, and technology integration in scholarly communication for researchers and academic institutions. Universities and libraries need to connect with international publication networks, improve digital literacy, and fortify institutional repositories. In order to ensure that Africa's research makes a significant contribution to international discourse, policymakers and funding organizations must establish supportive conditions for knowledge development and dissemination. Africa's research landscape may become more competitive and sustainable by embracing ethical norms, interdisciplinary collaborations, and creative publishing models. In order to improve research quality, accessibility, and impact and eventually create a more knowledge-driven and globally competitive Africa, this study promotes structural reforms and creative solutions.

Limitations of the Study and Suggestions for Further Research

Despite its thoroughness, this study has some limitations that should be noted. The inclusion of the most recent advancements in African research and scholarly publishing may be restricted due to its primary reliance on secondary data sources and literature studies. Deeper understanding of the opportunities and problems facing the industry may be possible with a more empirical approach, such as surveys or interviews with important players.

Second, the study concentrates on general continental trends, which might not adequately represent the distinct difficulties that various African nations or areas experience. In order to find localized answers for research rejuvenation, future studies could compare various African countries.

Furthermore, although the report talks about the importance of open-access publishing and digital technologies, it doesn't go into great detail about how these breakthroughs will be funded or sustained over the long run. How African institutions and policymakers may develop financially sustainable methods for research publishing and dissemination could be the subject of future studies. Lastly, another area that needs more research is how South-South partnerships and international collaborations affect raising Africa's profile in research. Future research should examine how African academics can remain in control of their knowledge production while successfully integrating into global research networks.

References

Aboyade, W., Ndubuisi-Okoh, E., Okoche, C., & Oladokun, B. (2024). Impact of Predatory Journal Publishing on Scholarly Practices among Academic Librarians in Nigeria: A Systematic Review of Literature. Seminars in Medical Writing and Education, 60(3), 10.56294/mw202460.

Adetunji, A.O. & Okuonghae, N. (2022). Challenges of copyright protection in the digital age: the nigerian perspective. Library Philosophy and Practice (e-journal). 7159. https://digitalcommons.unl.edu/libphilprac/7159.

African Research University Alliance, ARUA (2022). Towards African Collaborative Doctoral Programmes. A Synthesis Report, Retrieved from https://arua.org/wp-content/uploads/ARUA-Synthesis-December-2022_.pdf (accessed 06 March 2025).

Akindele, A., Keane, M., Geffers, J., Lin, Y.C., Yang, H.C., Koury, M., Badre, A., Erastus, K. & Coussens, A. (2024). Funding for research. In, Global State of Young Scientists (GloSYS) in Africa (pp.232-266)Chapter: 10Publisher: Global Young Academy.

Aldoseri, A., Al-Khalifa, K. N., & Hamouda, A. M. (2024). AI-Powered Innovation in Digital Transformation: Key Pillars and Industry Impact. Sustainability, 16(5), 1790. https://doi.org/10.3390/su16051.

Amboka P, Kariuki H, Orobaton N. (2024). Addressing research readiness challenges in african institutions: development and application of a modular assessment tool [version 1; peer review: awaiting peer review]. VeriXiv 2025, 2:16 (https://doi.org/10.12688/verixiv.558.1).

Amboka P, Krugman D, Simiyu A. (2024). Editorial practices of African journals: A Qualitative Analysis from Kenya, Ethiopia, Nigeria, and Mozambique [version 1; peer review: 2 approved with reservations]. VeriXiv 2025, 2:9 (https://doi.org/10.12688/verixiv.549.1).

Ajibade, P., & Muchaonyerwa, Nd. (2023). Promotion of open access publications and visibility by institutions in South Africa. South African Journal of Libraries and Information Science, 89(1), 1-14. https://doi.org/10.7553/89-1-2140.

Avissar-Whiting, M., Belliard, F., Bertozzi, S., Brand, A., Brown, K., Clément-S, G., Dawson, S., Dey, G., Ecer, D., Edmunds, S., Farley, A., Fischer, T., Franko, M., Fraser, J., Funk, K., Ganier, C., Harrison, M., Hatch, A., Hazlett, H., & Williams, M. (2024). Recommendations for accelerating open preprint peer review to improve the culture of science. PLOS Biology, 22. e3002502. 10.1371/journal.pbio.3002502.

Beaudry, C., Prozesky, H., St-Pierre, C., & Mirnezami, S. R. (2023). Factors that affect scientific publication in Africa-A gender perspective. Frontiers in Research Metrics and Analytics, 8, 1040823. https://doi.org/10.3389/frma.2023.1040823.

Ebekozien, A., Samsurijan, M.S., Aigbavboa, C., Radin Firdaus, R.B., Nor Azazi, N.A. and Amadi, G.C. (2023). Infrastructure development in higher institutions: the role of private organisations via unexplored expanded corporate social responsibility (ECSR). Property Management, 41(1), 149-168. https://doi.org/10.1108/PM-03-2022-0015.

Eticha, T. G., Brunninge, O., & Tessema, K.W. (2024). Strategy research in an African context: A systematic literature review. Africa Journal of Management, 10(3), 316–350. https://doi.org/10.1080/23322373.2024.2375949.

Ezema, I. & Okafor, V. (2016). Open access institutional repositories in Nigeria academic libraries: advocacy and issues in scholarly communication. Library Collections Acquisitions and Technical Services, 39(3), 10.1080/14649055.2016.1176842.

Ger, N., Lugossy, AM. & Petrucka, P. Status of "African research and its contribution to global health research: a review and an opinion". Discovery Public Health 21, 192 (2024). https://doi.org/10.1186/s12982-024-00323-6.

Gitobu, C. & Ogetonto, J. (2024). Harnessing artificial intelligence (ai) and blockchain technology for the advancement of finance technology (fintech) in businesses. Proceedings of London International Conferences. 196-210. 10.31039/plic.2024.11.244.

Gobena, E. B., Hean, S., Heaslip, V., & Studsrød, I. (2023). The challenge of western-influenced notions of knowledge and research training: lessons for decolonizing the research process and researcher

education. Journal of Ethnic & Cultural Diversity in Social Work, 33(5), 276–287. https://doi.org/10.1080/15313204.2023.2197272.
Grinin, L. & Korotayev, A.. (2023). Africa: The continent of the future. challenges and opportunities. 10.1007/978-3-031-34999-7_13.
Hamzah, F.B., Mahmod, R., Samad, N.H.A., Zainuddin, A.J., Haron, N.H., Tahir, W.A.W.M., Yusof, M.A.M. (2024). Predatory publishing: the dark side of academic dissemination. Library Progress International, 44(4), 1383-1391.
Hussain, H., Jun, W. & Radulescu, M. (2024). Innovation Performance in the Digital Divide Context: Nexus of Digital Infrastructure, Digital Innovation, and E-knowledge. Journal of Knowledge Economy, https://doi.org/10.1007/s13132-024-02058-w.
Kadikilo, A. C., Nayak, P., & Sahay, A. (2024). Barriers to research productivity of academics in Tanzania higher education institutions: the need for policy interventions. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2351285.
Kasprowicz, V.O., Chopera, D., Waddilove, K.D. Mark A. Brockman, Jill Gilmour, Eric Hunter, William Kilembe, Etienne Karita, Simani Gaseitsiwe, Eduard J. Sanders & Thumbi Ndung'u (2020. African-led health research and capacity building- is it working?. BMC Public Health 20, 1104. https://doi.org/10.1186/s12889-020-08875-3.
Ma, L., Buggle, J. & O'Neill, M. (2023) 'Open access at a crossroads: library publishing and bibliodiversity. Insights: the UKSG Journal, 36(1), p. 10. Available at: https://doi.org/10.1629/uksg.613.
Maboya, Mmabatho & McKay, Tracey. (2019). The financial sustainability challenges facing the South African non-profit sector. The Journal for Transdisciplinary Research in Southern Africa, 15. 10.4102/td.v15i1.693.
Mamabolo, M.J. and Durodolu, O.O. (2023), Rural accessibility to digital libraries: requirements and challenges. Digital Library Perspectives, 39 (4), 551-570. https://doi.org/10.1108/DLP-04-2023-0025.
Martinino, A., Campagnoli, G., Dallavalle, S., Soto, A., Pouwels, S., & Smeenk, F. (2024). Investigating country-specific perceptions of predatory journals and their impact on scholarly integrity: a systematic review. Cureus, 16(7), e64674. https://doi.org/10.7759/cureus.64674.
Mienye, I.D., Sun, Y., & Ileberi, E. (2024). Artificial intelligence and sustainable development in Africa: A comprehensive review, Machine Learning with Applications, 18, 100591, https://doi.org/10.1016/j.mlwa.2024.100591.
Mohammad Salehi, Mohammad Soltani, Hadis Tamleh, Shohreh Teimournezhad (2020). Publishing in predatory open access journals: Authors' perspectives. Learned Publishing, 33(2), 89-95.
Mouton, J, & Valentine, A. (2017) The extent of South African authored articles in predatory journals. SouthAfrican Journal of Science, 113(7/8), Art. #2017-0010, 9 pages. http://dx.doi.org/10.17159/sajs.2017/20170010.
Mthembu, M.S. & Ocholla, D.N. (2024). Research data management competencies of researchers in selected public universities in South Africa. Library Management, 45(3/4), 208-225. https://doi.org/10.1108/LM-03-2023-0022
Muwanga-Zake, J. W. F. & Kibukamusoke, M. (2024). Sustainability of Africa through technological innovations and indigenous knowledge systems: a discussion of key factors and way forward. African Journal of Social Work, 14(2), 59-69. https://dx.doi.org/10.4314/ajsw.v14i2.2.
Mwambari, D., Ali, F. A., & Barak, C. (2022). The impact of open access on knowledge production, consumption and dissemination in Kenya's higher education system. Third World Quarterly, 43(6), 1408–1424. https://doi.org/10.1080/01436597.2022.2056010.
Nabyonga-Orem, J., Asamani, J. A., Nyirenda, T., & Abimbola, S. (2020). Article processing charges are stalling the progress of African researchers: a call for urgent reforms. BMJ Global Health, 5(9), e003650. https://doi.org/10.1136/bmjgh-2020-003650.
Nabyonga-Orem1, J. , Avoka Asamani, J., Olushayo, O. (2024). Why are african researchers left behind in global scientific publications? – A Viewpoint. International Journal of Health Policy and Management, 13; 1-4.
Ng'oda M, Gatheru PM, Oyeyemi O, Busienei P, Karugu CH, Mugo S, et al. (2024) Mentorship in health research institutions in Africa: A systematic review of approaches, benefits, successes, gaps and challenges. PLOS Glob Public Health, 4(9): e0003314. https://doi.org/10.1371/journal.pgph.0003314.
Njoroge, J.. (2024). Potential role of African union in development of AI governance across the continent. European Journal of Social Sciences Studies, 10(4), 10.46827/ejsss.v10i4.1822.
Nguyen, L. T., & Tuamsuk, K. (2024). Factors influencing researchers' scientific integrity in scholarly publishing: a path analysis approach. Research Ethics, 0(0). https://doi.org/10.1177/17470161241257445.
Ocholla, D., Onyancha, O.B., & Adesina, A.O. (2024). Information, Knowledge, and Technology for Teaching and Research in Africa: Human Machine Interaction and User Interfaces. Nature Switzerland AG.
Okechukwu, Obediah & Ndubuisi-Okoh, Elizabeth & Okoche, Chukwu & Oladokun, Bolaji. (2024). Scholarly Publishing Practices among LIS Lecturers in Higher Institutions of Learning in Nigeria. Journal of Digital Learning and Education, 4(1), 50-60. 10.52562/jdle.v4i1.985.
Olabanji, Samuel Oladiipo and Olaniyi, Oluwaseun Oladeji and Olagbaju, Oladotun, Leveraging Artificial Intelligence (AI) and Blockchain for Enhanced Tax Compliance and Revenue Generation in Public Finance (November 21, 2024). Asian Journal of Economics, Business and Accounting, 24(11), 2024[10.9734/ajeba/2024/v24i111577], Available at SSRN: https://ssrn.com/abstract=5029197 or

http://dx.doi.org/10.9734/ajeba/2024/v24i111577.
Olubusola Odeyemi, Chinwe Chinazo Okoye, Onyeka Chrisanctus Ofodile, Omotayo Bukola Adeoye, Wilhelmina Afua Addy, Adeola Olusola Ajayi-Nifise (2024). Integrating ai with blockchain for enhanced financial services security. Finance & Accounting Research Journal, 6(3), DOI: https://doi.org/10.51594/farj.v6i3.855.
Omodan, B.I. (2023). Unveiling Epistemic Injustice in Education: A critical analysis of alternative approaches. Social Sciences & Humanities Open, 8(1), 100699, https://doi.org/10.1016/j.ssaho.2023.100699.
Owens, J. (2021). Systematic reviews: Brief overview of methods, limitations, and resources. Nurse Author & Editor, 31(3-4), 10.1111/nae2.28.
Partnership for African Social and Governance Research (PASGR) (2023). Initiatives. Retrieved from https://www.pasgr.org/our-programmes/higher-education/ (accessed 06 M arch 2025).
Philip Kwaku Kankam, Lawrencia Donkor Acheampong, DeGraft Johnson Dei, (2024). Dissemination of scientific information through open access by research scientists in a developing country, Heliyon, 10(7), e28605, https://doi.org/10.1016/j.heliyon.2024.e28605.
Raju, R. & Adam, A. & Powell, C. (2015). Promoting open scholarship in africa: benefits and best library practices. Library Trends, 64(1), 136-160. 10.1353/lib.2015.0036.
Richtig, G., Berger, M., Lange-Asschenfeldt, B., Aberer, W., & Richtig, E. (2018). Problems and challenges of predatory journals. Journal of the European Academy of Dermatology and Venereology: JEADV, 32(9), 1441–1449. https://doi.org/10.1111/jdv.15039.
Schira, H.R. & Hurst, C. (2024). University students' knowledge of potentially predatory journals: A focus group analysis. The Journal of Academic Librarianship, 50(5), 102926, https://doi.org/10.1016/j.acalib.2024.102926.
Science for African Foundation (2023). Inducing African governments to fund research and development. Retrieved from https://scienceforafrica.foundation/media-center/inducing-african-governments-fund-research-and-development (accessed 06 M arch 2025).
Severin, A., Egger, M., Eve, M. P., & Hürlimann, D. (2018). Discipline-specific open access publishing practices and barriers to change: an evidence-based review. F1000Research, 7, 1925. https://doi.org/10.12688/f1000research.17328.2.
Shaheen, S.N., Ramadan, A., Hefnawy, A., Ramadan, M.T., Ibrahim, A., Hassanein, I.A., Ashour, M.E., & Flouty, O. (2023) Appraising systematic reviews: a comprehensive guide to ensuring validity and reliability. Frontiers in Resources Metrology Analysis, 8:1268045. doi: 10.3389/frma.2023.1268045.
Shrestha, J. (2021). Predatory journals as threats to the academic publishing: a review. Journal of Agriculture and Natural Resources, 4(1), 1-10. 10.3126/janr.v4i2.33640.
Siyabonga Mhlongo, Khanyisile Mbatha, Boitumelo Ramatsetse, Reuben Dlamini, (2023). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments: An iterative review. Heliyon, 9(6), e16348, https://doi.org/10.1016/j.heliyon.2023.e16348.
STISA (2024). Science, Technology and Innovation Strategy for Africa (2024). https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english_-_final.pdf
Sun, Meiqi & Liu, Jiaqi & Lu, Jia. (2024). Digital Literacy in Africa: Exploring its Relationship with Infrastructure, Policy, and Social Inequality. African Journalism Studies, 44(1),1-22. 10.1080/23743670.2024.2329705.
Tella, A. & Onyancha, O.B. (2020): Scholarly Publishing Experience of Postgraduate Students in Nigerian Universities, Accountability in Research, DOI: 10.1080/08989621.2020.1843444.
Teixeira da Silva, Jaime & Dobránszki, Judit & Tsigaris, Panagiotis & Alkhatib, Aceil. (2019). Predatory and exploitative behaviour in academic publishing: An assessment. The Journal of Academic Librarianship, 45(6), 10.1016/j.acalib.2019.102071.
Tijssen, R. & Kraemer-Mbula, E. (2018). Research excellence in Africa: Policies, perceptions, and performance. Science and Public Policy, 45(3), 392-403. 10.1093/scipol/scx074.
Toluwase Victor Asubiaro PhD, Sodiq Onaolapo (2023). A comparative study of the coverage of African journals in Web of Science, Scopus, and CrossRef. Journal of the Association for Information Science and Technology, 74(7), 745-758.
Tove Faber Frandsen, Richard Bruce Lamptey, Edward Mensah Borteye (2024). Promotion standards to discourage publishing in questionable journals: a follow-up study. The Journal of Academic Librarianship, 50(5), 102895, https://doi.org/10.1016/j.acalib.2024.102895.
Trueblood, J.S., Allison, D.B., Field, S.M., Fishbach, A., Gaillard, S.D.M., Gigerenzer,G., Holmes, W.R., Lewandowsky,S., Matzke,D., Murphy, M.C., Musslick, S., Popov, V., Roskies, A.L., ter Schure, J., & Teodorescu, A.R. (2025). The misalignment of incentives in academic publishing and implications for journal reform, Proc. National Academic Science, 122 (5) e2401231121, https://doi.org/10.1073/pnas.2401231121 (2025).
UN (2024). Decade of accelerated implementation second ten-year implementation PLAN 2024 – 2033. Retrieved from https://www.un.org/osaa/sites/www.un.org.osaa/files/43517-wd-agenda_2063_styip_feb_2024_launch_version.pdf (accessed 06 M arch 2025).
Woldegiorgis, E. T. (2025). Hybrid knowledge systems: an alternative pathway to decolonising higher education in Africa. Comparative Education, 1–19. https://doi.org/10.1080/03050068.2025.2463805.
Zell, H. M. (2025). African Scholarly Journals Publishing: Current Challenges and Prospects. With a Select Literature Review. The African Book Publishing Record, 51(1), https://www.degruyter.com/journal/key/abpr/html?lang=en

Skills Development for Library and Information Science Sustainability in the 5th Industrial Revolution (5IR): A Survey

by

Abdulakeem Sodeeq SULYMAN
Department of Library and Information Science
Kwara State Polytechnic
Ilorin, Nigeria.
Sulyman.abdulakeem@obc.ac.uk

Aliyu Tsafe GADANGA, Ph.D.
University Library
Federal University Gusau
Zamfara State, Nigeria.
aliyutasafe@fugusau.edu.ng

Kennedy Arebamen EIRIEMIOKHALE, Ph.D.
Department of Library and Information Science,
Faculty of Information and Communication Technology,
Kwara State University, Malete, Nigeria.
kennedy.eiriemiokhale@kwasu.edu.ng

Shuaib Agboola OLARONGBE, Ph.D.
The Polytechnic Librarian
Kwara State Polytechnic
Ilorin, Nigeria.
Olarongbe.sa@unilorin.edu.ng

Idris Ibrahim SALEH
Abdullahi Fodiyo Library
Usmanu Danfodiyo University, Sokoto, Nigeria.
idrisibrahimsaleh@gmail.com

&
Dotun Emmanuel OLUSANYA
Agricultural and Rural Managemen t Training Institute,
Ilorin, Kwara State
Dotunolusanya86@gmail.com

Abstract

The possession of skills promises to catapult professionals for career relevance, particularly in this 5IR where technological disruptions are transforming the information provision and delivery landscapes. This assertion underscores why this study explores skills as an impetus for LIS sustainability in the 5IR. Descriptive survey design was adopted. The population of this study is 199 librarians on the WhatsApp platform of the Nigerian Library Association (NLA), Kwara State Chapter. Convenience sampling technique was adopted to allow members of the population participate in the study based on their willingness. A questionnaire designed with Google Forms was sent to the WhatsApp group. The data collected were presented and analysed in simple percentages, frequencies and mean (x). Findings revealed that the hard skills necessary for LIS sustainability include abilities to retrieve information timely and effectively (x = 3.68), render reference services (x = 3.57) and digital and information literacies (x = 3.50) respectively. The soft skills required for LIS sustainability encompass abilities to communicate clearly (x = 3.68), lead others (x = 3.57), social and cultural awareness (x = 3.54) respectively. Moreso, personal skills such as abilities to be creative and innovative (x = 3.75), control oneself (x = 3.64) and motivate oneself (x = 3.54) were found, while abilities to know about emerging LIS services (x = 3.64), know about copyright and other intellectual property rights (x = 3.61) and know about emerging LIS products (x = 3.54) were the knowledge-based skills needed for LIS sustainability in the 5IR. This study concludes that all the skills – hard, soft, personal and knowledge-based – are indispensable for LIS sustainability in the 5IR. One of the recommendations of this study is that LIS bodies, agencies and associations should prioritise equipping librarians with skills that will equip them with capacities to feature in the 5IR.

Keywords: Skills, LIS, Sustainability, Hard skills, Soft skills, Personal skills, Knowledge-based skills.

Background to the Study

The rapid development of information technology is bringing about unpredictable changes in the field of library and information management. The leap from conventional library management system to electronic library management has paved the way for great changes in the very structure and manner of library profession (Swaminathan et al., 2022). The continuous revolutions in the IT world have reached the point of the 5th Industrial Revolution (5IR), which establishes a transformation of libraries and information centers. Ayinde et al. (2024) submitted that the 5IR addresses the deficiencies of the 4th Industrial Revolution (4IR) with emphasis on renewed direction and development of the roles and skills of librarians in the rapidly emerging technological innovations that interplay between humans and technologies.

The changes in the information environment, ushered by the 5IR have paved the ways for massive adoption of emerging technologies such as artificial intelligence (AI), edge computing and machine learning for digital transformation, thus impacting on professional skills of librarians (Tshabalala & Dube, 2024). These technological products of the 5IR have become a dominant technological focus in the academic context by providing pathways for libraries to restructure their activities and services within the virtual workplace ecosystem, leading to seamless digital information flow that supports innovative services tailored to meet evolving user needs (Tshabalala & Dube, 2024).

As the digital age continues to revolutionise the ways information is handled and managed, it is essential that Library and Information Science professionals keep pace with these changes by acquiring necessary skills. This implies that much work is still needed to be done to ensure that librarians meet the evolving needs of the 21st century users (Technology from Sage, 2022). The transition to the 5IR gives librarians a competitive advantage by incorporating different communication technologies that provide sustainable and responsive solution such as digital workspaces (Luca et al. 2022). As a result of this phenomena transition, librarians must be firmly grounded in certain 21st Century skills (Luca et al. 2022).

The Organization for Economic Cooperation and Development (2016) defined 21st Century skills as knowledge and abilities related to digital devices (such as computers, smartphones, tablets), applications and environments. Friday and Onuh (2022) defined skills as innate or acquired abilities of individuals which enable them to perform a task easily or successfully. It has been used to refer to the ability to perform an act expertly or the expertness, practised ability or proficiency displayed in the performance of a task. Skills encompassed the knowledge and experience needed to perform a specific task or job, or capabilities of an individual, definable by content, to be acquired and activated through related professional training.

Jain and Akakandelwa (2016) submitted that to survive in the 5IR, librarians must have the requisite knowledge, skills and competencies required to be equal partners in their libraries in ensuring that through emerging technologies, libraries are digitally transformed to improve service delivery. Ayinde et al. (2024) stressed that these skills are critical for selecting the appropriate media for reading, interacting with and interpreting the content, as well as for using the content to solve problems. The skills needed by librarians to thrive in the 5IR include the ability to understand and implement AI tools and the Internet-of-things (IoT) to optimise workflows, cloud computing to offer innovative and flexible resources on economies of scale, robotics to automate repetitive tasks, including improving the services of digital libraries.

In the 5IR, librarians and information professionals are expected to thrive in the digital environment where they will be actively involved in the acquisition, application, use and implementation of new technologies in their organization with their new skills and competencies to fit-in in their changing roles (Uzohue & Yaya, 2016). Having understood that for librarians to remain relevant in the increasingly evolving digital-information landscape, they need to possess certain skillsets in their professional toolkits. The recognition of the essence of skills on sustainability of library and information professions sets the basis for this study to explore skills as an impetus for LIS sustainability in the 5IR.

Statement of the Problem

The roles, skills and implications of the 5IR to information professionals remain unclear (Ayinde et al., 2024). This is because the 5IR is an era marked by the continuous advancements in machines and technologies used in every aspect of human endeavour. With respect to libraries, the 5IR has transformed the processes of acquiring, organising, describing, storing, retrieving, disseminating and using information. As a result of this, it becomes imperative for librarians to possess sets of abilities and knowledge that enable them to effectively carry out assigned tasks and since these skills can be learnt, there is no justification for any librarians not to acquire them (Okeji et al., 2020).

As the world reaches the 5IR, it has become increasingly apparent that the librarians and other information professionals need to continually adapt to the dynamic context caused by the impact of digitization (Okeji et al., 2020). In the quest of determining the possibilities of thriving in the 5IR by librarians, many studies have been conducted. However, one of the notable defects of the available studies is their emphasis on digital

skills at the expense of others such as communication, leadership, collaboration and teamwork. Saleem and Ashiq (2020) emphasised the pressing requirement of communication and leadership skills among librarians in order to address the communication gaps on continuous professional programs aimed at equipping librarians with 5IR skills. This prompts one to question whether other skills are not important for librarians and underscores why this study explores skills as an impetus for LIS sustainability in the 5IR.

Research Objectives

This main objective of this study is to explore skills as an impetus for LIS sustainability in the 5IR. The specific objectives are to:

i. determine the hard skills necessary for LIS sustainability in the 5IR;
ii. ascertain the soft skills necessary for LIS sustainability in the 5IR;
iii. identify the personal skills necessary for LIS sustainability in the 5IR; and,
iv. examine the knowledge-based skills necessary for LIS sustainability in the 5IR.

Research Questions

This study seeks to answer the following questions:

1. What are hard skills necessary for LIS sustainability in the 5IR?
2. What are the soft skills necessary for LIS sustainability in the 5IR?
3. What are the personal skills necessary for LIS sustainability in the 5IR?
4. What are the knowledge-based skills necessary for LIS sustainability in the 5IR?

Literature Review

Digitization, as we all know, has not only impacted the information world, it has as well impacted the role, skills and method of services delivery of information professionals (Okeji et al., 2020). Library technologies are changing and it is quite imperative that both professional and paraprofessional personnel in libraries upgrade their skills so as to embrace digital technologies. Menabo et al. (2021) claimed that as technology continue to impact on teaching, learning and research, expectations on librarians to exploit technological advantages are rising, leading to pressures of having to toggle between pedagogy and technology in a seamless way. The extent to which this is well-executed depends on skills and willingness to employ technology by librarians.

Scholars have viewed skills required by librarians in the 5IR from different perspectives. Ayinde et al. (2024); Babalola (2018); Taiwo et al. (2024); Pinfield et al. (2017) opined that information, digital, research, computer, ICT, cognitive, networking and writing skills will highly contribute to the sustainability of LIS in the ever-evolving world. Specifically, Ayinde et al. (2024) established that technical, soft, upskill, re-skilling and mega-skilling are essential for seamless navigation, survival and sustainability of librarians in the 5IR.

From the skills itemised, ICT and digital skills have been highly explained and studied in the different contexts. For instance, Akinola et al. (2024) found that information professionals in Ekiti State Polytechnic, Nigeria, possessed ICT skills such as knowing how to access and use of electronic information resources. Additionally, Swaminathan et al. (2022) justified the essence of ICT skills in the emerging library and information landscape by dissecting the skills into managing information organizations, managing information resources, managing information services and applying information tools and technologies. The skills were further broken into varieties of abilities to use hardware, software, machine learning, AI, digital library, institutional repositories, content management system, plagiarism detection software, radio frequency identification, multimedia and database management system.

Friday and Onuh (2022) investigated acquisition of 21st Century librarianship skills by librarians in public university libraries in Bayelsa and Rivers States, Nigeria. Findings revealed that emailing, word processing, internet surfing, digital literacy and social networking skills were the 21st Century librarianship skills acquired by the respondents. Similarly, Owate and Chiekezie (2024) investigated information professionals' digital competence in promoting access to electronic information resources in academic libraries in Rivers State, Nigeria and found that the digital skills needed by information professionals in promoting access to electronic information resources are a strong digital literacy/information skill, technical proficiency, sound management skills on preservation of electronic materials and knowledge of best practices in digital asset management.

Nwankwo et al. (2020) assessed digital literacy skills of 21st Century librarians in college libraries in Anambra State. Findings showed that the respondents possessed some digital literacy skills like turning on computer, downloading files from databases, PowerPoint presentation, opening a computer file and word processing. In the same vein, Adedokun and Popoola (2024) reported that computer self-efficacy, computer literacy skills, and cognitive skills have a significant joint effect on the use of digital information resources in the emerging world. Furthermore, Okeji et al. (2020) assessed digital literacy skills of 21st Century

librarians in private university libraries in Anambra State, Nigeria. Findings revealed that academic librarians in private universities in Anambra State possessed digital literacy skills.

Sulyman et al. (2020) opined that information literacy skills will remain a lifetime skill for librarians and other information professionals. In validating this assertion, Salman et al. (2023) found information literacy skills, knowledge management skills and knowledge organization (cataloguing, classification, indexing and the likes) as impetuses for professional sustainability of LIS in the 21st Century. Joel and Ibrahim (2021) determined digital skills needed by librarians and information professionals for knowledge management of 21st Century university libraries in Borno State, Nigeria. The findings revealed that information technology skills, interpersonal skills and leadership skills are highly needed by librarians and information professionals for knowledge management of 21st century libraries in Borno State, Nigeria.

Since technologies are dominating our world, people are fond of being bias to technological skills than others. The needs for other skills such as interpersonal and leadership as revealed by Joel and Ibrahim (2021) opened the vistas for investigating the roles of other skills in the sustainability of LIS in the 5IR. In discouraging this trend, Read and Cox (2020) found that common technologies, such as internet, computers, and audio-visual technology, require the use of soft skills because the significance of developing soft skills to effectively utilise emerging technologies like artificial intelligence (AI) and augmented reality, currently employed by scholarly communication librarians. The need for soft or interpersonal skills in the sustainability of LIS in the 5IR was stressed by Ali et al. (2023) where they noted academic librarians in public and private universities in Pakistan perceived collaboration, communication, customer service, ethics and values, leadership, learning and innovation skills important for the emerging world of library services.

Awoyemi (2019) emphasized that soft skills are vital for LIS professionals to excel in digitally-focused workplaces and highlighted adaptability, communication, advocacy, change management, decision-making, problem-solving, initiative, innovation, writing, and presentation skills for librarians in the 5IR. One of the important aspects of the soft skills librarians are emphasising and striving to acquire are networking skills. Some LIS scholars are of the belief that networking skills are becoming indisputable for librarians that are ready to champion change in the emerging world of LIS. In justifying the need for networking skills among librarians, Howerton-Hicks and Maleeff (2016) submitted that networking is an important skill to practice, hone and mastered by all librarians because the advent of digital technologies has transformed many forms of interactions, exposing librarians to the delivery of services through social media, emails or phones.

In supporting the claims of Howerton-Hicks and Maleeff (2016), Taiwo et al. (2024) asserted that networking skills have become important for librarians because of the ever-growing nature of information practice. Networking skills are a veritable avenue for librarians to develop and position themselves for opportunities they desire to grow, fulfill their career objectives and become relevant in their profession. The claims of Taiwo et al. (2024) were validated by their findings which reported that librarians in Kwara State, Nigeria, are networked among themselves by engaging in skills development/acquisition to meet new people, reading current literature to connect with trending researchers, getting mentors, reviewing books, monographs and journal articles.

All the skills possessed by librarians cannot be considered important if cognitive/knowledge-based skills are lacking (Mak, De Vries & Willems, 2020; Leopold, Mayer & Dutke, 2019). The cognitive skills encompassed the librarians' mental abilities to reason and logically perform tasks. The skills involved mental imagery, which is the key to complete immersion needed for problem-solving at various levels of library operations. Also, the cognitive skills could influence librarians' learning, confidence and attitude towards emerging technologies used in the 5IR. This is because the cognitive processes involved in information retrieval can be deployed for learning, comprehending and speed in spotting information. These factors have a role to play in the effectiveness of librarians during a search process (Adedokun & Popoola, 2024).

Methodology

The quantitative nature of this study makes it adopt survey design to gather numerical data that was used in measuring the participants' views and opinions about the roles of skills on LIS sustainability in the 5IR. The population of this study is 199 librarians on the WhatsApp platform of the Nigerian Library Association (NLA), Kwara State Chapter. Convenience sampling technique was adopted to allow members of the population participate in the study based on their willingness. In the end, only 84 librarians responded to the questionnaire designed with Google Forms and sent to the stated WhatsApp group. The contents of the questionnaire were first validated by two LIS experts before they were designed with Google Forms. The data collected were presented and analysed in simple percentages, frequencies and mean ($\bar{x}$).

Data Analysis

Table 1: Demographic Information of Respondents

Options		F	%
Gender	Male	63	75.0
	Female	21	25.0
	Total	**84**	**100**
Age range	20-29 years	18	21.4
	30-39 years	30	35.7
	40-49 years	21	25.0
	50-59 years	15	17.9
	60 years and above	0	0.0
	Total	**84**	**100**
Academic qualification	ND	9	10.7
	HND	12	14.3
	BLIS	36	42.9
	MLIS	15	17.9
	PhD	12	14.3
	Total	**84**	**100**
Work experience	1-5 years	48	57.1
	6-10 years	12	14.3
	11-15 years	9	10.7
	16-20 years	6	7.1
	21 years and above	9	10.7
	Total	**84**	**100**

Source: Researchers' Field Survey, 2025

Table 1 shows that majority of the respondents 63 (75.0%) were male, followed by females (21 25.0%). Respondents within the age range 30 – 39 years are 30 (35.7%), followed by 40 – 49 years 21 (25.0%), 20 – 29 years 18 (21.4%) and 50 – 59 years (15 17.9%). Moreso, BLIS has the highest representation with 36 (42.9%), followed by MLIS with 15 (17.9%), HND and PhD have 12 (14.3%) respectively, while ND has only 9 (10.7%). Finally, respondents with 1 – 5 years work experience are 48 (57.1%), followed by 6 – 10 years 12 (14.3%), 11 – 15 years and 21 years and above have 9 (10.7%) respectively, while 16 – 20 years has only 6 (7.1%).

Table 2: Hard skills necessary for LIS sustainability in the 5IR

Options	M	DR
Ability to retrieve information timely and effectively	3.68	SA
Ability to render reference services	3.57	SA
Digital literacy	3.50	SA
Information literacy	3.50	SA
Ability to render research services	3.50	SA
Ability to abstract information resources	3.50	SA
Ability to classify information resources	3.50	SA
Ability to catalogue information resources	3.50	SA
Ability to render selective dissemination of information	3.46	SA
Ability to render current awareness services	3.46	SA
Ability to create and manage metadata	3.46	SA
Ability to compile bibliographies	3.43	SA
Ability to render document delivery services	3.39	SA
Ability to index information resources	3.36	SA
Grand mean = (4.00)		

Source: Researchers' Field Survey, 2025
Decision Rule: If mean ($\bar{x}$) is 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).

Table 2 shows that the respondents generally strongly agreed with the hard skills needed for the sustainability of LIS in the 5IR with (Grand mean = 4.00). In order of their mean scores ($\bar{x}$), the major options the respondents strongly agreed with include: Ability to retrieve information timely and effectively ($\bar{x}$= 3.68), followed by ability to render reference services ($\bar{x}$= 3.57), digital and information literacies, abilities to render research services, abstract, classify and catalogue information resources ($\bar{x}$ = 3.50) respectively. This indicates that the hard skills needed for LIS sustainability in the 5IR are abilities to retrieve information timely and effectively, render reference services, digital and information literacies, render research services, abstract, classify and catalogue information resources.

Table 3: Soft skills necessary for LIS sustainability in the 5IR

Options	M	DR
Ability to communicate clearly	3.68	SA
Ability to lead others	3.57	SA
Ability to understand the society I find myself	3.54	SA
Ability to understand the cultures of the people around me	3.54	SA
Ability to solve problems	3.50	SA
Ability to network and work with team members	3.46	SA
Ability to think analytically and critically	3.46	SA
Grand mean = (3.54)		

Source: Researchers' Field Survey, 2025

Decision Rule: If mean ($\bar{x}$) **is** 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).
Table 3 reveals that the respondents generally strongly agreed with the soft skills needed for the sustainability of LIS in the 5IR with (Grand mean = 3.54). In order of their mean scores ($\bar{x}$), the major options the respondents strongly agreed with include: Ability to communicate clearly ($\bar{x}$ = 3.68), followed by ability to lead others ($\bar{x}$ = 3.57), abilities to understand where they find oneself and the cultures of the people around them ($\bar{x}$ = 3.54) and solve problems ($\bar{x}$ = 3.50). This shows that the soft skills needed for LIS sustainability in the 5IR are abilities to communicate clearly, lead others, understand where they find oneself, understand the cultures of the people around them and solve problems.

Table 4: Personal skills necessary for LIS sustainability in the 5IR

Options	M	DR
Ability to be creative and innovative	3.75	SA
Ability to control myself	3.64	SA
Ability to be aware of myself	3.54	SA
Ability to feel the same way others are feeling	3.54	SA
Ability to motivate myself	3.54	SA
Ability to discipline myself	3.50	SA
Ability to write and edit works	3.50	SA
Ability to see tasks to their ends	3.50	SA
Ability to work under pressure	3.46	SA
Ability to manage stress	3.43	SA
Grand mean = (3.54)		

Source: Researchers' Field Survey, 2025
Decision Rule: If mean ($\bar{x}$) **is** 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).
Table 4 reveals that the respondents generally strongly agreed with the personal skills needed for the sustainability of LIS in the 5IR with (Grand mean = 3.54). In order of their mean scores ($\bar{x}$), the major options the respondents strongly agreed with include: Ability to be creative and innovative ($\bar{x}$ = 3.75), followed by abilities to control oneself ($\bar{x}$ = 3.64), abilities to be aware of oneself, motivate oneself and feel the same way others are feeling ($\bar{x}$ = 3.54) respectively. This shows that the personal skills needed for LIS sustainability in the 5IR are abilities to be creative and innovative, control oneself, being aware of oneself, motivate oneself and feel the same way others are feeling.

Table 5: Knowledge-based skills necessary for LIS sustainability in the 5IR

Options	M	SD
Ability to know about emerging LIS services	3.64	0.48
Ability to know about copyright and other intellectual property rights	3.61	0.49
Ability to know about emerging LIS products	3.54	0.50
Ability to know about basic concepts in LIS	3.50	0.57
Ability to know about regulations in LIS	3.50	0.50
Ability to acquaint myself with LIS history	3.50	0.50
Grand mean = (3.55)		

Source: Researchers' Field Survey, 2025

Decision Rule: If mean ($\bar{x}$) **is** 1.0 – 1.74 = Strongly Disagreed (SD); 1.75 – 2.49 = Disagreed (D); 2.50 – 3.24 = Agreed (A); 3.25 – 3.99 = Strongly Agreed (SA).
Table 5 points out that the respondents generally strongly agreed with the knowledge-based skills needed for the sustainability of LIS in the 5IR with (Grand mean = 3.55). In order of their mean scores ($\bar{x}$), the major options the respondents strongly agreed with include: Ability to know about emerging LIS services ($\bar{x}$ = 3.64), followed by know about copyright and other intellectual property rights ($\bar{x}$= 3.61), abilities to know about emerging LIS products ($\bar{x}$= 3.54), know about basic concepts in LIS and know about LIS regulations ($\bar{x}$ = 3.50) respectively. This implies that the knowledge-based skills needed for LIS sustainability in the 5IR are abilities to know about emerging LIS services, know about copyright and other intellectual property rights, know about emerging LIS products, know about basic concepts in LIS and know about LIS regulations.

Discussion of Findings
Findings revealed that the respondents believed that all hard skills can serve as impetus for the sustainability of LIS in the 5IR. Specifically, skills including abilities to retrieve information timely and effectively, render reference services, digital and information literacies, render research services, abstract, classify and catalogue information resources are considered paramount by the respondents. The hallmark of these findings is that the respondents believed in the possession of abilities to provide some traditional library operations and services, despite the apparent transitions.The respondents' acknowledgment of digital skills in sustaining LIS in the 5IR validate the reports of various studies attesting to the possession of digital/ICT abilities by librarians in the evolving LIS landscape. For instance, Swaminathan et al. (2022) justified the essence of digital skills in the emerging library and information landscape by submitting that librarians' abilities to apply information tools and technologies to libraries would distinguish them by indicating their expertise and mastery of their jobs. The findings further validate the reports of Akinola et al. (2024); Friday and Onuh (2022); Nwankwo et al. (2020) who found encouraging digital/ICT skills among Nigerian librarians.
Findings further revealed that the respondents believed that librarians' information literacy can help in sustaining LIS in the 5IR. This means that the respondents believed information literacy will continue to be relevant in LIS practice. This is consistent with the opinion of Salman et al. (2023); Sulyman et al. (2020) that information literacy skills will remain a lifetime skill for librarians and other information professionals. Also important to acknowledge among the skills are abilities to classify and catalogue information resources. These affirm the reports of Salman et al. (2023) that knowledge organization skills, which encompasses cataloguing, classification, indexing and abstracting are relevant to the professional sustainability of LIS in the 21st Century.

It is interesting to discover that the respondents' positive responses to extend beyond hard skills by opining that soft skills such as abilities to communicate clearly, lead others, understand where one find oneself, understand the cultures of the people around one as well as solve problems are needed for LIS sustainability in the 5IR. The respondents' views affirm the position of Awoyemi (2019) that soft skills are vital for LIS professionals to excel in digitally-focused workplaces.

The respondents' recognition of the abilities to communicate clearly and lead others in sustaining LIS in 5IR is also important to be emphasised because their views corroborate the assertion of Saleem and Ashiq (2020) that the possession of communication skills can help address the communication gaps, which are becoming prevalent in the evolving world. Moreso, the findings about leadership skills affirm the submission of Joel and Ibrahim (2021) that leadership skills are highly needed by librarians and information professionals in the 21st Century.

On the personal skills, findings revealed that abilities to be creative and innovative, control oneself, being aware of oneself, motivate oneself and feel the same way others are feeling are needed for LIS sustainability in the 5IR. The simplest interpretation of these findings is that the respondents are of the opinions that creativity and innovativeness, self-control, self-awareness, self-motivation and empathy can help sustain LIS in the 5IR. The blend of personal skills with other skills determines a librarian's ability to positively respond to changes that accompany the transformation of their profession.

Furthermore, it is important to discuss the respondents' opinions that the abilities to know about emerging LIS services, know about copyright and other intellectual property rights, know about emerging LIS products, know about basic concepts in LIS and know about LIS regulations are needed for LIS sustainability. These support the notion of Adedokun and Popoola (2024) that the knowledge-based skills could influence librarians' learning, confidence and attitude towards emerging technologies used in the 5IR. The knowledge-based skills are considered highly essential in the 5IR. It is true that librarians who want to remain relevant in the 5IR must be aware of the emerging LIS services and products such as research data management, data analytics, data visualisation, scholarly communication, green libraries and the likes. Librarians who are not knowledgeable about the emerging concepts, services, products and regulations are prone to be left behind in the waves of changes.

Putting the ability to know about copyright and other intellectual property rights into context. For instance, AI is one of the most sought-after technologies in the evolving LIS landscape. However, scholars have asserted that one of the problems of deploying AI for library services is copyright abuses and plagiarism. In view of this, it is trite to conclude that being knowledgeable about copyright and other intellectual property rights can give librarians a leverage in using AI for library operations and services.

Conclusion

Skills are considered as specific abilities required for one to stand-out in discharging one's duties and obligations. In the evolving 5IR, the roles of skills possessed by librarians cannot be overemphasised. This study has revealed that all the skills – hard, soft, personal and knowledge-based – are indispensable for librarians who want to remain relevant in the 5IR. Considering the technological disruptions that will accompany the 5IR, which will require an intense human-computer interactions, this study pointed out that librarians must be digital and information literate in order to know how to retrieve information timely and effectively, render reference and research services.

Also, librarians must be able to communicate clearly, lead others, understand where they find oneself, understand the cultures of the people around them and solve problems arising in the processes of rendering services and providing information to users. It is also worthy to stress that librarians in the 5IR must be creative and innovative, exhibit self-control, self-awareness, self-motivation and be empathetic. The aggregation of these skills will enable librarians to know about emerging LIS services and products, copyright and other intellectual property rights, basic LIS concepts and LIS regulations. This will enable librarians adopt emerging technologies for library services with due diligence and ethical considerations.

References

Adedokun, O.O. & Popoola, S.O (2024). Computer self-efficacy, computer literacy skills, cognitive skills and use of electronic resources by social science doctoral students in Nigerian federal universities. *International Journal of Information Science and Management*, 22(4), 185-205. DOI: https://doi.org/10.22034/ijism.2024.2007424.1187

Akinola, A.O., Akerele, J.A., Fagbemiro, A.O. & Giwa, A.O (2024). Demographic variables and ICT skills as predictors of intention to use technology among academic staff of Ekiti State Polytechnic, Isan-Ekiti, Nigeria. *Journal of Library Services and Technologies*, 6(2), 25 – 38. DOI: http://doi.org/10.47524/jlst.v6i2.26

Ali, M.A., Rafiq, M. & Arshad, A. (2023). Perceptions of academic librarians regarding their interpersonal competencies: A case of Pakistani universities. Journal of Librarianship and Information Science, 1–19. https://doi.org/10.1177/09610006231201409.

Awoyemi, R.A. (2019). Core competencies and innovation for Library and Information Science professional in 21st century digital-based environment. In: Jared K & Robert B (eds) Handbook of Research on Promoting Higher – Order Skills and Global Competencies in Life and Work. Hershey: IGI Global, pp.264–280.

Ayinde, A., Ajayi, A.O. & Adedeji, A. (2024). Reimagining the roles and skills of information professionals in the 5IR. *Business Information Review*, 0(0) 1–10. DOI: 10.1177/02663821241310380.

Babalola, E.O. & Omolafe, E.V. (2022). Effect of developed mobile application on undergraduates academic performance in computer science. ASEAN *Journal of Science and Engineering Education*, 2(3), 215-222. https://doi.org/10.17509/ajsee.v2i3.44833

Babalola, S. O. (2018). Factors influencing behavioral intention to the use of information and communication technology (ICT) among students of Federal Polytechnic, Ilaro. Ogun state. Nigeria. *Library Philosophy and Practice, (e-journal). 2153.*http://digitalcommons.unl.edu/libphilprac/2153.

Enyi, U.J. (2022). Impact of computer literacy on students' academic performance in art education. *International Journal of Science and Research Methodology*, 20(4), 205-214. https://ijsrm.humanjournals.com/wp-content/uploads/2022/03/15.EnyiUko-Jairus.pdf

Friday, J.E. & Onuh, N.S. (2022). Acquisition of 21st Century librarianship skills by librarians in public university libraries in Bayelsa and Rivers States, Nigeria. *Library Philosophy and Practice (e-journal). 7265*. https://digitalcommons.unl.edu/libphilprac/7265.

Howerton-Hicks, L. & Maleeff, T.Z. (2016). Network like nobody's watching: Demystifying networking as a skill for the librarian and information professional community. *International Journal of Librarianship*, 45(2), 47 – 58.

Jain, P. & Akakandelwa, A. 2016. Challenges of twenty-first century academic libraries in Africa. *African Journal of Library, Archives & Information Science*, 26(2), 147 – 160.

Joel, A.P. & Ibrahim, F.L. (2021). Digital competencies needed by librarians and information professionals for knowledge management of 21st century university libraries in Borno State. *Library Philosophy and Practice (e-journal)*. 5355. https://digitalcommons.unl.edu/libphilprac/5355.

Leopold, C., Mayer, R.E. & Dutke, S. (2019). The power of imagination and perspective in learning from science text. *Journal of Educational Psychology*, 111(5), 793–808. https://doi.org/10.1037/edu0000310

Luca, E., Narayan, B. & Cox, A. 2022. Artificial intelligence and robots for the library and information professions. *Journal of the Australian Library and Information Association*, 71(3), 185-188.

Mak, M., De Vries, C. & Willems, R.M. (2020). The influence of mental imagery instructions and personality characteristics on reading experiences. *Collabra: Psychology,* 6(1), 43. https://doi.org/10.1525/collabra.281

Menabò, L., Sansavini, A., Brighi, A., Skrzypiec, G., & Guarini, A. (2021). Promoting the integration of technology in teaching: An analysis of the factors that increase the intention to use technologies among Italian teachers. *Journal of Computer-assisted Learning*, 37(6), 1566-1577.https://doi.org/10.1111/jcal.12554.

Nwankwo, N.G., Seimode, D.F. & Ismaila, O.S. (2020). Assessment of digital literacy skills of 21st century librarians in college libraries in Anambra State, Nigeria. *International Journal of Social Sciences and Humanities Reviews*, 10(2), 201 – 211.

Okeji, C.C., Nwankwo, N.G., Anene, I.A. & Olorunfemi, E.A. (2020). Assessment of digital literacy skills of 21st century librarians in private university libraries in Anambra State. *International Journal of Library and Information Science Studies*, 6(4), 34-47.

Oladokun, B.D., Ayinde, L. & Enakrire, R.T. (2024). The fifth industrial revolution: Information professionals and skills. *Information Matters*, 4(8), 1–4.

Owate, C.N. & Chikezie, H.E. (2024). Assessment of information professionals' digital competence in promoting access to electronic information resources in academic libraries in Rivers State, Nigeria. *The Catalyst Journal of Library and Information Literacy,* 3(2), 52-67.

Pinfield, S., Cox, A. & Rutter, S. (2017). Mapping the future of academic libraries: A report for SCONUL.

Read, A. & Cox, A. (2020). Underrated or overstated? The need for technological competencies in scholarly communication librarianship. *The Journal of Academic Librarianship*, 46(4): 102155.

Saleem, Q.U.A. & Ashiq, M. (2020). The facts of continuing professional development for LIS professionals in Pakistan: A literature review. The Bottom Line, 33(3), 263–271.

Salman, A.A., Ajani, F.O. & Sulyman, A.S. (2023). The nexus between professional ethics, competence and emerging technologies on sustainability of LIS profession. *Information Technology and Librarianship: A Journal of the NLA IT Section,* 3(2), 59 – 76.

Sulyman, S.A., Adeyemi, Y.A. & Kolawole, A.A. (2020). Information literacy. In Kaushik, A. & Reveera, N. (Eds.). Handbook of Research on Emerging Trends and Technologies in Library and Information Science. IGI Global: Pennsylvania. 156-168. DOI: 10.4018/978-1-5225-9825-1.ch012

Swaminathan, K.S.M., Magudeeswaran, T. & Lal S. (2022). ICT skills required for librarians in digital era: An Overview. Indian J Lib Inf Sci,16(2), 129–135.
Taiwo, M.A., Sulyman, A.S., Idris, A.O., Olosasa, A.T. & Uzoh, U.L. (2024). Perceived effects of professional networking on career growth of librarians in Kwara State, Nigeria. *International Journal of Knowledge Dissemination*, 5(1), 43-54. https://doi.org/10.70118/ijkd.0202405010.5
Technology from Sage (2022). Librarian futures part II: The knowledge gap between librarians and students; contrasting librarian and student perspectives on the undergraduate workflow. United Kingdom: Sage Publishing.
The Organization for Economic Cooperation and Development [OECD] (2016). OECD Technical report of the survey of adult skills (PIAAC) (2nd ed.). United States of America: OECD.
Tshabalala, N. & Dube, L. (2024). Emerging technologies and skills to improve service delivery in digital libraries. *South African Journal of Libraries and Information Science*, 90(2), 1 – 12.
Uzohue, C. E., & Yaya, J. A. (2016). Knowledge management competencies required for library and information professionals in 21st century Nigerian libraries. *American Journal of Business and Society*, 1(3), 90 – 97.
van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020). Determinants of 21st-Century skills and 21st-Century digital skills for workers: A systematic literature review. *SAGE Open,* 10(1), 215824401990017. https://doi.org/10.1177/2158244019900176
Vodă, A.I., Cautisanu, C., Grădinaru, C., Tănăsescu, C. & de Moraes, G.H.S.M. (2022). Exploring digital literacy skills in social sciences and humanities students. *Sustainability*, 14(5), 2483. https://doi.org/10.3390/su14052483
Yeşilyurt, E. & Vezne, R. (2023). Digital literacy, technological literacy, and internet literacy as predictors of attitude toward applying computer-supported education. *Education and Information Technologies,* 28(8), 9885-9911. https://doi.org/10.1007/s10639-022-11311- 1.

Skills Gap Analysis for the Sustainability of Librarianship in the Era of the Fifth Industrial Revolution (5IR)

Yusuf Ayodeji AJANI
Department of Library and Information Science
University of Abuja, Federal Capital Territory, Nigeria
trustusouph@gmail.com/https://orcid.org/0000-0002-2786-4461

Roseline Ifeoma **ECHEZONA**
Department of Library and Information Science
University of Abuja, Federal Capital Territory, Nigeria
Ifeoma.echezona@uniabuja.edu.ng/https://orcid.org/0000-0003-3610-6969

Abdulganiy Okanla AHMED
Department of Library and Information Science
University of Abuja, Federal Capital Territory, Nigeria
abdulganiy.ahmed@uniabuja.edu.ng/https://orcid.org/0009-0006-6271-8669

Abstract

Despite the global momentum toward sustainability and technological innovation in the Fifth Industrial Revolution (5IR), academic librarians in Nigeria are facing significant challenges due to outdated skills, limited exposure to emerging technologies, and inconsistent institutional support. These gaps hinder their ability to remain relevant and contribute meaningfully to sustainable development in evolving information landscapes. In response to these challenge, this study aimed to assess the competencies required for sustainability in academic librarianship and identify critical skill gaps within the 5IR context. Using a mixed-methods approach with a descriptive design, data were gathered via a semi-structured online survey administered to 5,900 certified academic librarians across Nigeria's six geopolitical zones, yielding 678 valid responses. Convenience sampling was used, and the instrument was validated and pilot-tested. Descriptive statistics and thematic analysis were employed for quantitative and qualitative data, respectively. Findings revealed strong traditional skills but significant deficiencies in areas like artificial intelligence, blockchain, data analytics, and green practices. Adaptability and emotional intelligence were only moderately developed. Additionally, just 41.3% of respondents reported receiving relevant institutional training. The study concludes that bridging these gaps requires coordinated professional development, institutional investment, and strategic alignment with global sustainability frameworks. Recommendations. Includes coordinated professional development, national skills frameworks, and strategic alignment with the UN Sustainable Development Goals (SDGs).

Keywords: Skills gap, Sustainability, Fifth Industrial Revolution, Academic librarians, Nigeria, Professional development.

Introduction

The Fifth Industrial Revolution (5IR) is reshaping various sectors worldwide, driven by advancements in technology and a growing emphasis on sustainability. In advanced economies, this transformation has led to the integration of artificial intelligence, big data, and automation into everyday practices, promoting efficiency and innovation. As the 5IR progresses, the demand for skilled professionals capable of navigating the complexities of sustainable practices has become increasingly essential. For instance, libraries in developed countries are increasingly adopting smart technologies to enhance user experience and streamline operations. They are also focusing on sustainability initiatives that not only improve resource management but also foster community engagement through educational programs on environmental stewardship (Moreland & Kammer, 2020). Within the realm of librarianship in Nigeria, this revolution necessitates a critical reassessment of the skills required to maintain the relevance and effectiveness of libraries. Librarians are required to cultivate competencies that extend beyond traditional information management to include advanced technological skills, project management capabilities, and a comprehensive understanding of sustainability principles.

Key skills encompass analytical abilities for assessing data and trends, effective communication to engage diverse stakeholders, and adaptability to embrace emerging technologies (Challoumis, 2024). Other sectors are actively pursuing sustainability within the framework of 5IR. Industries such as renewable energy, sustainable engineering, and environmental management are thriving by integrating innovative practices that prioritise both economic growth and ecological balance. For instance, sustainability managers are increasingly sought after for their expertise in implementing green initiatives and ensuring compliance with

environmental regulations (Arzo & Hong, 2024). As these sectors evolve, they underscore the importance of interdisciplinary collaboration and continuous skill development, which can serve as a model for librarianship. Despite the important role librarians play in supporting education, research, and community engagement, many libraries in Nigeria face significant skills gaps that impede their ability to effectively leverage new technologies. Factors such as outdated training programmes, limited access to professional development resources, and a lack of awareness regarding emerging technologies contribute to these gaps (Ajani et al., 2024). Moreover, the gap between current skill sets and the competencies demanded by the 5IR emphasis the need for a targeted investigation.

Problem Staatement

As the emergence of the 5IR brought about a paradigm shift in professional practices, placing greater emphasis on human-centered innovation, digital fluency, and sustainable development. Librarians are expected to move beyond traditional roles to embrace new competencies that support sustainability and technological integration. However, the Nigerian context presents a unique set of challenges that hinder this transition. Many academic librarians in Nigeria face significant skills gaps due to outdated training programs, limited professional development opportunities, and inadequate exposure to emerging technologies (Ndibalema, 2025). These limitations affect their ability to deliver services that align with user expectations in an increasingly digital and sustainability-driven age (Onunka et al., 2024). Despite growing global debate around sustainability in librarianship, there remains a lack of comprehensive understanding of the specific competencies required for librarians to thrive in the 5IR. Furthermore, institutional support systems, which are critical for fostering continuous learning and innovation, are often insufficient or underutilized. Therefore, this study seeks to conduct a skills gap analysis to assess the current capabilities of academic librarians in Nigeria, identify the sustainability-focused skills essential for professional relevance in the 5IR, and evaluate the extent of institutional support available for capacity building. To address these issues, this study seeks to propose actionable strategies for professional development that will align with global best practices and position Nigerian academic librarians for success in an increasingly dynamic information environment.

Objectives of the Study

The study seeks to investigate a skills gap analysis to identify the competencies required for academic librarians to sustain their roles effectively in the context of the 5IR. While the specific objectives were to;

1. assess the current sets of skills of academic librarians for sustainability practices in the 5IR.
2. analyse the sustainability set skills that are necessary for academic librarians to thrive in the 5IR
3. identify gaps between academic librarians' current sets of skills and required competencies for sustainability to thrive in the 5IR
4. investigate the support provided by academic institutions in enhancing the skills of librarians for sustainable initiatives in the 5IR.

Literature Review

Libraries globally have been experiencing significant transformations due to technological advancements, particularly in the realm of user-generated content (Byrkovych et al., 2023). The rapid pace of digitalisation has reshaped the library profession, prompting librarians to adapt to new skill demands. Ajani et al. (2025) emphasised that academic librarians are now required to embrace emerging technologies such as automation and AI, which are becoming integral to service delivery in the 5IR. According to Panda (2023), libraries are shifting to incorporate user-centric, technologically enhanced services. Additionally, Adigun et al. (2024) pointed out that user expectations have evolved alongside these technological advancements, placing pressure on librarians to stay updated with the necessary skills for sustainability practices in the 5IR. As a result, librarians are now focusing on skills that enable them to integrate technological innovations, navigate digital resources, and adapt to automation trends, all while maintaining their core functions of knowledge preservation and dissemination (Tella & Ajani, 2022).

The 5IR demands that librarians not only maintain traditional skills but also acquire competencies in emerging fields such as AI, data analytics, and digital literacy (Ayinde et al., 2025). The 5IR integrates human intelligence with advanced technologies, requiring a balance between technical expertise and human-centric skills like empathy and ethical reasoning (Anne et al., 2025). In this context, Demirdis (2025) highlighted the growing need for librarians to develop higher cognitive skills, including problem-solving and emotional intelligence, to address the complex challenges posed by sustainability initiatives. Similarly, Ajani and Oladokun (2024) stressed the importance of digital literacy in navigating electronic resources and incorporating innovative technologies into library services, a necessity for librarians to thrive

in the 5IR. Despite the advancements in technology, there remain significant gaps in the current skill sets of librarians when compared to the competencies required to thrive in the 5IR (Dube et al., 2024). Li (2018) observed that while lower-skilled roles in librarianship are rapidly disappearing due to automation, new roles requiring advanced technical expertise are emerging.

Studies by Hawksworth et al. (2018) revealed that sectors like librarianship face a high risk of automation, which necessitates a focus on upskilling to remain relevant. Shen and Zhang (2024) estimated that nearly 47% of jobs, including roles in librarianship, could be automated within two decades. However, many librarians lack the necessary skills in AI, data science, and digital content management to meet these challenges. This skills gap, if left unaddressed, poses a threat to the sustainability of the profession in the 5IR era. The sustainability of the information profession in the 5IR hinges on institutional support for professional development and skills enhancement. Research indicates that academic institutions and professional organisations play a critical role in providing the necessary training for librarians to adapt to technological advancements (Shahzad et al., 2023; Dhakal et al., 2024). Lo (2024) highlighted the need for institutions to foster continuous learning and reskilling opportunities, particularly in AI and data analytics, to enable librarians to remain competitive in the evolving job market. Academic institutions must cultivate a culture of adaptability, ensuring that librarians receive the support needed to acquire new skills.

The World Economic Forum (2023) also emphasised the importance of human-centred competencies in achieving sustainability goals, urging academic libraries to invest in skill development programs that align with the broader objectives of the 5IR. To inform local strategies for skills development, best practices from leading global institutions can provide valuable insights. According to Syafruddin et al. (2025), addressing critical skill shortages requires comprehensive workforce policies and effective long-term strategies. These strategies include fostering collaboration between libraries and technology companies, offering specialised training in emerging technologies, and implementing policies that prioritise skills development aligned with global sustainability goals. Moreover, Aslam et al. (2025) emphasised that some institutions have successfully integrated AI and automation into their library services, creating new roles that require advanced technological competencies. By examining these global best practices, local institutions can develop strategies tailored to the specific needs of academic librarians in the 5IR, ensuring that they possess the skills necessary to thrive in the changing landscape of librarianship.

Empirical Studies

A Study by Byrkovych et al. (2023) highlighted the significant transformations that libraries globally have undergone in response to shifting socio-economic and technological landscapes. These changes, particularly the move towards digital storage, automation, and online services, have necessitated the acquisition of new digital and technological skills by librarians. As they adapt to the evolving needs of users in the 5IR, librarians are increasingly adopting emerging technologies such as artificial intelligence (AI), wearable devices, and automation. Molla et al. (2025), as well as Akobe et al. (2025), provided valuable insights into the rising demand for technological expertise within the library profession, particularly in light of AI advancements. Both studies underlined that while new roles requiring advanced skills are emerging, many librarians still lack competencies in areas such as AI, digital literacy, and information management. Dhakal et al. (2024), though focused on critical skill shortages in the Asia-Pacific region, offered relevant insights for academic librarians, identifying similar shortages in skills like critical thinking, problem-solving, and digital technologies essential for the 5IR.

Dondi et al. (2021) emphasised the need for a blend of advanced technological skills and human-centred competencies for professionals in the 5IR. For academic librarians, this involves acquiring proficiency in AI, data analytics, and digital literacy, alongside higher cognitive skills such as emotional intelligence, adaptability, and creativity. The research emphasised the growing significance of these skills for librarians to navigate the rapidly evolving information landscape. A study by Xwayi (2024) further stressed the importance of digital skill acquisition for librarians to sustain their roles in research and information management. As information professionals increasingly collaborate with researchers and manage complex data systems, expertise in digital technologies, especially AI and big data, becomes essential for success in the 5IR. Saleema et al. (2025) discussed the shift from low-skilled tasks that can be handled by machines to high-skilled tasks such as problem-solving, creativity, and critical thinking. This finding aligns with the demands placed on academic librarians in the 5IR, where the integration of human judgment with digital expertise is crucial.

A study conducted by Frey and Osborne (2017) estimated that approximately 47% of jobs in the United States could be fully automated within two decades, highlighting the challenges for roles that do not require social intelligence or creativity. While many academic librarians are still adapting to the technological demands of the 4IR, the 5IR presents an even greater need for adaptability and advanced technological

skills. This study identified a significant gap between current skill sets and the requirements needed to sustain roles in a highly automated future. Hawksworth et al. (2018) found that 56.3% of professionals in the information sector predicted that librarianship would undergo significant transformations due to AI, but many librarians lacked the necessary technological proficiency to remain unaffected by these changes. This gap highlights the pressing need for upskilling and reskilling among librarians to bridge the competency divide in the 5IR.

Wood and Evans (2018) discovered that 43.69% of professionals with high technological proficiency believed that AI would have minimal impact on their work, underscoring the importance of institutional support for upskilling and training. Institutions that invest in training opportunities for academic librarians, particularly in AI, data science, and digital content management, will play a key role in ensuring the sustainability of the profession. Shah et al. (2024) also emphasised the importance of academic institutions offering ongoing training for librarians, especially as the profession continues to evolve due to technological advancements. The study suggested that the sustainability of library roles is contingent on institutions' commitment to reskilling and continuous learning for librarians. Dhakal et al. (2024) offered insights into workforce development strategies across the Asia-Pacific region, emphasising how leading institutions implement comprehensive policies to address skill shortages and promote long-term sustainable development. These best practices include workforce planning, strategic reskilling, and training programmes focused on soft skills and technological competencies. Such approaches can inform local strategies for academic librarians in other regions, including Nigeria, to better align with 5IR demands. Similarly, Hawksworth et al. (2018) provided insights into best practices for skill development, stressing that institutions and professional organisations must actively collaborate to develop training programmes that address emerging skill demands. Specifically, developing skills in software development, AI, and data management has become a priority for sustaining librarianship in leading global institutions.

Literature Gap

While several studies have explored the impact of technological advancements and the need for upskilling in the context of the 5IR, many critical gaps remain particularly regarding academic librarians in Africa, and Nigeria in particular. Much of the existing research emphasizes global or Western contexts, overlooking region-specific infrastructural and institutional challenges. Though the importance of acquiring AI, data analytics, and digital literacy skills is widely acknowledged (Byrkovych et al., 2023; Ajani et al., 2023), limited research exists on how Nigerian institutions can implement effective, targeted professional development programmes. In addition, empirical evaluations of reskilling initiatives and their long-term effects on sustainability in academic libraries are scarce. Another overlooked area is the integration of human-centred skills like emotional intelligence, creativity, and problem-solving with advanced technological competencies. Most studies emphasize technical abilities, with little focus on balancing soft skills within AI-driven library environments (Demirdis, 2025). There is also a shortage of locally grounded case studies addressing how librarians in resource-constrained settings can adapt global best practices to their realities. Future research should focus on these overlooked dimensions to inform sustainable, context-specific strategies for librarianship in Nigeria and across Africa.

Methodology

This study used a mixed-methods approach with a descriptive research design to examine the skills gap among academic librarians in Nigeria concerning sustainability practices in the context of the 5IR. The study population consisted of 5,900 certified academic librarians listed in the 2023 Library Registration Council of Nigeria (LRCN) handbook, spanning across public and private tertiary institutions across Nigeria's six geopolitical zones. To ensure broad representation, convenience sampling was employed. Data were collected using a semi-structured online survey created with Google Forms and distributed via NLA-managed WhatsApp and Facebook groups, as well as LRCN mailing lists. The instrument aligned with the study's objectives and was validated by experts in the field of library and information science, computer science, and economics, and pilot-tested with librarians outside the main sample to ensure clarity and reliability. Data collection took place over a period of 16 weeks, begining from the 1st of September to 26th December 2024, yielding 678 valid responses. A convergent parallel design guided the analysis: quantitative data were analysed using descriptive statistics, while qualitative responses underwent thematic analysis. Ethical approval was obtained, and all participants gave informed consent. Confidentiality, anonymity, and voluntary participation were strictly upheld.

Result and Analysis

Table 2: Current sets of skills of academic librarians for sustainability practices in the 5IR

Skills	1:No Proficiency (F/%)	2:Basic (F/%)	3:Intermediate (F/%)	4: Advanced (F/%)	5: Expert (F/%)	Mean Score	Interpretation
Traditional Library Skills							
Cataloguing and Classification	20 (2.9%)	40 (5.9%)	100 (14.7%)	250 (36.9%)	268 (39.6%)	4.2	Highly proficient
Reference and Information Services	15 (2.2%)	35 (5.2%)	80 (11.8%)	270 (39.8%)	278 (41.0%)	4.5	Most proficient skill
Information Literacy Instruction	18 (2.7%)	50 (7.4%)	120 (17.7%)	230 (33.9%)	260 (38.3%)	4.3	Highly proficient
Collection Development and Mgmt.	25 (3.7%)	60 (8.8%)	140 (20.6%)	210 (30.9%)	243 (35.8%)	4.1	Highly proficient
Library Resource Curation	40 (5.9%)	70 (10.3%)	200 (29.5%)	210 (30.9%)	158 (23.3%)	3.9	Moderately proficient
Digital and Technological Skills							
Digital Collection Management	50 (7.4%)	100 (14.7%)	180 (26.5%)	200 (29.5%)	148 (21.8%)	3.8	Moderately proficient
Metadata Creation and Management	60 (8.8%)	120 (17.7%)	200 (29.5%)	180 (26.5%)	118 (17.4%)	3.7	Moderately proficient
Integrative Library System Administration	80 (11.8%)	130 (19.2%)	180 (26.5%)	150 (22.1%)	138 (20.3%)	3.6	Moderate but needs improvement
Research Data Management (RDM)	90 (13.3%)	150 (22.1%)	160 (23.6%)	130 (19.2%)	148 (21.8%)	3.4	Needs significant improvement
Open Access Publishing Support	70 (10.3%)	140 (20.6%)	160 (23.6%)	150 (22.1%)	158 (23.3%)	3.5	Moderately proficient
Digital Preservation Techniques	80 (11.8%)	150 (22.1%)	160 (23.6%)	120 (17.7%)	168 (24.8%)	3.3	Moderate, needs strengthening
AI in Library Operations	120 (17.7%)	170 (25.1%)	150 (22.1%)	120 (17.7%)	118 (17.4%)	2.9	Requires significant improvement
VR/AR Integration in Libraries	140 (20.6%)	180 (26.5%)	150 (22.1%)	108 (15.9%)	100 (14.7%)	2.5	Requires the most improvement
Emerging Technology Skills							
Blockchain Technology	200 (29.5%)	150 (22.1%)	100 (14.7%)	120 (17.7%)	108 (15.9%)	2.4	Requires urgent attention
IoT in Library Automation	170 (25.1%)	150 (22.1%)	130 (19.2%)	128 (18.9%)	100 (14.7%)	2.6	Needs Improvement
Programming and Coding Skills	160 (23.6%)	150 (22.1%)	120 (17.7%)	128 (18.9%)	120 (17.7%)	2.8	Moderate but needs growth
Machine Learning and Analytics	170 (25.1%)	160 (23.6%)	120 (17.7%)	118 (17.4%)	110 (16.2%)	2.5	Requires significant improvement
Soft Skill							
Communication and Stakeholder Engagement	50 (7.4%)	80 (11.8%)	130 (19.2%)	230 (33.9%)	188 (27.7%)	3.9	Highly proficient
Problem-Solving	60 (8.8%)	100 (14.7%)	140 (20.6%)	210 (30.9%)	168 (24.8%)	3.7	Moderately proficient
Emotional Intelligence	70 (10.3%)	120 (17.7%)	150 (22.1%)	190 (28.0%)	148 (21.8%)	3.6	Moderate but needs improvement
Adaptability to Change	80 (11.8%)	130 (19.2%)	160 (23.6%)	170 (25.1%)	138 (20.3%)	3.5	Moderate but requires growth

Objective 1: Assess the current sets of skills of academic librarians for sustainability practices in the 5IR

Table 2 indicates the proficiency levels of 678 academic librarians across a range of skill sets essential for sustainability practices within the 5IR. The results are categorised into Traditional Library Skills, Digital and Technological Skills, and Emerging Technology Skills, with frequency, percentage, and mean scores calculated to identify areas of strength and potential gaps.

Traditional Library Skills: The findings showed that academic librarians demonstrate high proficiency in traditional library functions, achieving an overall **mean score of 4.2**, indicating advanced capability. The strongest skill in this category is **Reference and Information Services** with a mean of **4.5**, followed by **Information Literacy Instruction 4.3** and **Cataloging and Classification 4.2**. These scores reflect well-established expertise in foundational library operations.

Digital and Technological Skills:The findings also indicate that Proficiency in **digital and technological skills** is moderate, with an overall mean score of **3.3**. While competencies like **Digital Collection Management 3.8** and **Metadata Creation and Management 3.7** show strength, areas such as **AI in Library Operations 2.9** and **VR and AR Integration in Libraries 2.5** highlight gaps.

Emerging Technology Skills*:* Emerging technologies represent the least proficient area for academic librarians, with an overall mean score of **2.6**. The weakest skill in this category is **Blockchain Technology for Libraries 2.4**, followed by **Machine Learning and Predictive Analytics 2.5** and **IoT in Library Automation 2.6**.

Soft Skills: The findings also showed that academic librarians demonstrate moderate proficiency in soft skills, achieving a mean score of 3.7, indicating room for growth in critical areas that underpin effective communication, problem-solving, emotional intelligence, and adaptability. The strongest skill in this category is Communication and Stakeholder Engagement, with a mean of 3.9, followed by Problem-Solving at 3.7, Emotional Intelligence at 3.6, and Adaptability to Change at 3.5. These scores reflect the growing importance of interpersonal and managerial competencies in supporting library operations and navigating the challenges of the 5IR.

Objective 2: Analyse the Sustainability Skills Necessary for Academic Librarians to Thrive in the 5IR: Below is the result for 678 participants assessing their ratings on the sustainability-related skills necessary for academic librarians to thrive in the 5IR. Each skill is rated on a scale of 1 (not important) to 5 (extremely important). The table includes frequency counts, percentages, and mean scores (weighted mean).

Table 3: Sustainability Skills Necessary for Academic Librarians to Thrive in the 5IR

Skill	1 (F/%)	2 (F/%)	3 (F/%)	4 (F/%)	5 (F/%)	Mean Score	Interpretation
Artificial Intelligence (AI)	80 (11.8%)	120 (17.7%)	150 (22.1%)	170 (25.1%)	158 (23.3%)	3.95	Very important
Data Analytics	60 (8.8%)	110 (16.2%)	140 (20.6%)	190 (28.0%)	178 (26.3%)	4.22	Highly important
Digital Literacy	50 (7.4%)	90 (13.3%)	120 (17.7%)	200 (29.5%)	218 (32.2%)	4.49	Critically important
Environmental Stewardship	70 (10.3%)	120 (17.7%)	160 (23.6%)	170 (25.1%)	158 (23.3%)	4.02	Very important
Resource Management	80 (11.8%)	130 (19.2%)	140 (20.6%)	160 (23.6%)	168 (24.8%)	3.92	Very important
Community Engagement	70 (10.3%)	110 (16.2%)	130 (19.2%)	190 (28.0%)	178 (26.3%)	4.16	Highly important
Project Management	60 (8.8%)	100 (14.7%)	130 (19.2%)	180 (26.5%)	208 (30.7%)	4.35	Critically important
Knowledge of Green Technologies	100 (14.7%)	140 (20.6%)	150 (22.1%)	140 (20.6%)	148 (21.8%)	3.66	Moderately important
Climate Literacy	80 (11.8%)	120 (17.7%)	140 (20.6%)	170 (25.1%)	168 (24.8%)	4.04	Very important
Advocacy and Policy Development	90 (13.3%)	130 (19.2%)	140 (20.6%)	150 (22.1%)	168 (24.8%)	3.93	Very important

Table 3 highlights the importance of sustainability-related skills for academic librarians to thrive in the 5IR. These findings are categorised into highly rated skills, moderately rated skills, and critical gaps, with mean scores providing a clear understanding of the perceived significance of each skill.

Highly Rated Skills (Mean ≥ 4.0)

The findings showed that academic librarians identified several skills as highly important for sustainability practices, achieving mean scores of 4.0 or higher. Digital Literacy rated a Mean score of 4.49. This skill emerged as the highest-rated competency, with 32.2% of participants rating it as "extremely important". Its high rating reflects the foundational role of digital literacy in managing resources and supporting sustainable practices in libraries. Project Management rated with a Mean score of 4.35. This shows that the ability to plan, implement, and oversee sustainability initiatives was rated as critically important by 30.7% of participants. This indicates the role of project management in executing effective sustainability strategies in libraries in the 5IR. Community Engagement rated the score Mean of 4.16. As a result, participants recognised the importance of engaging communities to promote sustainability, highlighting the value of collaboration and outreach in fostering environmentally conscious practices.

Moderately Rated Skills (Mean score of 3.5-4.0)

Several skills were rated as moderately important, with mean scores ranging from 3.5 to 4.0. AI rated the Mean score of 3.95, while considered essential, AI ranked slightly lower than digital literacy, reflecting its emerging role in library operations and sustainability initiatives. Advocacy and Policy Development also rated the Mean score of 3.93. This shows that Librarians acknowledged the importance of influencing policies related to sustainability, emphasising the need for advocacy skills to drive institutional and societal change. Knowledge of Green Technologies also rated the Mean score of 3.66. Although it is recognised as important, this skill received a relatively lower rating, suggesting gaps in librarians' awareness or practical application of green technologies.

Critical Gaps
Knowledge of Green Technologies rating a score Mean of 3.66. Among the listed skills, this skill received the lowest rating, emphasising the need for increased training and awareness in this area. As libraries transition towards sustainable practices, familiarity with energy-efficient systems and green infrastructure is becoming increasingly vital.

Objective 3: Identify Gaps Between Academic Librarians' Current Skills and Required Competencies for Sustainability in the 5IR
The findings from the participants revealed significant skills gaps hindering academic librarians' ability to achieve sustainability in librarianship within the 5IR. The findings are categorised into recurring themes, providing insight into the areas where participants feel least prepared and identifying development opportunities. Examples from participants' responses further illustrate these gaps, which are analysed below:

Emerging Technology Skills: A recurring theme, highlighted by **38% of participants**, was the lack of proficiency in emerging technologies, which are central to 5IR sustainability practices. Many librarians expressed concerns about their limited knowledge and practical application of advanced tools and systems. Participants frequently mentioned challenges with **AI**, noting the growing importance of AI in automating library tasks such as cataloguing, personalised resource recommendations, and user service optimisation. One participant stated: *"AI could help us personalise the library experience for our users, but I have no training in implementing such systems."* Similarly, knowledge of **Blockchain Technology** was identified as a critical gap. Participants recognised its potential for resource authentication and secure data management, yet few had any practical experience. Another participant admitted: *"I've read about blockchain being used to authenticate digital resources, but I have no idea how to apply it in a library setting."* The integration of **IoT**and**VR/AR** also emerged as problematic. A participant shared: *"Our library has explored using VR to create immersive learning experiences, but we lack the skills to implement these technologies effectively."* These examples underscore the pressing need for upskilling in emerging technology areas to remain relevant in the 5IR.

Data and Analytical Skills: Approximately **27% of participants** highlighted gaps in data literacy and analytical skills, which are increasingly critical for sustainability in library operations. Many librarians expressed difficulty in leveraging data for decision-making, resource management, and service improvement. For example, several participants mentioned challenges with **data analytics,** specifically in interpreting usage data to optimise resource allocation. One participant noted: *"We collect so much data on resource usage, but I don't have the skills to analyse it and make informed decisions."* Similarly, there were concerns about **RDM**, particularly in organising and preserving research outputs. A participant explained: *"As the demand for RDM grows, I realise I lack the expertise to manage research datasets sustainably."* Additionally, **big data analysis** was identified as an area of weakness. One librarian remarked: *"Big data holds great potential for strategic library planning, but working with large datasets feels overwhelming without proper training."*

Sustainability and Environmental Skills: About **20% of participants**reported gaps in sustainability-related skills, particularly in implementing green practices and promoting environmental stewardship. For instance, participants cited difficulties in adopting **green library practices**, such as energy-efficient operations and waste reduction. One participant remarked: *"Our library could reduce its environmental footprint, but we don't know where to start with sustainable facility management."* Another key area was **climate literacy,** where participants expressed a lack of confidence in educating users about sustainability issues. One librarian shared: *"I want to teach our patrons about climate change, but I don't feel knowledgeable enough to lead those discussions effectively."* **Resource management** was also a concern, particularly in optimising resource usage while minimising waste. A participant explained: *"Balancing the need for digital and physical resources with sustainability goals is a constant challenge."*

Digital Transformation Skills: 18% of participants noted gaps in digital transformation skills, particularly in modernising library operations to align with the demands of 5IR. One commonly cited area was **digital preservation,** where participants acknowledged the difficulty in ensuring long-term accessibility to digital resources. A participant remarked: *"We digitise materials, but I lack the technical skills to preserve them effectively over time."* Similarly, gaps in **open-access publishing support** were highlighted. One librarian explained: *"Supporting open-access initiatives is critical for sustainability, but I*

don't have the expertise to navigate copyright or licensing issues effectively." Another participant expressed concerns about **LMS***"Integrating library resources into our university's LMS has been a struggle because I don't fully understand the platform's functionalities."*

Advocacy and Leadership Skills: 15% of participants identified gaps in advocacy and leadership skills, particularly in promoting sustainability within their institutions. For example, some participants mentioned difficulties in **strategic planning,** stating that they lacked the expertise to develop long-term sustainability strategies. One librarian shared: *"I want to lead sustainability initiatives in my library, but I'm unsure how to align them with institutional goals."* Others cited challenges with **advocating for sustainability,** particularly in securing institutional support. A participant noted: *"Convincing stakeholders to invest in green technologies is tough when I don't have the tools to make a strong case."* **Leadership in change management was** also highlighted as a gap, with participants admitting they felt unprepared to lead teams through organisational transformation. As one librarian put it: *"Managing resistance to change in sustainability projects is one of my biggest challenges as a leader."*

Collaboration and Community Engagement: Finally, **12% of participants** emphasised the importance of collaboration and community engagement, but noted a lack of skills in these areas. One participant commented on the difficulty of **building partnerships**with external organisations: *"We need to collaborate with environmental groups, but I lack experience in forming such partnerships."* Others mentioned challenges with **user engagement,** particularly in involving patrons in sustainability discussions. One librarian stated: *"I want to create programmes that engage users in sustainability, but I don't know how to make it interactive or impactful."* The need for **interdisciplinary collaboration** was also raised. A participant shared: *"Libraries can't work in isolation we need to partner with other departments to address sustainability holistically, but I lack the skills to initiate such collaborations."*

Objective 4: Investigate the Support Provided by Academic Institutions in Enhancing the Skills of Librarians for Sustainable Initiatives in the 5IR

Participants were asked whether their institution provided any training or professional development opportunities related to sustainability and 5IR skills.

Table 4: Support Provided by Academic Institutions

Response	Frequency	Percentage (%)
Yes	280	41.3%
No	398	58.7%
Total	**678**	**100%**

The participants who acknowledged yes recounted that many responses were thematically analysed below:
Digital and Technological Skills: A few participants noted that they are receiving training on digital tools and emerging technologies to optimise library operations and services. For example, 62 participants noted that their institutions were given workshops on how librarians can leverage AI for automating cataloguing, offering personalised user experiences, and enabling predictive analytics. As one librarian shared, *"We had a session on using AI chatbots to streamline user support, making our services more efficient."* Similarly, participants also recounted that they received **data analytics training.** This training enables librarians to interpret user data and assess resource utilisation for informed decision-making. Another participant noted, *"We were trained to use data analytics tools to monitor library resource usage and evaluate environmental impact."* A few participants also noted that they developed a skill via the training received in **metadata management,** ensuring digital resources are accessible and discoverable.

Sustainability Practices and Green Library Initiatives: A few participants also noted that they received training Training in sustainability practices has become a key priority, they noted that this training has helped them align library operations with global environmental goals. The **Green Library practices** a focus on sustainability, which includes energy-efficient facility management and waste reduction. A participant stated: For instance, our institution introduced solar-powered lighting systems after training us on sustainable infrastructure planning. **Climate literacy programmes**are also gaining traction, with one participant stating that learning how to educate users on climate change and sustainability has helped us gain much knowledge on sustainability. Another librarian shared, *"We developed workshops to teach students about climate change, using real-world case studies and digital resources."* Additionally, a Few participants also do not that receiving **sustainable resource management training** has equipped them to balance the use of physical and digital collections while minimising waste.

Leadership and Strategic Planning: Participants indicated that their Institutions are preparing them to lead sustainability initiatives through strategic planning and change management. They recounted that they received training on **strategic sustainability planning, and as a result, this** empowered them to develop long-term goals for integrating sustainability into library services. One librarian described his experience: *"We created a five-year sustainability plan focusing on transitioning to digital-first operations."* **Advocacy training** is another key area that participants recounted that their institution gave them. This training equipped librarians to promote sustainability initiatives and secure institutional support. As one participant explained, *"Our training helped us craft proposals to advocate for funding energy-efficient library upgrades."* Additionally, leadership workshops on **change management** are another training support received, few librarians noted that this training taught them how to guide team members through transitions and manage resistance to sustainability projects.

Community Engagement and Collaboration: The majority of participants stated that are being trained to engage communities and collaborate with stakeholders to promote sustainability. Programmes on **user-centred sustainability** empower librarians how to design workshops and campaigns that engage users in sustainability topics. To validate this, one participant shared, *"We hosted a community recycling event to encourage sustainable practices among library users."* **Partnership building** is also emphasized in the support training programme received by their institution. A participant recounted that the programme enables librarians to collaborate with external organisations and academic departments. Another participant stated: We partnered with the engineering department to implement green technologies in my library. As a result, few participants stated that training in **interdisciplinary collaboration** further equips them to work across fields to develop holistic sustainability solutions.

Project and Resource Management: Some Participants stated that are being equipped with the skills to manage sustainability projects effectively. They recounted that **Project management training** given by their institution helps them plan, execute, and evaluate green initiatives. One librarian explained, *"We used project management tools to oversee the implementation of campus-wide recycling bins."* **Resource optimisation** is another training recounted received by the participants. They stated that the experience garnered from it enables their library to balance physical and digital collections while reducing environmental impact. As one participant noted, *"We learned how to reduce paper usage by shifting most of our resources to digital formats."*

Digital Literacy and Open Access: A few participants stated that their institutions are emphasising **digital literacy training** to improve librarians' proficiency in using digital tools and teaching users to navigate online resources responsibly so that they can better serve their community of users. To validate this, one librarian noted, *"We conducted workshops for students on how to access open-access platforms for their research needs."* Additionally, participants also noted that they received training support on **open-access publishing** which equips librarians to manage platforms that promote free and sustainable access to research outputs.

Discussion of Findings

The findings from the study reveal a deep understanding of the evolving skill requirements for academic librarians in the era of the 5IR. While participants demonstrated strong proficiency in traditional librarianship functions such as cataloguing, metadata management, and reference services there was evidence of moderate competence in digital preservation practices and emerging gaps in technological adaptability. These findings align with Byrkovych et al. (2023) and Ajani et al. (2025), who observed that although traditional competencies remain vital, the rapid digitisation of library services necessitates an urgent upgrade in digital skills to ensure relevance in the 5IR context. The findings of the study also indicated limited preparedness for adopting advanced technologies such as AI, blockchain, the IoT, and machine-based practices. This observation corroborates prior research by Adigun et al. (2024) and Dube et al. (2024), which identified a significant disparity between the technological demands of modern librarianship and the current skillsets of many professionals. Similarly, Li (2018) warned of the disappearance of lower-skilled roles due to automation, replaced by positions requiring specialised technical expertise an evolution echoed by Shen and Zhang (2024) and Frey and Osborne (2017). Furthermore, although academic librarians exhibited commendable abilities in communication and stakeholder engagement, soft skills such as emotional intelligence, problem-solving, adaptability, and creativity were reported as insufficiently developed. These findings resonate with the arguments made by Demirdis (2025) and Dondi et al. (2021), who emphasised the increasing importance of higher-order cognitive and emotional skills in addressing sustainability challenges within information institutions. In this context, the integration of human-centred competencies with technological expertise becomes a cornerstone for success in the 5IR (Ayinde et al., 2025; Anne et al., 2025). A notable proportion of participants identified digital literacy, project management, and community engagement as the most critical skills for sustainable librarianship in the 5IR. These results mirror the assertions of Ajani and

Oladokun (2024) and Xwayi (2024), who advocated for the prioritisation of digital fluency and outreach capacity in navigating the digital information landscape. Conversely, skills such as AI literacy and advocacy were rated as moderately important, suggesting a recognition of their growing relevance but also indicating potential uncertainty or lack of exposure. Green technologies and climate literacy were consistently reported as areas of substantial deficiency, echoing Shahzad et al. (2023) and Lo (2024), who called for institutional efforts to integrate environmental sustainability within academic librarianship. The findings further revealed that out of 678 respondents, only 280 confirmed that their institutions had offered any form of training or professional development related to sustainability or 5IR-related competencies. This finding suggests a mixed level of institutional responsiveness. Although some institutions are beginning to acknowledge the necessity of preparing librarians for the 5IR, the majority still fall short in providing systematic support for upskilling. This reinforces arguments presented by Shah et al. (2024) and Dhakal et al. (2024), who identified institutional training as a critical factor in bridging skill gaps and fostering sustainable information services. The role of institutional support in enabling sustainability-aligned professional development cannot be overstated. Evidence from Syafruddin et al. (2025) and Aslam et al. (2025) highlighted that institutions which implement comprehensive workforce development strategies through collaborations with tech companies, structured reskilling initiatives, and continuous learning platforms tend to equip their librarians more effectively for emerging demands. These strategies offer valuable models that can be contextualised and adopted by Nigerian institutions to enhance librarians' adaptability and relevance in the 5IR. In sum, the findings of this study support existing literature that underscores the pressing need for a comprehensive and strategic approach to skills development among academic librarians. Bridging the skills gap requires a dual emphasis on technical competencies such as AI, data analytics, and automation and soft skills such as adaptability, critical thinking, and emotional intelligence. Institutional commitment to ongoing training, collaborative learning, and responsive policy frameworks will be essential to ensuring the sustainability of librarianship in the age of the 5IR.

Conclusion

This study examined the skills gap among academic librarians in Nigeria concerning sustainability and the evolving demands of the 5IR. While participants demonstrated strong proficiency in traditional competenciessuch as cataloguing, reference services, and information literacysignificant gaps were identified in digital and emerging technologies, particularly AI, blockchain, IoT, and data analytics. Additionally, sustainability-related skills, including green practices and climate literacy, were found to be underdeveloped.The findings further revealed that institutional support for professional development is inconsistent, with many librarians lacking access to relevant training. Although some institutions have initiated programmes in digital literacy, project management, and AI, these efforts remain insufficient and lack strategic alignment with 5IR priorities.Soft skills such as adaptability, emotional intelligence, and leadership were moderately developed, yet are increasingly essential for managing change and fostering sustainable practices in library environments. In conclusion, the study emphasised the urgent need for a coordinated response to bridge the skills gap. As a result, librarians must be equipped with both technical and human-centred competencies to remain relevant and contribute meaningfully to sustainability goals in librarianship.

Recommendations

As a result of the study findings, the following recommendations are essential to preparing librarians for the evolving landscape of the 5IR:

1. The Nigerian government, in collaboration with the Library Registration Council of Nigeria (LRCN), should create a national framework for librarians' skills development, focusing on sustainability and 5IR competencies. This framework should include guidelines for training, funding, and monitoring progress.
2. The Nigerian government should also support research initiatives that explore the intersection of librarianship, sustainability, and emerging technologies. They should provide grants for librarians to conduct research and pilot projects in green library practices and digital transformation.
3. Librarians should actively advocate for their role in achieving sustainability goals within their institutions and communities. They should endeavour to develop advocacy toolkits to help librarians communicate the value of their contributions to sustainability and 5IR.
4. Libraries should align their services and operations with the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action). They should develop sustainability reports to track and communicate progress towards these goals.

REFERENCES

Adigun, G. O., Ajani, Y. A., & Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) Industrial Revolution. *Libri*, *74*(3), 211-223.

Ajani, Y. A., Danmaigoro, F., Ilori, O. O., Onanuga, A. O., Amaechi, N. M., Ishola, S. O., & Onyebinama, C.

O. (2025). Flying books: a new frontier of mobile libraries in the era of Fifth Industrial Revolution (5IR). *Library Hi Tech News*, *42*(3), 8-14.
Ajani, Y. A., Tella, A., & Oladokun, B. D. (2024). Social innovation in Nigerian public libraries: A roadmap for navigating the challenges and opportunities of inclusivity and diversity in the 5IR era. *Business Information Review*, 02663821241289845.
Ajani, Y., & Oladokun, B. (2024). Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution. *Folia Toruniensia*, *24*, 29-51. https://doi.org/10.12775/FT.2024.002
Akobe, O. D., Adeboye, F. L., Dauda, B. A., & Yacim, H. (2025). Improving Library and Information Science Education in Nigeria: Using Smart Technology and AI-Powered Tools for Better Learning. In *Using AI Tools in Text Analysis, Simplification, Classification, and Synthesis* (pp. 377-410). IGI Global Scientific Publishing.
Anne, O., Adenike, M., Isaiah, A., & Ngozi, C. (2025). The Industry 5.0 Revolution: Challenges and Opportunities of Emerging Digitalization Trends in Business and Management from a Developing Country Perspective. *Emerging Digitalization Trends in Business and Management*, 77-108.
Arzo, S., & Hong, M. (2024). Resilient green infrastructure: Navigating environmental resistance for sustainable development, social mobility in climate change policy. *Heliyon*, *10*(13), e33524-e33524.
Aslam, S., Jabeen, M., & Jabeen, M. (2025). Fostering innovation in smart library services: An in-depth exploration of empowered capabilities and dynamic strategies among university librarians in Pakistan. *Information Development*, *0*(0). https://doi.org/10.1177/02666669241305379
Ayinde, L., Ajayi, A. O., & Adedeji, A. (2025). Reimagining the roles and skills of information professionals in the 5IR. *Business Information Review*, *42*(1), 10-19.
Byrkovych, T., Humenchuk, A., Kobyzcha, N., Akimova, L., Grinberg, L., & Akimov, O. (2023). Economic effectiveness of state policy in reforming higher library and information education in Ukraine. *Economic Affairs, 68*(1). https://doi.org/10.46852/0424-2513.1.2023.28
Challoumis, C. (2024). The Imperative of Skill Development in an AI Revolution. In *XIX International Scientific Conference. London. Great Britain* (pp. 132-168).
Demirdis, B. (2025). Integrating Digital Literacy to Enhance Emotional and Social Skills in Education. In *Innovative Educational Frameworks for Future Skills and Competencies* (pp. 1-38). IGI Global Scientific Publishing.
Dhakal, S. P., Nankervis, A., & Burgess, J. (2024). *The future of work in the Asia Pacific: Addressing critical skills shortages for sustainable development*. Taylor and Francis Ltd. https://doi.org/10.4324/9781003379065
Dondi, M., Klier, J., Panier, F., & Schubert, J. (2021). Defining the skills citizens will need in the future world of work. McKinsey Global Institute. *Available at: defining-the-skills-citizens-will-need-in-the-future-world-of-work. Pdf (mckinsey. com)*
Dube, T. V., Rammutloa, M. W., & Matatiele, R. (2024). Skills and competencies of academic librarians to use information technology tools in the digital era: A systematic literature review. *Information Development*, *0*(0). https://doi.org/10.1177/02666669241302054
Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change*, *114*, 254-280. https://doi.org/10.1016/j.techfore.2016.08.019
Hawksworth, J., Berriman, R., & Goel, S. (2018). *Will robots steal our jobs? An international analysis of the potential long-term impact of automation*. PwC. https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf
Li, L. (2024). Reskilling and upskilling the future-ready workforce for Industry 4.0 and beyond. *Information Systems Frontiers*, *26*(5), 1697-1712. https://doi.org/10.1007/s10796-022-10308-y
Lo, L. S. (2024). Transforming academic librarianship through AI reskilling: Insights from the GPT-4 exploration program. *The Journal of Academic Librarianship*, *50*(3), 102883.
Molla, A., Gekara, V., Karanasios, S., & Snell, D. (2025). Modelling digital skills beyond the IT workforce: construct definition, measurement and impact on digitalization value. *Information Technology & People*, *38*(3), 1461-1504.
Moreland, D., & Kammer, J. (2020). School and Public Library Collaboration: Opportunities for Sharing and Community Connections. *Knowledge Quest*, *49*(1), 41-44.
Ndibalema, P. (2025). Digital literacy gaps in promoting 21st century skills among students in higher education institutions in Sub-Saharan Africa: a systematic review. *Cogent Education*, *12*(1), 2452085.
Onunka, O., Onunka, T., Fawole, A. A., Adeleke, I. J., & Daraojimba, C. (2023). Library and information services in the digital age: Opportunities and challenges. *Acta Informatica Malaysia*, *7*(1), 113-121.
Panda, S., & Kaur, N. (2023). Enhancing user experience and accessibility in digital libraries through emerging technologies. *KP Sinhamahapatra [et al.](Eds.), Digital Libraries: Sustainable Development in Education, Presented on*, *21*, 676-703.

Saleema, J. S., Iyer, L. S., & Sankaran, L. (2025). Framework for Bridging the Skill Gap between Higher Education Institutions and Industry: A Machine Learning Approach. In *Cloud Computing for Smart Education and Collaborative Learning* (pp. 222-244). Chapman and Hall/CRC.

Shah, S. H., Shah, N. U., & Jbeen, A. (2024). Exploration of LIS professional efforts in Pakistan towards the improvements of technological competencies in the 21st century. *Global Knowledge, Memory and Communication*, *73*(4/5), 596-613.

Shahzad, K., Khan, S. A., Javed, Y., & Iqbal, A. (2023). E-learning for continuing professional development of university librarians: a systematic review. *Sustainability*, *15*(1), 849.

Shen, Y., & Zhang, X. (2024). The impact of artificial intelligence on employment: The role of virtual agglomeration. *Humanities and Social Sciences Communications, 11*, 122. https://doi.org/10.1057/s41599-024-02647-9

Syafruddin, S., Syarif, E., Sukandar, E. R., & Kustiyono, K. (2025). Bridging the Skills Gap: The Role of Vocational Education in Developing Competent Human Resources for Sustainable Tourism. *The Journal of Academic Science*, *2*(1), 290-299.

Tella, A., & Ajani, Y. A. (2022). Robots and public libraries. *Library Hi Tech News*, *39*(7), 15-18.

Wood, B. A., & Evans, D. (2018). Librarians' perceptions of artificial intelligence and its potential impact on the profession. *Computers in Libraries*, *38*(1). https://www.infotoday.com/cilmag/jan18/Wood-Evans--Librarians-Perceptions-of-Artificial-Intelligence.shtml

World Economic Forum. (2023). *Fourth Industrial Revolution*. Retrieved from https://www.weforum.org/focus/fourth-industrial-revolution

Xwayi, N. A. (2024). *Digital literacy skills of librarians in the 21st century: A case study of the University of the Western Cape* (Doctoral dissertation, University of the Western Cape). https://hdl.handle.net/10566/20331

Strategies for Empowering Information Professionals in the Fifth Industrial Revolution Era for Sustainable Library Services in Nigeria

By

Amina Suleiman Hamza (CLN)
Department of Library and Information Science, Northwest University Kano, Kano State
E-mail: suleiman.amina@rocketmail.com
Phone no: +2348033553420 (**WhatsApp no: 08033553420)**
&
Prof. Bappah Magaji Abubakar
University Library,
Federal University of Health Sciences, Azare, Bauchi State
bmagaji02@gmail.com, librarian@fuhsa.edu.ng
Cell: 08063514814, **(WhatsApp no: 09075437934)**

Abstract

This paper attempt to explore the crucial changing roles of librarians as information managers in effective information service delivery in libraries in Nigeria in the Fifth Industrial Revolution also known as Industry 5.0. The advent of Information and Communication Technologies (ICTs) have revolutionized how information is generated, accessed, processed, managed and disseminated. The role of library and information professionals is dramatically changing due to the emergence of the Industry 5.0 era that came along with new concepts such, big data, robotics and cloud computing among others. Additionally, the role is to ensure proper collection, processing, organization and dissemination for effective and sustainable library functions. The paper discusses the strategies for empowering library and information professionals in order to prepare them for the challenges of the Fifth Industrial Revolution. It sheds light on the need for information professionals to continuously improve on their skills, techniques and strategies. Thus, in addition to the traditional library and information management skills, librarians now need to possess additional skills and expertise particularly in the use of modern automated information service, electronic publishing, and application of artificial intelligence in library services, virtual assistance powered by AI, digital Information management and knowledge management. It stresses that librarians should make efforts to acquire 21st century skills like personal computer knowledge, hardware skills to manage virtual environment etc. through personal training so as to be relevant and dynamic in the transformative period. The paper also discusses the challenges including lack of funding, inadequate materials, unfavorable government policies, lack of maintenance culture among others, therefore the librarians may encounter in the Industry 5.0 era and how they can be overcome to ensure sustainability of library services in Nigeria. The paper finally stresses that librarians should be ready to learn, unlearn and constantly be trained and retrained. The libraries should serve as a catalyst in the promotion of education, information and knowledge through timely and up-to-date information dissemination in this rapidly changing period.

Keywords: *Fifth Industrial Revolution, Information Professionals, Information service delivery, Sustainable Library Services, Libraries, Skills, Knowledge, Nigeria.*

Introduction

The emergence of information and communication technology (ICT) has revolutionized the way information is being access, process, store, retrieve and disseminate within organizations and across the globe. The information could be is vocal, pictorial, textual, numeric, and macro-electric based. Libraries play a very vital role in imparting education by providing relevant information to users. Presently, due to advent of information and communication technologies, there is tremendous shift in providing information to its users. Nowadays libraries are not only providing information to users but also having collaboration with users and due to this collaboration, users are participating with libraries and librarians (Shen, 2023). In the midst of the transformative waves of the Fifth Industrial Revolution (5IR), there's a notable shifts in how knowledge, information, and the roles of both librarians and information users are handled. The development of societies in recent times have been facilitated by the growing demand of access to information, and libraries are the prime source in providing this access. The paradigm shift in the format and dynamics of information and knowledge as a result of the rapid advancement in computer technology and software applications have shifted libraries to a demand of the commensurate supply of the same technologies. Unless libraries begin to exploit the new technologies and innovate their information services delivery, they may face obsolescence in this era advanced technology. Availability of advanced technologies gives libraries the ability to offer improved, customer-driven services to their users (Andrew, Wright, & Rasking, 2016).

This change highlights the urgent need for fostering innovation and acquiring new skills within the realm of knowledge systems. (Benjamin & Bolaji, 2024). With the onset of the Fifth Industrial Revolution (5IR), characterized by the integration of digital technologies, artificial intelligence, and the Internet of Things, the role of libraries is undergoing a significant transformation. In this era of unprecedented change and innovation, the preparedness of librarians in skills and knowledge is crucial to ensure that libraries continue

to fulfill their vital role as hubs of information and knowledge. It's important to note that librarians are now at the forefront of managing extensive digital repositories, navigating complex information landscapes, and facilitating access to a variety of information resources. To effectively tackle the challenges and seize the opportunities brought by the Fifth industrial Revolution, librarians need to possess a diverse set of skills, knowledge and expertise that encompasses both traditional library practices and emerging technological competencies. Artificial Intelligence matters to libraries because it be used for organizing and making available large collections of information (ALA, 2019).

In the 21st Century, an Information professional is a specialist of information who manages and organizes information, combines the functionality for information, elicitation, planning, data mining, knowledge mining, digital reference services, electronic information services, representation of information, extraction, and distribution of information, co-ordination, searching notably CD-ROMs, online, Internet-based WWW, multimedia access and retrieval. In this era of digital information, electronic technology, WWW's growing popularity and the tremendous growth of CD-ROM products, libraries now offer a huge range of multimedia information, everything from movies, speeches, images and photos to sounds, text and beyond. The 21st century is the millennium of information. Asemi and Asemi (2018) asserted that, it is also seen as the era of explosion of information output and information sources. It is known as the beginning of knowledge age. New patterns of work and new business practices have developed as a result; new kinds of work with new and different skills are required. In this century, the meaning of knowledge has changed. Knowledge is no longer what is stored in the minds of experts, represented in books and classified in disciplines. The amounts of online, CD-ROMs and other digital sources of information are exploding and infrastructure for accessing material improves almost daily. Therefore, information professionals requires, requires new strategies and skills artificial for locating of relevant information and up to date cost effective information and also disseminating it in a wide variety of a formats of digital information system. It is a known fact that libraries have witnessed significant changes in recent years. This change which is brought about by information and communication technologies has impacted on the mode of providing information services. The traditional methods of information dissemination have given way to electronic means of communication. The librarian no longer plays a passive role rather he assumes an active role. He is no longer a custodian of books but the gate way to a myriad of information sources. Libraries in Nigeria are not divorced from this technology revolution. As information providers, they are constantly under pressure to provide relevant sources of information to their immediate communities. Therefore, in this work, the strategies for empowering library and information professionals in order to prepare them for the challenges of the Fifth Industrial Revolution era, so as to shed light on the need for information professionals to continuously improve on their skills, techniques and strategies in order to be relevant in today's technological driven society. Also, challenges associated with the challenges the librarians may encounter in the Industry 5.0 era and how they can be overcome to ensure sustainability of library services in Nigeria, as well as the way forward have equally been discussed.

Strategies for Empowering Information Professionals in the Fifth Industrial Revolution Era

Fifth Industrial Revolution also known as Industry 5.0 is the current technology that incorporates the concepts of sustainability as well as utilization of Artificial Intelligence which evolved with huge prospects and promising applications in libraries The development of societies in recent times have been facilitated by the growing demand of access to information, and libraries are the prime source in providing this access. Information Professionals now need to possess a limited knowledge of data mining and discovery of knowledge from today's modern libraries in order to extract unmet information needs of users, they also requires a comprehensive knowledge of the retrieval engines and indexing structure so that the he can achieve the goal of creating information queries with respect to the search system. Furthermore, Asemi and Asemi (2018) asserted that the field of artificial intelligence deals with the study and development of computer systems or machines that exhibit some forms of human intelligence, such as learning new concepts and tasks, reasoning and drawing useful conclusions about a specific task, natural language processing or perception and comprehension of visual scene etc. Artificial Intelligence is now adopted in libraries because it be used for organizing and making available large collections of information (ALA, 2019). According to Sridevi and Shanmugam (2017), artificial intelligence is the modern technology which is used to manage the digital library.

The integration of cutting edge technologies such as Artificial Intelligence and the internet,are the things that defines the skills and competences required in the Fifth IR. Librarians plays crucial roles in adapting to technological changes and ensuring inclusive access to library services, particularly for users in open and distance learning institution (Ziatdinov et al. 2024). The utilization of Artificial intelligence and Robotics in service delivery have expanded access to services for learners across different location as Noted by Nabiyeb (2024). Despite this benefits, librarians may face challenges in implementing Fifth Industrial Revolution in services provision such as lack of necessary skills, infrastructure etc. addressing these issues requires the necessary. In the digital era, library professions setup and develop the digital library using technical implementation, installation and customization of digital library open source software, creating metadata, creates usage reports and preserving digital information. There are many strategies systems and method to help build librarian skills and competence in the utilization digital information technologies in the 5th IR; some of these include the following:

1) **Personal computer knowledge:** A personal computer is known to be one of the best invention of mankind computer has undergone many changes with respect to size memory space and portability. Computer is an extraordinary apparatus because of its ability to store information and process huge amount of information that is used to perform various technical task as well as used to create gadgets. The multimedia librarian most have knowledge about search engines, word processing, spreadsheet, virus/malware scanning, connecting a computer to a network security and privacy etc. all these skills should be acquired by multimedia librarian and He/ She need to be competent in them.
2) **Internet Knowledge:** Thiruppathi (2024) observed that one important skill required of a librarian or library professional is internet knowledge. Before the librarian can guide library client on how to use the internet, he most have deep knowledge about how to carry out successful. He must be conversant with how to identify right information when found as well as how to navigate the web; librarians should have a clear knowledge about the notion of prevision vis-a-vis recall.
3) **Networking Knowledge:** The needs to possess knowledge on how to manage networks are being upheld as highly significant for proper library management in information age (Tuner 2012) specially connection of two or more computer through networking tools, internet protocol (IP)as well as various basic configuration will help multimedia librarian operations.
4) **Hardware Knowledge:** It is important that multimedia librarians have idea on how computer system are joined together to work respectively the components within computer systems ranging from mother board to other part, librarians needs to be equipped with knowledge about central processing unit (CPU), understanding of mouse, keyboard and monitor etc. in this age that library and library resources are formatted into electronic categories the computer competences of multimedia librarians most cover a high range of information and communication technology tools and their operations.
5) **Software Knowledge:** Different soft wares are today applied to library functions from simple routine of clearance to complex functions of as well as daily activities of office operations software are being used some notable software are content management system, library management system (CDS/ISIS/New general library etc.).
6) **Digital information system, online, optical information**: Librarians now require skills in digital information system including; interfacing online and off-ramps, twists and turns of digital knowledge, development of digital information sources and digitization of print collections.

Application of Artificial Intelligence in Library Services

According to Heath (2018), artificial intelligence is the technology that enables machines be to have the abilities to plan, learn, reason, solve problems, move, and be creative to some extent. According to Harris (2016), AI has made a significant inroad into education as IBM has come up with the Teacher Advisor an AI system which has been built to help teachers draw up personalized lesson plans by pointing them to best lessons in math and then customizing the lesson to fit their unique classroom needs. artificial intelligence is the modern technology which is used to manage the digital library. The ultimate promise of artificial intelligence is to develop computer systems or machines that think, behave and in fact rival human intelligence, and this clearly has major implications on librarianship. Artificial intelligence is not just an intelligent system or software program, it is a biologically motivated technology used to replicate human ways of perceiving and processing information (Sridevi & Shanmugam, 2017).

Intelligent library automation systems rely on artificial intelligence technologies to provide knowledge-based services to library clientele and staff. Artificial intelligence in libraries should not be misconstrued with library automation. While the later implies the degree of mechanisation to routine library operations, the former goes beyond just automating library activities, and create intelligent rational systems that behave and act like librarians and requires little or no human intervention. Artificial intelligent systems can replicate and thus replace a human being in the library, although Li, Huang, Kurniawan and Ho (2015) believed that this invention will never replace librarians, but will center on menial and time-consuming library operations such as shelf reading and leave the librarians to engage with the patrons. Corroborating this assertion, Murphy (2015) maintained that the application of robots in libraries will bring librarians and users closer together, against the notion that robots will alienate librarians from their users.

Some fields of artificial intelligence that are used in library management system include: Natural Language Processing (NLP), Expert Systems (ES), Pattern Recognition, Robotics etc (Sridevi and Shanmugam, 2017). Succinctly, Natural Language Processing (NLP) is the analysis and generation of natural language text by computers. Artificial intelligence has gained tremendous application in library information services, these include but are not limited to:

1. **Automatic cataloguing and classification using Optical Character Recognition (OCR)**: Information retrieval is an aspect of librarianship that has felt the touch of artificial intelligence. Library information retrieval deals with the recall of information or resources from a file or database, it is concerned with the structure, analysis, organization, storage, searching, and retrieval of information stored in a library's collections, information centre or the Internet (Croft,

Metzler & Strohman, 2015). As the information held in libraries grew, several types of information retrieval tools were invented to cope with the vast amount of information therein and make them accessible to users. Optical Character Recognition and automatic indexing software, which will allow the user to browse through the material, search and analyse the full-text generated from the scanned images of the item. Nowadays, handwritten document are as well as printed books are scan and converted to electronic document without retyping or rekeying using optical character recognition software (OCR).

2. **Resource Development/Collection Development of the Library** : collection development deals with the resource selection, acquisition and development in the library, or simply the process of meeting the information needs of library users in a timely and economical manner mainly through acquisitions (purchase), or gifts from sister organization and various other bodies (Udensi & Akor, 2016). After the selection of books that would be purchased by a library, a list is normally sent to book sellers and vendors to submit the prices with respect to the quality and format (print or electronic, paper-binding or hardcover-binding). Likewise, the intelligent system can learn from past experiences and submit the list of items to be acquired based on the previous performances of the book-sellers or vendors, especially now that most book-sellers and vendors can be accessed via their emails or homepage. Corroborating this assertion, Romero (2018) reported that artificial intelligence systems can give suggestions based on past purchases or user interests - a strategic method to improve acquisition of library materials and enhance the user experience via recommendations of magazines, journals, authors, books, etc.

3. **Automatic translation of foreign language materials using Natural Language Processing (NLP)**: Most web search engines today such as Google, incorporates speech recognition to their system. This enable their users to speak the word or phrase they want to search and the web search engines types it into the search box via the use of Natural Language Processing (NLP) before searching and displaying the search results. In addition, Murphy (2015) reported that robotics technology is being used to free space restraints and make information resources readily accessible to users.

4. **User-structured information environment**: The modern information retrieval tools now used in libraries to provide quick and innovative access to information include: electronic databases, Online Public Access Catalogue (OPAC), web search engines, and robotic systems customised for book retrieval and delivery. In addition, Murphy (2015) reported that robotics technology is being used to free space restraints and make information resources readily accessible to users.

5. **Intelligent Document Delivery Services (DDS)**: book retrieval system is the bookBot technology. According to Stone (2019), this technology has been in existence and used in manufacturing for years, but now being applied in libraries. The bookBot is a book-delivery system that automatically retrieves books for users on demand through the library automated catalogue. Within minutes of receiving a request, one of the bookBot's robotic cranes retrieves the requested item from the shelves and delivers it the unit in-charge for onward delivery to the user within or outside the library when the user intends to borrow the material. Also, The robotic cranes stores and retrieves materials for users on request from the online catalogue of stored books. Once the request is made, the robotic crane automatically search for the item and retrieves it from the appropriate bin to the library staff in charge, who then retrieves the requested book and delivers it to the library's hold shelf where the user can pick it up.

6. **Portable computer reader services for the handicapped**: Libraries are embedding Radio Frequency Identification (RFID) tags into their collections. These tags in form of barcodes, contains unique identifying labels for each book in the library, and is used to quickly scan the library's collection using wireless, handheld RFID scanners/readers. According to Li *et al* (2015), smart shelves containing several RFID antennas can automatically register when books are removed from their stacks or returned. This can be used for automatic shelve reading and generate reports for miss-shelved or missing books.

7. **Automatic indexing using Expert System**: Nowadays, there are intelligent systems that offer greater accuracy than humans although they are expensive to purchase and maintain These systems provide outlining detailed map of the entire library for the movement of robot, computing and processing the distance between the robot and an obstacle (shelf, books, tables, users) to anticipate direction changes. It also provides Automatic keyword indexing and abstracting of electronic resources via the use of Expert Systems.

Digital Information Management and Knowledge management in Nigeria

For generations, libraries have stood as revered repositories of knowledge and information, playing essential roles in communities worldwide. However, in the era of the Fifth Industrial Revolution (5IR),

characterized by the fusion of digital technologies and the explosion of data, libraries are experiencing a profound transformation. Awoyemi (2023) emphasizes that the shift from traditional to digital libraries marks a significant paradigm change in how information is accessed, organized, and disseminated. Traditional libraries, with their physical collections of books and periodicals, are being complemented and, in some instances, replaced by digital information repositories accessible via the Internet. This transition has democratized knowledge access, enabling users to retrieve information from any location with internet connectivity.

Libraries in Nigeria are not divorced from this technology revolution. As information providers, they are constantly under pressure to provide relevant sources of information to their immediate communities. Technology enables change and technology enforces change. According to Bales (2023), librarians, staff and patrons must make a number of adjustments as a result of any library automation project, whether it is an original implementation or a migration. Furthermore, as noted by Baro et al. (2018), digital libraries offer advanced search capabilities and the ability to store vast amounts of information in a fraction of the space required by physical collections. Alongside the transition to digital libraries, the roles and responsibilities of librarians have evolved to meet the changing needs of users in the 5IR. Ajani et al. (2022) argue that librarians are no longer solely responsible for cataloging and shelving books; they now serve as curators of digital content, navigators of information landscapes, and educators in digital literacy. In another report, Bashorun et al. (2023) mention that librarians play a crucial role in helping users navigate the complexities of the digital world, providing guidance on information retrieval, evaluation, and citation. Moreover, librarians are increasingly involved in the development and implementation of digital initiatives, such as digitization projects, online learning platforms, and virtual reference services.

The 21st century is the millennium of information. It is also seen as the era of explosion of information output and information sources. It is known as the beginning of knowledge age. New patterns of work and new business practices have developed as a result; new kinds of work with new and different skills are required. In this century, the meaning of knowledge has changed. Knowledge is no longer what is stored in the minds of experts, represented in books and classified in disciplines. It is now thought of as being like a form of energy, as a system of networks and flows – something that does things or makes things happen. In the knowledge age, change not stability is a given. Knowledge age workers need to be able to locate, assess and represent new information quickly. They need to communicate this to others. Management systems have simplified the organization and retrieval of digital content, while data analytics tools have provided insights into user behavior and preferences. Moreover, Tella et al. (2023) state that emerging technologies, such as artificial intelligence and machine learning, hold the promise of further revolutionizing library services, from personalized recommendation engines to virtual reality-enhanced learning experiences. Librarians are expected to have a deep understanding of these technologies and their applications in the library context (Eiriemiokhale & Sulyman, 2023). should harness their potential to enhance the efficiency, accessibility, and effectiveness of library services. However, given the fact that issues surrounding copyright and intellectual property rights are more complex than ever before, it becomes imperative for librarians to possess a comprehensive understanding of copyright law, fair use provisions, licensing agreements, and digital rights management practices. In so doing, Alojaiman (2023) posits that librarians can navigate the nuances of intellectual property rights in the digital realm, including issues related to digitization, preservation, and access to digital content. By complying with copyright laws and advocating for the rights of creators and users, it is then important that librarians foster a balanced and equitable information ecosystem. Librarians must be familiar with established metadata standards such as Dublin Core, MODS, and METS, as well as emerging standards for linked data and semantic web technologies.

In the context of the Fifth Industrial Revolution (5IR), another vital area of knowledge for librarians is ethical considerations. According to Ajani et al. (2023), ethical considerations hold paramount importance in the digital era, where issues such as privacy, data security, and intellectual freedom are increasingly at the forefront. Librarians are keenly aware of ethical principles and adhere to best practices in information management, encompassing professional codes of ethics, privacy regulations, and data protection laws. Scholars like Tella et al. (2023) and Ajakaye (2021) advocate for the ethical use of information and technology, championing intellectual freedom, diversity of perspectives, and the responsible stewardship of digital resources.

Furthermore, collaboration and partnerships with other institutions, organizations, and stakeholders are essential for librarians to enhance their preparedness in the 5IR. Oladokun et al. (2020) underscore that librarians seek opportunities to collaborate with academic institutions, technology companies, community organizations, and government agencies to leverage collective expertise and resources. Perhaps, the integration of emerging technologies into library services is crucial for librarians to remain relevant and responsive to the needs of users in the 5IR

Information packaging: Packaging of information in various formats has become the norm in the digital era. This has created new opportunities for the library to provide value added services in the academic environment. Users of the 21st century are at home with electronic sources of information which permit multiple use of a material by different users at the same time. To exploit this advantage, the librarian can develop and preserve research output of his institution through digitizing projects, theses and dissertations. Schwab (2017) highlights that cultivating a culture of innovation within libraries is crucial for improving

librarian preparedness in the 5IR. Building upon this notion, Singh et al. (2023) emphasize the importance of encouraging creativity, experimentation, and risk-taking among library staff to empower them to explore novel ideas and approaches to library services. This may entail establishing innovation labs or maker spaces within libraries, organizing hackathons or design thinking workshops, or fostering opportunities for staff collaboration on innovative projects. It is undeniable that enhancing librarian preparedness in the era of the Fifth Industrial Revolution demands a proactive and multifaceted approach. Furthermore, the quality of a good reference service depends on the competency and skill of the reference librarian. The 21st century librarian should employs his in-depth knowledge and search strategy to meet user information needs. He does not just point to a row of shelves rather he involves himself in the search process. He is not satisfied until he has satisfied his client. By so doing, he improves his knowledge as well as the image of the library.

Challenges Librarians will encounter in the Industry 5.0 Era in Nigeria

Although 5IR hold great a potentials in supporting and augmenting existing information resources and services in libraries, but there are certain challenges that serves as stumbling block to the librarians as information professionals engaging in knowledge management in Nigeria that include:

1. **Inadequate Financial support:** Almost all African libraries and information centres do not allocate adequate funds in their annual budget for the preserved and conservation of information of information materials their holding. This has caused low priority or lack of desired attention given to the preservation of such information resources.
2. **Insufficiency of Materials/Equipment:** Lack of inadequate equipment and materials contributes significantly to the present poor status of digital information materials as well as the maintenance of information materials in African libraries and information centers.
3. **Unfavorable Government Economic Policies:** The Economic policies of most African government do not favour library services, so digitalization activities are not given priority attention they deserve.
4. **Maintenance Culture:** African countries generally lack maintenance culture have poor maintenance culture of infrastructural facilities such as telephones, electricity, water, laboratory equipment disaster control devices etc meant for preservation and conservation operations. Infact this factor is responsible for quick deterioration of their collection.
5. **Administrative Problem:** Majority of libraries and information centers concentrate much on the effective provision of information services to users. There is lack of proper recognition of the need to train all library professionals in Nigeria.
6. **Technology**: The pre-requisite hardware/software to set up ICT based library is still very expensive and requires large investors. A wide range of multimedia software is not available to integrate, control co-ordinate, manage and adapt different media for the latest home computer interfaces is lack of support software facilitating the authorizing, composition and production of multimedia content. Poor support technology in the area of multimedia data and document storage and manipulation, lack of software support technology for groups, decisions making and co-operative decision making and working. Also converting multimedia resources into digital media is difficult.
7. **Skilled Manpower:** Lack of skilled manpower for the development and management of multimedia databases. Good multimedia content creation requires multi-disciplinary knowledge, multi technological skills and experience. The main barrier to the widespread use of multimedia technology is the absence of standardization among various platforms and between hardware and software. Yee (2012)
8. **Poor Networking:** When facilities are reluctantly switched on, the rate of downloading information are normally slow and in most case fool, when information is being shared from a far networked.
9. **Erratic power supply:** The effectiveness and use of AI technologies depends largely on effective and constant power supply. Most of this technology cannot operate without electricity for electric power supply. It is therefore necessary for the libraries and information centers that which to operate these technologies should make adequate provision for constant electricity supply since NEPA which is now known as KEDCO has become epileptic. A generating set is mostly used in libraries and information centers in countries like Nigeria this situation in most cases affect the effectiveness and of such multimedia technologies libraries and information.
10. **Cultural factors:** language is one of the major factors that hinder the easy assimilation and used of multimedia technologies by many developing countries this hinder the transfer of technologies. The Radio, TV programmes, computer software and printed text produced in different countries bearing cultural backgrounds among others.

THE WAY FORWARD

The followings are some of the possible solutions to the identified challenges:

1. Adequate funds should be allocated to library and general education sector in Nigeria.
2. Government should ensure adequate provision of ICT based facilities at cheaper price.

3. Strengthened regulations and Policies on the use
4. Strengthened Maintenance and Management Concept: This implies that you mustn't wait until electronic equipment breaks down before it is maintained.
5. There is a need for heads of libraries to create an avenue for technical staff to constantly improve their professional skill. There may be a need to train library staff and users as well.
6. Librarians and other library staff should accept and embrace the new technology since change is inevitable. They can do this by embarking on in-service training, attending workshop and seminars on basic computer and use of computers in information access, dissemination and transfer.

7. The curriculum of study for training of new librarians should be upgraded to include basic computer skills such as operating systems, desktop environment, use of the internet, software design, database management and web 2.0.

8. The government should ensure increased funding of the libraries in Nigeria irrespective of the type. Also, the library should source for fund from Philanthropists around their community and introduced fee-based library services to attract fund to the library. Also, a certain percentage of the money provided for the library should be kept for the acquisition and maintenance of ICT appliances.

9. Nigerian government should improve on the availability of power supply in the country. The library should provide alternative power supply through acquisition and use of solar energy and generators to supplement when there is no electricity.

10. Library users should be encouraged to embark on personal computer training to master how to use the computer in information access and retrieval.

11. The internet bandwidth should be increased in order to increase the speed in the network provided for the retrieval of information.

12. A digital web preservation management policy needs to be formulated. this may be done by adopting digital preservation policy of IFLA

CONCLUSION

Advancement in technologies has brought a paradigm shift for Libraries in Nigeria. ICT has enhanced access, research and communication. Hence, the benefits of using ICT in carrying out library operations cannot be overemphasized. It has made libraries and librarians to be relevant in this digital era. It has also reduced the work load of library staff, most of all the library routine services are performed faster using computer. Librarians and other information professionals are bound to fail and perhaps fade out if they refused to undergo retraining to enhance their skills. However, the strategies outlined for empowering librarians in the Fifth Industrial Revolution (5IR) encapsulate a proactive approach to addressing the challenges posed by the evolving landscape of information management. It has been identified that ICT based library services in Nigeria have been working on daunting set of challenges for several years now, the libraries have to overcome these challenges and look ahead for the betterment of information services in the country, through financial sustainability, awareness, training, policy as well as proper maintenance of the digital library materials. The paper also emphasizes that librarians can adapt and thrive in the rapidly evolving landscape of information management and dissemination, ensuring that libraries remain dynamic and relevant institutions in the digital age.

References

Adebayo, O.A, Olayinka, Y., et al (2018). The Roleof ICT in Provisionof LibraryServices: a Panaceafor Sustainable Developmentin Nigeria. Digital Commons, Universityof Nebraska's website. 28-01-2019. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=5305&context=libphilprac

Ahmad, A. Manaf (2018). Use of Multimedia Technologies in Libraries: *National conference on Agricultural libraries in Collaborative Era.* Nauni, Solan Impact of Mulitmedia in Libraries.pp384-392DOI 10.13140/RG.2.1.2945.3842

Alojaiman, B. (2023). Technological Modernizations in the Industry 5.0 Era: A Descriptive Analysis and Future Research Directions. Processes, 11(5), 1318.

American Library Association. (2019). *Artificial Intelligence*. Retrieved December 25, 2024 from: http://www.ala.org/tools/future/trends/artificialintelligence/

Awoyemi, R. R. (2023). Library Engagement with Emerging Technologies in Research and Learning. Handbook of Research on Facilitating Collaborative Learning. Through Digital Content and Learning Technologies, 400-418.

Bashorun, M. T., Ajani, Y. A., & Fagbola, O. O. (2023). Revolutionizing libraries: leveraging the deep Web as a lasting solution for displacement and replacement challenges. Library Hi Tech News. (Ahead-of-

print).
Bales, A. (2023). Library automation and organizational changes: management of information environment. Library Management. Vol 31, 1 / 2.
Benjamin, A. & Bolaji, O. (2024). Knowledge Organisation and Information Retrieval. Okigwe: Whyterm Publishers.
Croft, B. W., Metzler, D., & Strohman, T. (2015). *Search engines: information retrieval in practice*. Pearson Education, Inc. Retrieved December, 2024 from: http:// ciir.cs.umass.edu/downloads/SEIRiP.pdf
Eiriemiokhale, K. A., & Sulyman, A. S. (2023). Awareness and Perceptions of Artificial Intelligence among Librarians in University Libraries in Kwara State, Nigeria. Indonesian Journal of Librarianship, 107-118.
Harris, E. A. (2016). *Next target for IBM's Watson? Third-Grade Math*. Retrieved January, 2025 from: https://www.nytimes.com/2016/09/08/nyregion/ibm-watsoncommon-core.html
Heath, N. (2018). *What is AI? Everything you need to know about artificial intelligence*. Retrieved March 3, 2025from: www.zdnet.com/article/what-is-aieverything-you-need-to-know-about-artificial-intelligence/
Karen Kalhoun, (2014). 3 Key challenges in digital libraries: perspective, practical and Prosperity by facet ALA neal –mschuman publishers.

Kastellee, M. (2012) practical limits to the scope of digital preservation. Information technology & libraries, 31 (2), 63 -71.
Li, R., Huang, Z., Kurniawan, E., & Ho, C. K. (2015). AuRoSS: An autonomous robotic shelf scanning system. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 6100–6105. DOI: 10.1109/IROS.2015.7354246
Murphy, D. (2015). *Robotics and the human touch in libraries and museums*. Retrieved Febuary, 2025 from: https://slis.simmons.edu/blogs/unbound/2015/04/06/ robotics-and-the-human-touch-in-libraries-and-museums/
Romero, V. (2018). 4 *ways libraries can improve with AI & big data*. TechSoup Canada. Retrieved July 15, 2019 from: https://www.techsoupcanada.ca/en/community/blog/4ways-libraries-can-improve-with-ai-big-data
Udensi, J. N., & Akor, P. U. (2016). *Fundamentals of library and information science*. Zaria, Nigeria: Ahmadu Bello University Press.
Sridevi, P. C., & Shanmugam, A. P. (2017). *Artificial intelligence and its applications in Libraries. In* E-Resources Management. Retrieved April 7, 2025 from: https://www.researchgate.net/publication/327831852_Artificial_Intelligence_and_its_applications_in_Libraries
Tella, A., Bamidele, S. S., Olaniyi, O. T. &Yusuf Ayodeji Ajani (2023). Library and Information Science Graduate Skills Needed in the Fourth Industrial Revolution: A Nigerian. Information Services for a Sustainable Society: Current Developments in an Era of Information Disorder, 183, 342.
Thiruppathi, K. (2024). Librarian's role in the digital age: reimagining the profession in the era of Information abundance. *International Journal of Library and Information Science (IJLIS)*. 13(1) 1-9.https://iaeme.com/Home/issue/IJLIS?Volume=13&issue=1
Ziatdinov, R., Atteraya, M.S., & Nabiyeb, R. (2024).The fifth industrial revolution as transformative step towards society 5.0.society, 14(20,1-19.https://doi.org//0.3390/soc/4020019

Sustainable Development Goals (SDGs) and the 5th Industrial Revolution: The Role of E-Libraries in Achieving a More Equitable Information Access

IDOKO NKECHI ANTHONIA Ph.D, CLN, Jp
Principal Librarian /Senior Lecturer
University of Nigeria Nsukka
nkechi.idoko@unn.edu.ng

EDEH, Emmanuel Ekene (MLIS)
Manager
UAC Food Franchise Nnewi, Anambra State
kenechi85@gmail.com

OBANDE, Bonnie Obeka (CLN)
Librarian 1
Igbinedion University, Okada, Edo State
Bonnie.obande@iuokada.edu.ng

Abstract

This study explores how e-libraries can contribute to the realization of the SDGs, through the adoption of emerging technologies such as artificial intelligence (AI), blockchain, and the Internet of Things (IoT). A ***descriptive survey research design*** *was used to gather information from librarians who are members of the Nigerian Library Association in Anambra, Ekiti and Edo states chapter. A cluster sampling method was employed to select 150 librarians comprising 50 from each state chapter of the NLA that has adequate knowledge about SDG and have worked/working in the e-libraries in the respective states. Primary data was gathered using* ***structured questionnaires****. The quantitative data was analyzed using* ***descriptive statistics*** *such as mean scores, and standard deviation. The findings revealed that the roles of e-libraries in advancing equitable access to information in support of the SDGs are widely acknowledged among librarians. Librarians generally agree that emerging technologies of the 5th Industrial Revolution have significantly enhanced the functionality and accessibility of e-libraries. E-libraries in developing regions face a combination of infrastructural, technological, socio-cultural, and policy-related challenges that hinder inclusive and equitable access to information. Strengthening e-library roles toward achieving SDGs requires both technical and human resource improvements, strategic collaborations, and policy support were the strategies that significantly enhance the equitable access to information for all users, especially in developing contexts. The study concludes that by leveraging the technologies of the 5th Industrial Revolution, e-libraries can become a powerful tool for promoting inclusive and equitable knowledge dissemination globally. The study will recommend strategic policies, investment in digital infrastructure, and the integration of AI-driven solutions to maximize the impact of e-libraries in achieving SDGs.*

Keywords: *Sustainable Development Goals (SDGs), 5th Industrial Revolution, e-libraries, Equitable Information Access, Digital Inclusion, Artificial Intelligence.*

Introduction

The United Nations' Sustainable Development Goals (SDGs) represent a global framework for achieving a more just and sustainable world by 2030. Among the 17 goals, several emphasize the importance of information access and digital inclusion, recognizing that equitable access to information is crucial for achieving sustainable development (IFLA, 2016). Goal 16, for instance, promotes peaceful and inclusive societies, access to justice for all, and building effective, accountable, and inclusive institutions at all levels, which inherently relies on the free flow of information. E-libraries, with their capacity to provide digital resources and services, are positioned to play a vital role in realizing these goals.

Concurrently, the world is experiencing the transformative wave of the 5th Industrial Revolution (5IR), characterized by the convergence of human intelligence and advanced technologies like artificial intelligence (AI), big data, and the Internet of Things (IoT) (Bagavathi, 2023). The 5IR is not only changing how information is produced and consumed but also reshaping societal structures and interactions. This revolution presents both opportunities and challenges for information access. While it has the potential to democratize knowledge dissemination, it also risks exacerbating existing inequalities, creating a digital divide where those without access to technology and digital literacy are further marginalized.

E-libraries are crucial in navigating this complex landscape. Unlike traditional libraries, e-libraries offer 24/7 access to a vast array of digital resources, transcending geographical barriers and physical limitations

(Agim, Ninyio, Abubakar & Rabi'u, 2021). They can provide access to diverse formats of information, including text, audio, and video, catering to different learning styles and needs. By leveraging the technologies of the 5IR, e-libraries can enhance their services, offering personalized information retrieval, AI-powered research assistance, and immersive learning experiences. According to Bi, Wang, Zhang, Huang, Wu, Gong and Ni (2022), this enhanced accessibility and functionality can empower individuals and communities, enabling them to participate more fully in the knowledge society and contribute to sustainable development.

The role of e-libraries in promoting equitable information access is particularly significant in developing countries, where disparities in access to information resources are often more pronounced. E-libraries can bridge the gap between the information-rich and the information-poor, providing access to educational materials, research findings, and other vital resources that can support economic development, social progress, and environmental sustainability (Cao, Liang & Li. (2018). They can also serve as hubs for digital literacy training, equipping individuals with the skills they need to navigate the digital world and utilize information effectively.

The study on "Sustainable Development Goals (SDGs) and the 5th Industrial Revolution: The Role of E-Libraries in Achieving a More Equitable Information Access" is significant because it highlights how e-libraries, empowered by advanced technologies of the 5th Industrial Revolution such as artificial intelligence, big data, and IoT, can play a critical role in bridging the digital divide and promoting equitable access to information. This research provides valuable insights for policymakers, librarians, and stakeholders aiming to leverage emerging technologies to enhance library services, promote sustainable development, and ensure that marginalized populations gain fair access to vital information resources in an increasingly digital world

Statement of the Problem

Despite the recognized potential of e-libraries to advance equitable access to information in alignment with the Sustainable Development Goals (SDGs), their effective implementation remains hindered by multiple challenges, particularly in developing regions where they are most needed. This study seeks to examine the role of e-libraries in promoting equitable information access as envisioned by the SDGs, while assessing how emerging technologies of the 5th Industrial Revolution-such as artificial intelligence, big data analytics, and the Internet of Things-enhance the functionality and accessibility of e-library services. However, significant gaps persist in infrastructure, including unreliable internet connectivity, inadequate hardware and software, and insufficient funding models, which limit the reach and impact of e-libraries. Moreover, the lack of culturally relevant and linguistically diverse digital content further restricts inclusivity, especially for users outside dominant language groups. These challenges underscore the need to identify barriers that e-libraries face in fostering inclusive access to information and to evaluate strategies that can strengthen their role in achieving the SDGs' goal of equitable information access.

Furthermore, the study addresses the critical issue of digital literacy and awareness, which remains low among potential e-library users, preventing many from fully benefiting from available resources. The responsible and ethical application of 5th Industrial Revolution technologies in e-libraries also requires attention, particularly concerning data privacy, algorithmic biases, and misinformation risks. There is a pressing need for comprehensive research that not only investigates these challenges but also evaluates effective strategies and policy frameworks to enhance e-library services. Therefore, this study aims to fill existing knowledge gaps and provide actionable recommendations to optimize the contribution of e-libraries toward sustainable and equitable information access in developing contexts, thereby supporting global development agendas.

Objectives of the study

1. **Examine the role of e-libraries in advancing equitable access to information in line with the SDGs.**
2. **Assess how emerging technologies of the 5th Industrial Revolution enhance the functionality and accessibility of e-libraries.**
3. **Identify challenges faced by e-libraries in promoting inclusive and equitable access to information, particularly in developing regions.**
4. **Evaluate strategies that can strengthen the role of e-libraries in achieving the SDGs goal of equitable information access**

REVIEW OF RELATED LITERATURE

The Sustainable Development Goals (SDGs) and Information Access

The Sustainable Development Goals (SDGs), adopted by the United Nations in 2015, provide a global

framework for achieving a more sustainable future. Central to the success of these goals is the concept of information access, which acts as a catalyst for development across various dimensions. According to Missingham (2020), access to information is not merely a goal in itself but a cross-cutting issue that underpins the achievement of many other SDGs. For instance, quality education (SDG 4) relies heavily on access to diverse and reliable information resources, and the promotion of peaceful and inclusive societies (SDG 16) is facilitated by transparent and accountable institutions that ensure public access to information. Indeed, as emphasized by Dei and Asante (2022), effective library and information services enhance socio-economic development by empowering people and fostering knowledge societies, which are crucial for realizing the ambitious targets set forth by the SDGs.

The relationship between information access and the SDGs is multifaceted. Access to information empowers individuals to make informed decisions, participate in democratic processes, and hold their governments accountable (Bradley, 2016). When people have access to relevant and timely information, they are better equipped to improve their lives, communities, and contribute to national development. Libraries, as key providers of information, play a vital role in bridging the information gap and ensuring that all members of society, regardless of their background or location, have the knowledge they need to thrive. According to **Obiekwe and** Agim (2021), libraries play a vital role in helping to meet the challenges "from promoting literacy, to offering free access to information; libraries are safe welcoming spaces, at the heart of communities."

However, significant challenges remain in achieving equitable information access, particularly in developing countries. These challenges include inadequate infrastructure, limited digital literacy, and restrictive information policies (Bradley, 2016). Overcoming these barriers requires a concerted effort from governments, international organizations, and civil society. Libraries, with their expertise in information management and their commitment to public service, are well-positioned to play a leading role in promoting information access and supporting the achievement of the SDGs. As noted by Poluru (2019), research libraries have historically played a crucial role in unlocking knowledge, and their contributions remain vital in the context of the SDGs.

The 5th Industrial Revolution (5IR) and its Impact on Information Access

The 5th Industrial Revolution (5IR) is characterized by the convergence of human intelligence and advanced technologies, such as artificial intelligence (AI), the Internet of Things (IoT), and robotics, fundamentally reshaping how information is created, disseminated, and accessed. This era is marked by a shift towards personalized, human-centric approaches, where technology is tailored to meet individual needs and enhance human capabilities (Ibinaiye, Jiyane & Africa, n.d.). The 5IR holds the potential to democratize information access by breaking down geographical barriers and providing customized learning experiences. For instance, AI-powered systems can personalize information retrieval, ensuring users receive the most relevant and accurate data, while IoT devices can provide real-time information in various contexts, making knowledge more accessible and actionable.

However, the 5IR also presents challenges to equitable information access. The increasing reliance on technology may exacerbate the digital divide, creating disparities between those who have access to and the skills to use these technologies, and those who do not. Issues such as data privacy, algorithmic bias, and the spread of misinformation are significant concerns that need to be addressed to ensure that the benefits of the 5IR are shared by all (Apriliyanti, 2022). Moreover, as information becomes increasingly digital, there is a risk of excluding marginalized communities who lack the necessary infrastructure or digital literacy skills, highlighting the need for proactive measures to promote inclusivity.

In navigating the complexities of the 5IR, it is crucial to adopt a human-centered approach that prioritizes ethical considerations and ensures that technology empowers individuals and promotes social good. Libraries and information institutions play a vital role in this process by providing access to technology, promoting digital literacy, and curating reliable information sources. As Ibinaiye, et al (n.d.) suggest, libraries are encouraged to integrate 5IR technologies to enhance information access and improve user experiences. By embracing these new technologies while addressing the associated challenges, societies can harness the transformative potential of the 5IR to create a more informed, equitable, and inclusive world.

Role of E-Libraries in Promoting Equitable Information Access

E-libraries have emerged as crucial institutions in the digital age, playing a pivotal role in promoting equitable information access. Unlike traditional libraries with physical constraints, e-libraries offer digital resources that can be accessed remotely, breaking down geographical barriers and expanding access to information for users worldwide (Nwobu, Dumbiri, Ibia & Oladokun, 2024). This is particularly significant

for individuals in underserved communities, rural areas, or developing countries who may lack access to physical libraries or up-to-date resources. The accessibility of e-libraries supports crucial Sustainable Development Goals, such as quality education (SDG 4) and reducing inequalities (SDG 10), by providing learning materials and research resources to a broader audience (Dei & Asante, 2022).

E-libraries also enhance information access through various features and technologies. They offer diverse digital formats, including e-books, audiobooks, and multimedia resources, catering to different learning styles and accessibility needs. Apriliyanti (2022) stated that advanced search functionalities, metadata, and digital tools enable users to efficiently locate relevant information, while features like text-to-speech and screen readers improve accessibility for individuals with disabilities. Furthermore, e-libraries often provide access to a wealth of scholarly databases, research journals, and open educational resources (OER), supporting academic research and lifelong learning. As emphasized by Agim, et al (2021), e-learning platforms and digital libraries, incorporating Universal Design for Learning (UDL), improve accessibility, usability, and academic outcomes.

Despite the numerous advantages, ensuring equitable information access through e-libraries requires addressing several challenges. The digital divide, characterized by disparities in access to technology and digital literacy, remains a significant barrier (Bradley, 2016). Many individuals, particularly in marginalized communities, may lack the necessary devices, internet connectivity, or skills to effectively use e-libraries. To overcome these challenges, libraries and governments must invest in infrastructure, provide digital literacy training, and develop user-friendly interfaces (**Obiekwe &**Agim, 2021). Efforts should also be made to preserve digital information and ensure its long-term accessibility. By addressing these challenges, e-libraries can truly fulfill their potential as powerful tools for promoting equitable information access and empowering individuals and communities.

E-Libraries and the 5IR: Convergence and Transformation

The convergence of e-libraries with the Fifth Industrial Revolution (5IR) is creating a transformative shift in how information is accessed, managed, and utilized. The 5IR, characterized by the fusion of human-machine collaboration with advanced technologies like AI, IoT, and big data, is pushing e-libraries beyond their traditional roles of digital repositories (Bi, et al, 2022). This convergence enables e-libraries to offer more personalized, interactive, and intelligent services, catering to the evolving needs of users in a rapidly changing information landscape.

One key transformation is the enhanced ability of e-libraries to provide customized and user-centric experiences. AI-powered systems can analyze user behavior, preferences, and information needs to deliver tailored content, personalized recommendations, and adaptive learning pathways (Affum & Dwomoh, 2023). Furthermore, the integration of IoT devices and sensors can create smart library environments that respond to user needs in real-time, offering seamless access to resources and services. This shift towards a more human-centered approach aligns with the core principles of the 5IR, where technology is used to augment human capabilities and enhance the overall user experience.

However, this convergence also presents significant challenges and requires careful consideration. Issues such as data privacy, algorithmic bias, and the digital divide must be addressed to ensure that the transformation of e-libraries in the 5IR is equitable and inclusive. Librarians and information professionals need to acquire new skills in areas such as data science, AI, and user experience design to effectively navigate this evolving landscape (Nwobu, et al, 2024). By embracing these changes while addressing the associated challenges, e-libraries can play a crucial role in fostering knowledge creation, promoting digital literacy, and empowering individuals in the 5IR era.

Challenges for E-Libraries in Achieving Equitable Information Access and SDGs in the 5th Industrial Revolution

E-libraries face significant challenges in contributing effectively to the SDGs within the context of the 5th Industrial Revolution, especially in developing countries. Key obstacles include unstable power supply, inadequate and outdated hardware, insufficient internet connectivity, and limited funding, which hamper the smooth operation and accessibility of e-library services (Obande et al., 2024). Additionally, there is a critical shortage of skilled librarians and ICT professionals capable of managing and innovating e-library systems to meet evolving user needs. The digital divide further exacerbates inequitable access, as many potential users lack digital literacy or awareness of e-library resources, limiting their ability to benefit from these services (EIFL, 2018). Content-related challenges such as lack of digitization, linguistic diversity, and culturally relevant materials also restrict inclusivity and user engagement (IADIS, 2002). Moreover, ethical concerns around data privacy, algorithmic biases in AI-driven services, and misinformation pose additional risks that need addressing to ensure trustworthy and equitable information access (The Digital Librarian,

2025). These multifaceted challenges highlight the complexity of leveraging e-libraries to support SDGs goals in the era of advanced technologies.

Strategies for Enhancing the Role of E-Libraries in Achieving SDGs in the 5th Industrial Revolution

To overcome these challenges, a multi-pronged strategy is essential. Investment in robust digital infrastructure, including reliable power supply and high-speed internet connectivity, is fundamental to ensuring uninterrupted e-library services. Capacity building through continuous training programs for librarians and users can enhance digital literacy and empower stakeholders to utilize e-library resources effectively (EIFL, 2018). Partnerships between governments, educational institutions, technology vendors, and international organizations can mobilize funding, facilitate access to affordable digital resources, and promote open access initiatives to reduce cost barriers (IADIS, 2002). Additionally, the integration of emerging 5IR technologies such as AI and big data analytics should be guided by ethical frameworks to address privacy and bias concerns, ensuring equitable and trustworthy service delivery (The Digital Librarian, 2025). Developing localized, multilingual, and culturally relevant digital content can improve inclusivity and user engagement, supporting diverse communities (Obande et al., 2024). Finally, policy reforms and advocacy for supportive copyright laws are necessary to enable broader access to knowledge and foster sustainable development through e-libraries (EIFL, 2018). Collectively, these strategies can strengthen e-libraries' capacity to advance equitable information access aligned with the SDGs in the transformative context of the 5th Industrial Revolution.

Methodology

This study adopted a descriptive survey research design, which is appropriate for examining the role of e-libraries in achieving equitable information access within the framework of the SDGs and the 5th Industrial Revolution. The survey design allows for the collection of detailed data on librarians' perceptions, experiences, and challenges in managing e-library services, without manipulating variables. The population for this study consists of 1921 professional librarians who are registered members of the Nigerian Library Association (NLA). Specifically, the study will focus on librarians from the Anambra, Ekiti, and Edo State chapters of the NLA. These states were selected to represent diverse geopolitical zones in Nigeria-Anambra from the South-East, Ekiti from the South-West, and Edo from the South-South-thereby providing a balanced regional perspective on e-library development and challenges. This zonal representation ensures the findings are more generalizable across different socio-cultural and infrastructural contexts within Nigeria's library profession. A cluster sampling technique was used to select 50 respondents each from the three state chapters to ensure proportional representation of librarians across the zones. This approach minimizes bias and ensures that each subgroup within the population is adequately represented. Data was collected using a structured questionnaire. The instrument was structured on a 4 point scale of SA- Strongly agree; A = agree; D = Disagree and SD = Strongly disagree with criterion mean cut on 3.00-3.50, 2.50-2.99, 2.00-2.49, and 1.50-1.99 respectively for the 4 scales. A cut of point mean of 2.50 was taken as agreed while a mean score below 2.50 was regarded as disagreed. The questionnaire was validated through expert review and pilot testing to ensure clarity and reliability. Collected quantitative data was analyzed using descriptive statistics such as means, and standard deviations

Results and Discussion

Research Objective 1: The Roles of e-libraries in advancing equitable access to information in line with the SDGs?

Table 1: Mean and Standard Deviation on the Roles of E-Libraries in Advancing Equitable Access to Information in Line with the SDGs

S/N	Item	SA	A	D	SD	Mean	SD	Decision
1	E-libraries provide remote access to learning materials for marginalized groups.	55	62	23	10	2.86	0.75	Agree
2	E-libraries reduce information inequality between urban and rural users.	58	65	20	7	2.92	0.68	Agree
3	E-libraries promote inclusive education for all, in alignment with SDG 4.	80	53	13	4	3.28	0.59	Strongly Agree
4	E-libraries enhance access to affordable, quality research information.	60	64	18	8	2.97	0.65	Agree
5	E-libraries foster lifelong learning opportunities through open access resources.	85	50	11	4	3.32	0.61	Strongly Agree

6	E-libraries bridge the knowledge gap among vulnerable populations.	566620	8	2.880.72		Agree
7	E-libraries support gender equality in education by removing physical barriers.	755515	5	3.190.64		Strongly Agree
8	E-libraries contribute to building sustainable knowledge societies.	835210	5	3.300.58		Strongly Agree
9	E-libraries empower users digital literacy skills necessary for global goals.	785412	6	3.250.62		Strongly Agree
	Grand Mean			**3.08**		**Agree**

The interpretation of the result shows that the librarians agreed that e-libraries provide remote access to learning materials for marginalized groups (mean = 2.86), reduce information inequality between urban and rural users (mean = 2.92), enhance access to affordable, quality research information (mean = 2.97), and bridge the knowledge gap among vulnerable populations (mean = 2.88). Meanwhile, the respondents strongly agreed that e-libraries promote inclusive education for all in line with SDG 4 (mean = 3.28), foster lifelong learning opportunities through open-access resources (mean = 3.32), support gender equality in education by removing physical barriers (mean = 3.19), contribute to building sustainable knowledge societies (mean = 3.30), and empower users with digital literacy skills necessary for achieving global goals (mean = 3.25).The grand mean score of 3.08 indicates a general positive agreement towards the importance of e-libraries in promoting inclusive, equitable, and sustainable access to information.

The summary of the table reveals that the roles of e-libraries in advancing equitable access to information in support of the Sustainable Development Goals (SDGs) are widely acknowledged among librarians in academic libraries. Several empirical studies corroborate the findings of this study. For instance, Adebayo, Ahmed and Adeniran (2018) found that e-libraries significantly contribute to digital inclusion and equitable access to educational resources for underserved populations. Electronic resources enhance information accessibility among students and researchers, promoting lifelong learning and information equality. Moreover, Dei and Asante (2022) emphasized that the deployment of e-library services is crucial for achieving SDG targets, particularly in developing countries where physical access to libraries is often limited. These studies affirm that e-libraries play a vital role in democratizing access to information and building inclusive knowledge societies.

Research Objective 2: How emerging technologies of the 5th Industrial Revolution enhance the functionality and accessibility of e-libraries?

Table 2: Mean and Standard Deviation on How Emerging Technologies of the 5th Industrial Revolution Enhance the Functionality and Accessibility of E-Libraries

S/N	Item	SA	A	D	SD	Mean	SD.	Decision
1	AI-driven systems have improved personalized access to e-library resources.	85	50	10	5	3.32	0.61	Strongly Agree
2	Blockchain ensures the security and integrity of digital library records.	80	55	12	3	3.28	0.58	Strongly Agree
3	IoT devices have moderately improved remote access to library services.	55	70	15	10	2.92	0.70	Agree
4	AI-powered chatbots have enhanced user interaction and support in e-libraries.	83	52	10	5	3.30	0.64	Strongly Agree
5	Blockchain supports digital rights management for library content.	77	54	14	5	3.21	0.67	Strongly Agree
6	AI enhances automated indexing and retrieval of digital materials.	79	53	13	5	3.25	0.62	Strongly Agree
7	IoT technologies facilitate smart management of library facilities and resources.	75	55	15	5	3.19	0.65	Strongly Agree
8	The adoption of 5IR technologies is still limited in many academic libraries.	53	68	20	9	2.85	0.75	Agree
9	Lack of infrastructure hinders the full realization of 5IR benefits in e-library services.	54	66	22	8	2.90	0.73	Agree
	Grand Mean					**3.14**		**Agree**

The table shows that the respondents agreed that IoT devices have moderately improved remote access to library services (mean = 2.92), the adoption of 5IR technologies is still limited in many academic libraries (mean = 2.85), and lack of infrastructure hinders the full realization of 5IR benefits in e-library services (mean = 2.90). However, librarians strongly agreed that AI-driven systems have improved personalized access to e-library resources (mean = 3.32), blockchain ensures the security and integrity of digital library records (mean = 3.28), AI-powered chatbots have enhanced user interaction and support in e-libraries (mean = 3.30), blockchain supports digital rights management for library content (mean = 3.21), AI enhances automated indexing and retrieval of digital materials (mean = 3.25), and IoT technologies facilitate smart management of library facilities and resources (mean = 3.19).The grand mean of 3.14 indicates a positive perception towards the contribution of 5IR technologies to library services.
The result shows that librarians in academic libraries generally agree that emerging technologies of the 5th Industrial Revolution (such as AI, blockchain, and IoT) have significantly enhanced the functionality and accessibility of e-libraries, although certain barriers such as limited adoption and infrastructure challenges still exist. The results are consistent with prior studies. For example, Cao, et al (2018) found that AI applications in libraries significantly enhance searchability, user engagement, and access to information resources. Similarly, Blockchain technology ensures transparency, security, and intellectual property management in digital libraries. Furthermore, Bi, et al (2022) established that IoT adoption in libraries improves facilities management and user service delivery but noted that infrastructural barriers must be addressed for full optimization. These studies support the finding that 5IR technologies are crucial enablers of modern e-library functionality and accessibility.

Research Objective 3: Challenges faced by e-libraries in promoting inclusive and equitable access to information, particularly in developing regions?

Table 3: Mean and Standard Deviation on Challenges Faced by E-Libraries in Promoting Inclusive and Equitable Access to Information in Developing Regions

S/N	Item	SA	A	D	SD	Mean	SD	Decision
1	Inadequate ICT infrastructure limits e-library accessibility.	84	55	8	3	3.32	0.63	Strongly Agree
2	Limited digital literacy among users hinders effective e-library utilization.	60	67	15	8	2.92	0.68	Agree
3	Poor internet connectivity affects seamless access to e-library services.	80	60	8	2	3.28	0.61	Strongly Agree
4	Lack of local content in e-libraries affects relevance for diverse communities.	58	68	18	6	2.88	0.71	Agree
5	Insufficient funding restricts e-library expansion and maintenance.	82	58	7	3	3.25	0.60	Strongly Agree
6	High cost of digital resources limits equitable access to information.	77	60	10	3	3.18	0.66	Strongly Agree
7	Cultural and language barriers limit the effective use of e-library resources.	62	65	17	6	2.90	0.70	Agree
8	Inadequate training of librarians on emerging digital tools affects service delivery.	78	59	10	3	3.21	0.64	Strongly Agree
9	Lack of government policy support towards digital library initiatives.	83	57	8	2	3.30	0.59	Strongly Agree
	Grand Mean					**3.14**		**Agree**

The table reveals that librarians agreed that limited digital literacy among users (mean = 2.92), lack of local content (mean = 2.88), and cultural and language barriers (mean = 2.90) are significant challenges faced by e-libraries in promoting inclusive and equitable access to information. On the other hand, respondents strongly agreed that inadequate ICT infrastructure (mean = 3.32), poor internet connectivity (mean = 3.28), insufficient funding (mean = 3.25), high cost of digital resources (mean = 3.18), inadequate training of librarians (mean = 3.21), and lack of government policy support (mean = 3.30) pose even more critical challenges in developing regions.The grand mean score of 3.14 shows a general strong agreement among librarians that these challenges significantly impact the efficiency and effectiveness of e-libraries in developing areas

The overall result indicates that e-libraries in developing regions face a combination of infrastructural, technological, socio-cultural, and policy-related challenges that hinder inclusive and equitable access to information.The findings are corroborated by several empirical studies. Apriliyanti (2022) observed that poor internet connectivity, lack of funding, and insufficient ICT infrastructure are critical barriers to e-library development in Nigeria. Similarly, limited digital literacy among users and librarians poses a significant hindrance to the optimal use of electronic library resources. In another study,Agim, et al (2021) found that the absence of local content and language diversity issues significantly limit the inclusivity of e-library platforms. Together, these studies affirm that multifaceted challenges must be addressed to enhance e-library access in developing regions.

Research Objective 4: Strategies that can strengthen the role of e-libraries in achieving the SDGs goal of equitable information access

Table 4: Mean and Standard Deviation on Strategies that Can Strengthen the Role of E-Libraries in Achieving the SDGs Goal of Equitable Information Access

S/N	Item	SA	A	D	SD	Mean	SD.	Decision
1	Regular user training programs to improve digital literacy.	62	65	17	6	2.92	0.65	Agree
2	Expansion of broadband and ICT infrastructure for wider e-library access.	83	57	8	2	3.30	0.62	Strongly Agree
3	Increasing funding and grants for e-library development and maintenance.	58	65	20	7	2.85	0.68	Agree
4	Developing multilingual and culturally relevant digital content.	76	58	12	4	3.18	0.64	Strongly Agree
5	Strengthening collaboration between libraries at local, national, and global levels.	60	66	16	8	2.88	0.70	Agree
6	Policy advocacy for national digital inclusion initiatives.	65	64	15	6	2.95	0.67	Agree
7	Training librarians on emerging digital technologies and innovations.	78	60	10	2	3.22	0.61	Strongly Agree
8	Implementing user-centered design for e-library platforms to improve accessibility.	80	59	9	2	3.28	0.60	Strongly Agree
9	Building public-private partnerships to support e-library growth and sustainability.	79	60	9	2	3.25	0.59	Strongly Agree
	Grand Mean					**3.09**		**Agree**

The interpretation of the table shows that librarians agreed on the importance of regular user training programs to boost digital literacy (mean = 2.92), increasing funding and grants (mean = 2.85), strengthening collaboration among libraries (mean = 2.88), and policy advocacy for digital inclusion (mean = 2.95) as essential strategies for strengthening e-libraries in achieving SDGs. Furthermore, respondents strongly agreed that expanding broadband infrastructure (mean = 3.30), developing multilingual content (mean = 3.18), training librarians in digital technologies (mean = 3.22), implementing user-centered design (mean = 3.28), and fostering public-private partnerships (mean = 3.25) would greatly enhance equitable access through e-libraries.The grand mean of 3.09 indicates a general strong agreement among librarians that these strategies, if well implemented, will significantly enhance the equitable access to information for all users, especially in developing contexts

The results reveal that strengthening e-library roles toward achieving SDGs requires both technical and human resource improvements, strategic collaborations, and policy support.Empirical evidence from past studies supports these findings. In a study by Nwobu, et al (2024), it was found that librarian training in emerging technologies and user-centered approaches significantly improved e-library functionality and user satisfaction. Also, Broadband expansion, local content creation, and funding opportunities were critical strategies for advancing equitable digital access through libraries in Ghana and other developing countries. Furthermore, Bagavathi (2023) demonstrated that partnerships between public institutions and private sectors considerably boosted the growth and sustainability of e-libraries in Southeast Asia, aligning well with the SDG goals for inclusive information access.

Conclusion

The study concluded that e-libraries in academic institutions play an indispensable role in promoting equitable access to information, a key pillar for achieving the Sustainable Development Goals (SDGs).

Librarians recognize the transformative potential of emerging technologies of the 5th Industrial Revolution, such as artificial intelligence, blockchain, and the Internet of Things, in enhancing e-library functionalities. However, barriers such as infrastructural deficiencies and low adoption rates persist, especially in developing regions. Furthermore, challenges spanning from socio-cultural to policy-related factors continue to impede the full realization of inclusive and equitable access to information.Therefore, achieving the SDGs through e-libraries requires a multi-pronged approach: investing in digital infrastructure, building the capacity of library personnel, implementing supportive policies, and fostering local and international collaborations. By addressing these critical areas, e-libraries can be empowered to serve as vibrant catalysts for social equity, educational advancement, and sustainable development across diverse global communities, especially where information gaps are most profound.

Recommendations

- Librarians and e-library administrators should intensify advocacy and public awareness campaigns to promote the pivotal role of e-libraries in achieving equitable access to information and supporting the SDGs among stakeholders and policymakers.
- Academic libraries should establish continuous professional development programs focused on SDG-related services, equipping librarians with the skills to align library activities with global development agendas.
- Institutions should invest in upgrading digital infrastructure, including high-speed internet, modern hardware, and software, to support the seamless integration of emerging technologies into e-library systems.
- Organize regular training workshops and seminars for librarians on the application and maintenance of 5IR technologies (such as AI, blockchain, and IoT) to maximize their adoption and effective utilization.
- Governments and educational institutions should collaborate to provide subsidies or financial incentives for infrastructural development and technology acquisition for e-libraries.
- Policy reforms should be advocated at national and institutional levels to prioritize digital inclusion initiatives, ensuring that socio-cultural barriers such as language, literacy, and accessibility needs are addressed.
- E-libraries should form strategic alliances with international organizations, tech firms, and NGOs to leverage technical expertise, funding, and innovative solutions that drive sustainable development efforts.
- Institutions should design targeted recruitment and capacity-building programs that attract and retain skilled digital librarians who are capable of managing advanced e-library systems and aligning them with SDG objectives.

REFERENCES

Adebayo, O. A., Y. O. Ahmed, and R. T. Adeniran. 2018. The role of ICT in provision of library services: a panacea for sustainable development in nigeria. Library Philosophy & Practice. http://digitalcommons.unl.edu/libphilprac/1951

Affum, M. Q., & Dwomoh, O. K. (2023). Investigating the Potential Impact of Artificial Intelligence in Librarianship. Library Philosophy and Practice, 1-12

Agim, E.C. & Azolo, M, (2022) Investigation of the Users' Access to Health information for Sustainable Development during the Covid 19 Era in Professor Kenneth Dike E-Central Library, Awka, Anambra State. Library Philosophy and Practice (e-journal). 7496. https://digitalcommons.unl.edu/libphilprac/7496

Agim, E.C., Ninyio, H.T., Abubakar T,A. & Rabi'u, A (2021) Optimization of e-platforms for teaching and learning in the era of Covid 19 lockdown: A case for librarians in Africa. *International Journal of Studies in Education, 17* (1), 144-152

Apriliyanti, M., & M, I. (2022). Challenges of The Industrial Revolution Era 1.0 to 5.0 : University Digital Library In Indoensia. Library Philosophy and Practice (E-Journal). Retrieved from https://digitalcommons.unl.edu/libphilprac/6994

Bagavathi, A. 2023. "Emerging Trends and Impact of Internet of Things in Academic Libraries." *Library of Progress-Library Science, Information Technology & Computer* 43 (1). https://doi.org/10.48165/bpas.2023.43.1.1.

Bi, S., C. Wang, J. Zhang, W. Huang, B. Wu, Y. Gong, and W. Ni. 2022. "A Survey on Artificial Intelligence Aided Internet-Of-Things Technologies in Emerging Smart Libraries." *Sensors* 22 (8): 2991. https://doi.org/10.3390/s22082991.

Bradley, F. (2016). 'A world with universal literacy': The role of libraries and access to information in the UN 2030 Agenda. IFLA Journal, 42(2), 118–125. https://doi.org/10.1177/0340035216647393

Cao, G., M. Liang, and X. Li. 2018. "How to Make the Library Smart? The Conceptualization of the S Library." *The Electronic Library* 36 (5): 811–25. https://doi.org/10.1108/EL-11-2017-248

Dei, D.-G.J. and Asante, F.Y. (2022), "Role of academic libraries in the achievement of quality education as a sustainable development goal", Library Management, Vol. 43 No. 6/7, pp. 439-459. https://doi.org/10.1108/LM-02-2022-0013

Ibinaiye, I., Jiyane, G., & Africa, S. (n.d.). The Prospect of 5th Industrial Revolution and Academic Library Services: Exploring the role of Data Science in the Post Pandemic Period. Retrieved from https://event.academiainformationtechnology.org/proceedings/14.pdf

IFLA. (2016). IFLA and the Sustainable Development Goals: A story telling manual. International Federation of Library Associations and Institutions.

Missingham, R. (2020). Sustainable Development Goals: Insights from Research Libraries. *International Journal of Librarianship*, *5*(2), 13–25. https://doi.org/10.23974/ijol.2020.vol5.2.167

Nwobu, B. K., Dumbiri, R., Ibia, M. J., & Oladokun, B. D., (2024). Libraries in the Fifth Industrial Revolution: Skills and Knowledge Required in Preparing Librarians for an Uncertain Future. In U. C. Udofot et al. (Eds.), Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria. (3 – 13). Port Harcourt: Chadick Printing Press

Obiekwe, O.L, &Agim, E.C., (2021) Enhancing Information Literacy during the Covid 19 Pandemic: The roles of Librarian. *International Journal of Library and Information Technology (IJLIT), 1* (1), 53-65. http://www.gojamss.net/journal/index.php/IJLIT

Poluru, L. (2019). Sustainable Development Goals (SDGs): The Role of Libraries and Access of Information for Transformation on 20th December 2019 during MANLIBENT 2019 – International Conference on "Sustainable Librarianship: Reimagining & Re engineering Libraries that was jointly organized by MANLIBNET and Parul University, Waghodia – Vadodara, Gujarat from 19-21 December 2019.

EIFL. (2018). Libraries need good connectivity! Presented at E-Age Conference Organized by ASREN, Amman. https://www.eifl.net

IADIS. (2002). Digital libraries in developing countries. International Association for Development of the Information Society. https://www.iadisportal.org/digital-library/digital-libraries-in-the-developing-countries

Obande, B. O., Helen, E., Tsenongu, C. T., & Tarbo, D. N. (2024). Challenges of e-library in developing countries higher educational institutions. Computing and Artificial Intelligence, 2(1), 1349. https://doi.org/10.24294/cai.v2i1.1349

The Digital Librarian. (2025). Library tech trends for 2025. https://the-digital-librarian.com/2025/01/21/library-tech-trends-for-2025/

The 5th Industrial Revolution and the Future of Public Libraries in Nigeria: Benefits, Challenges ad Strategies

Maifata, Nurudeen Mu'azu (PhD)
Nasarawa State University, Keffi
Department of Library and Information Science
08035965064
maifata22@gmail.com

Enyi, Kingsley Emmanuel (PhD)
Federal University of Lafia, Library
Department of Reference Service
08034367172
kingsleyenyi12@gmail.com
enyi.kingsley@fulafia.edu.ng
&
Philip Chike Chukwunonso Aghadiuno (PhD)
Isa Mustapha Agwai 1 Polytechnic, Lafia
Department of Library and Information Science
http//:0000-0002-0986-3721
08069431826
chike.aghadiuno@imap.edu.ng

Abstract

The paper investigates ***the 5th industrial revolution and the future of public libraries in Nigeria: Benefits, challenges and strategies.*** *The studylooked at the benefits of the* ***5th industrial revolution to public libraries, the effects of the 5th industrial revolution to public libraries, the challenges of the 5th industrial revolution to public libraries and the strategies to be used in adverting the challenges faced by the 5th industrial revolution to public libraries.*** *Four (4) research questions and one null hypothesis guided the study. Qualitative method and a descriptive survey design were adopted for the study. The total population used wasone hundred and nine (109) librarians from three Ta'al Modern Libraries (Public Libraries) in Nasarawa State. Stratified random sampling technique was used to determine the selection of the three Ta'al Modern Libraries in Nasarawa State.The instruments for data collection include questionnaire and interviews.Two experts in the Department of Library and Information Science validated the instrument at the Federal University of Lafia.Data was collected using a close-ended questionnaire and analyzed using frequency counts, percentage, relative frequencies,simple Mean (X) and standard deviation (SD) with table. It was recommended that, libraries should totally embraced the implementation of the 5th Industrial Revolution in developing it services which are gears towards library profession in exploring its benefits for the future of public libraries, that the 5th Industrial Revolution powered services should be embraced in all libraries in Nigeria irrespective of their status.In addition to improved operational efficiency: The integration of 5th Industrial Revolution and automation can streamline library operations, allowing librarians to focus on more critical tasks and services. Libraries should focus on the human centered technology applications that connect people with things that would eventually lead to IR 5.0.*

Keywords: 5th Industrial Revolution, Public Libraries, Benefits, Challenges, Strategies.

Introduction

Generally, libraries have experienced several changes in their technological process and socio-economic landscape over the years (Byrkovych et al. 2023). However, the current revolution era is experiencing a new level of transformation with the increasing collaborative and user-generated content which mostly occur in an unprecedented pace interval. To this end, Green (2023) noted that librarians are recognizing the importance of aligning library services with the lifestyles and preferences of their user communities, a principle which has led to multiple changes in librarianship in recent years. The major drivers of these innovations are the increasing advancements in technology and the increasing demand for a closer mingling or relationship between librarians and their users. It is widely noticed that libraries leveraging emerging technologies have the potential to establish stronger connections with their communities on a global scale (Ajani et al. 2023). Therefore, libraries globally are adopting various emerging technologies and approaches to tailor library services to the specific needs of their communities (Tella, Ajani, and Ailaku 2023). One of this is a familiar example of integrating technology into library systems as meaningful labels to signify improved service models. Some of these terminologies like robotics, cloud computing, artificial intelligence, Internet of Things, virtual/augmented reality, metaverse and blockchain are gaining popularity among library discipline and users (Carrión 2023).

However, the adoption of such terminologies in describing these new models, ideas and techniques in library profession is not without controversy, with the concept of "Intelligent Libraries" sparking a lot of arguments. Also, some experts argue that "Intelligent Libraries" is commonly used to refer to "smart libraries," public opinion on this trend varies (Khan et al. 2023). Some library professionals find it exciting and believable that it can enhance library services, foster innovation and delivery of effective services while, on the other hand, some librarians view it as empty and unrealizable. Some critics claims that labelling trends in library profession such as "Intelligent Libraries" is merely a marketing strategy to enhance the image of libraries (Mupaikwa 2024). They suggest that this terminology mount a lot of pressure on librarians in transforming abstract concepts into practical realities, where innovations and ideologies can be implemented to sustain the knowledge system in the era of the Fifth Industrial Revolution (5IR). Thus, the 5IR is taking us into an era of remarkable technological advancements and societal transformations (Ajani et al. 2022; Tella, Amuda, and Ajani 2022; Moll 2023).

At this critical juncture, it's essential to scrutinize the role of libraries, information professionals and institutions that are mainly involved with knowledge conservation and preservation, in a world marked by rapid digitalization and automation. Pose as a question here is, what is the role of libraries is in an environment where information flows effortlessly across boundaries and digital devices, and how libraries, deeply rooted in long-standing traditions, can adapt to the changing needs of individuals and communities in this digital era. Traditionally, libraries have been referred to as a place dedicated to collecting, conserving, preserving/ safeguarding, and disseminating information, however, the very nature of information and how it can be access has undergone a profound transformation (Tella, Ajani, and Ailaku 2023).

The new digital world, with its search engines, algorithms and vast databases has revolutionized how one can search for, use, and share knowledge. In a landscape characterized by information overload and constant evolution of technology, libraries must not just confine and limit themselves to a particular space but widen and redefine their purpose. This is the place were smart technologies come into play, as transformative force with the potential to disrupt and revitalize libraries in ways previously unimaginable. AI-powered libraries offer the promise of improving the user experience, streamlining operations, and making knowledge more accessible to all (Doğan and Niyet 2024). Consequently, this progress raises ethical and privacy concerns, challenging the core principles of libraries, such as inclusivity, transparency, and intellectual freedom. Thus, how can libraries effectively leverage the capabilities of smart technologies while preserving and safeguarding these values and respecting the rights and values of individuals in a world where machines are taking on more decision-making roles? These are the critical questions at the heart of the discussion surrounding "Intelligent Libraries in the 5IR," however, this concept has the potential to reshape the essence of libraries in the digital era. It is therefore, essential to explore these questions and create a path for libraries as they navigate the uncreated territories of the 5IR.

Statement of the Problem

The 5IR era is changing how libraries work, with technology and globalization impacting everything from how libraries get information to how they store and share it. Nowadays, information is stored digitally and accessed online, which makes it easier to store great amounts of information and for people to find what they need. Most libraries now focus on electronic resources and use technology like self-service machines, online databases, and mobile devices (Bagavathi 2023); it have migrated it focus from just collecting books to helping people find and use information in various ways. However, there are still challenges in adapting to new technologies like artificial intelligence and wearable devices, and library users' expectations have also changed because of technology (Jha 2023). To remain relevant in this era, libraries need to be flexible and learn new skills using the 5th industrial revolution medium that are faster and safer. While librarians should be open to new technologies and use them to meet the needs of individual users, embracing these changes, libraries can continue to be important in the 5IR era as an intelligent space, where knowledge and technology are constantly evolving. As libraries have always held a revered place as bastions of knowledge, serving as the guardians of wisdom and repositories of our shared cultural heritage, their role within knowledge systems is far from static; they continually adapt to meet the ever-evolving needs of our society. As such, there are multifaceted contributions that libraries make to our knowledge systems, drawing from various scholarly sources. At the core of their mission, libraries serve as sentinels of cultural heritage, preserving a diverse range of books, manuscripts, and historical records. Within the walls of these institutions, they protect the narratives, literature, and accumulated wisdom of past civilizations, ensuring that this invaluable heritage remains accessible to future generations (Doğaray 2023). Moreover, libraries transcend their role as mere preservers of the past. They are sanctuaries of learning, providing individuals of all ages with access to resources that foster lifelong learning. Whether through printed materials, digital archives, or educational programs, libraries empower people to embark on journeys of intellectual growth and personal development. Libraries also play a vital role in advancing research and innovation. Furthermore, libraries actively engage in the preservation of digital knowledge, archiving websites, electronic journals, and other digital content, securing it for posterity and mitigating the risks of information loss in the digital age. Thus, libraries uphold the fundamental principle of intellectual freedom and unrestricted access to information. They provide safe spaces for the expression of diverse voices and perspectives, ensuring that censorship and restrictions do not hinder the free exchange of ideas. In their commitment to remaining relevant, libraries adapt to technological advancements by embracing digital catalogues, e-books, online databases, and other digital resources. Most librarians are face with several challenges that affect their efficiency which has also resulted to the

quality services they deliver to users. It is based on this assumption that the adoption of the 5th Industrial Resolution is been suggested for to see how public libraries and information centers can improved in their services.

Research Questions

1. What are the benefits of the 5th industrial revolution to staff of Ta'al Model Library in Nasarawa State?
2. What are the effects of the 5th industrial revolution on staff of Ta'al Model Library in Nasarawa State?
3. What 5th industrial revolution challenges are encountered by staff of Ta'al Model Library in Nasarawa State?
4. What strategies to be used in adverting the challenges are faced by 5th industrial revolution in Ta'al Model Library in Nasarawa State?

Hypotheses

One null hypotheses was formulated to guide the study and was tested at 0.05 level of significance. **Ho_1:** Benefits of the 5th industrial revolution has no significant impact on the library staff of Ta'al Modern Library.

Significance of the study

Generally, this study will undoubtedly add to the existing body of knowledge in library and information science. In addition, this work's findings are expected to benefit public libraries, media resource centres (school libraries), university librarians, lecturers, students and researchers.

To the public libraries, the findings will reveal the relevant information on the 5th industrial revolution in the libraries and their impact on research productivity among users.

Also expected to benefit from the findings are media resource centres (school libraries), as the findings will give them an insight into the understanding of 5th industrial revolution devices that are not available in the public libraries. It will also enlighten librarians on their awareness on 5th industrial revolution in the libraries used to deliver effective services. These will help the management and managers of the university libraries and the school libraries in their decision of choice and strategies on the area of the 5th industrial revolution the libraries should alien with in line with its services in the users.

The lecturers and school teacher librarians who provide guidance and valuable information to the pupils and students will also find the findings of the work relevant as it will provide insight into the areas of challenges and remedies faced by the students regarding 5th industrial revolution in the libraries and school libraries (media resource centres) when carrying out research. This will enable them to adopt adequate measures that will guide the students in effectively using media resources.

Furthermore, researchers' deduction will be that the work will be relevant in conducting empirical and non-empirical studies related to this topic, which will be helpful particularly in reviewing related empirical studies.

Literature Review

The 5th industrial Revolution also known as IR 5.0 holds the promise to solve societal problems, such as natural resource exhaustion and economic disparity across the entire globe. This process can be achieved by acquiring new knowledge and generating new values that could connect people and things together, and create a resource efficient smart society with better lifestyle for its dwellers. The optimized resource planning for smart societies is where a planned energy efficient smart city uses a hybrid smart grid that achieves energy efficiency by optimizing connected devices. As the 4th IR was primarily focused on mass production using robots, machines and other digitized systems, 5th IR brings back the humans at the core of the production processes. The issues when humans work with robots and factory systems would lead to a new IR 5.0 employment market, which is visualized and obtainable. There is significant progress at collaborative engineering robots that would enhance human craftsmanship.

Xu (2021) presents an industrial smart society information integration that is trans-disciplinary between cyber-physical systems, IoT, and cloud computing and then explores each of these disciplines with technologies systems employed. In human-machine collaboration, information security and confidentiality at work will become a multifaceted concern in essential research area in information security. IR 5.0 will blend the human intelligence and creativity with smart, digitized, and advanced industrial processes, which will result in personalized products. The market feedback indicates that the human craftsmanship in Industry 5.0 would be inevitable, as there is no alternative to human intelligence for minimizing the mistakes and errors, thereby preventing losses. The 5th industrial revolution is characterized by combining human intellect with the highest standard of digitization, to optimize the human efficiency. Industry 5.0 will take personalization of the end products to a new level. This will ensure the customer satisfaction and will lead to sustainability by ensuring new product and job opportunities, for all the residents of the planet. In that framework, this section reviews the above discussed notions in various societal domains. We focus on the human centered technology applications that connect people with things that would eventually lead to IR 5.0.

Methodology

A quantitative method and descriptive survey research design was adopted in this study to investigate the 5th industrial revolution and the future of public libraries in Nigeria. A total population of one hundred and nine (109) library staff from the three selected Ta'al Modern (Ta'al Modern Library, Lafia, Ta'al Modern Library, Akwanga and Ta'al Modern Library, Keffi) in Libraries in Nasarawa State. No sampling technique was used, as the entire library staff was studied. Two experts in the Department of Library and Information Science validated the instrument at the Federal University of Lafia.

Data was collected using a close-ended questionnaire and analyzed using frequency counts, relative frequencies, means, standard deviation, tables and charts. Stratified random sampling technique was used to determine the selection of three (3) Modern Libraries in Nasarawa State. The choice of adopting this technique is to give a uniform percentage of the public libraries used all share similar futures and characteristics.

Results and Discussion

A total of one hundred and nine (109) copies of the instruments were administered to the respondents, and ninety eight (98) copies were duly filled and returned, and used for the study. Since the population is small, it was relatively managed. The data collected, finding and implication of the findings are presented in this section.

Research Question One: What are the benefits of the 5th industrial revolution to staff of Ta'al Model Library in Nasarawa State?

Table1: Benefits of the 5th Industrial Revolution to Staff of Ta'al Model Library in Nasarawa State?

S/N	Items Statement	Mean	Std. Dev	Remark
1	Digital transformation: Libraries can leverage 5IR technologies like AI Internet of Things (IoT) to enhanced digital services, improve resources discovery and increase accessibility.	3.35	.82	High Extent
2	Virtual and augmented reality: Librarie s can utilize VR and AR technologies to create immersive learning experience, enhanced cultural heritage preservation and promote literacy	3.21	.90	High Extent
3	Collaboration and innovation: 5IR can facilitate collaboration between libraries, academia, and industry, driving innovation and knowledge creation	3.26	.83	High Extent
4	Personalized services: AI -powered recommendation systems can help librarie s provide personalized book recommendations, research assistance and learning resources.	3.19	.85	High Extent
5	Digital divide: The 5IR may exacerbate existing digital divides, making it essential for libraries to ensure equitable access to digital resources and technologies	3.25	.80	High Extent
6	Increase accessibility: The 5IR technology can improve access to library resources and services for users with disabilities, remote users, or those to underserved communities more accessibl e to users with disabilities.	3.27	.94	High Extent

7	Improved operational efficiency: The integration of AI and automation can streamline library operations, allowing librarians to focus on more critical tasks and services.	3.25	.90	High Extent
8	Global knowledge network: Libraries can foster global knowledge networks, promoting, collaboration, innovations, and knowledge sharing across borders.	3.33	.83	High Extent
9	Preservation of core principles: Despite the adoption of new technologies, libraries can preserved their core principles of inclusivity, transparency and intellectual freedom.	3.00	.91	High Extent
10	Sustainable knowledge system: The 5IR enables libraries to redefine their roles and expand their impact on t he knowledge ecosystem,	3.26	.83	High Extent

Source: Field Work, 2025

Results in table 1 shows that all the twelve (12) items on the benefits of the 5th Industrial Revolution in Ta'al Model Library to a high extent affected the library staff as perceived by the respondents with Mean score ranges between 3.00-3.35 which is above the benchmark of 2.50. The table also revealed high Standard Deviation values ranging from .80-.94 which showed that the respondents were homogeneous in their responses. The grand mean of all the items was revealed to be 3.23 and SD= .86.

Research Question Two: To answer the above question, data on the effect of the 5th industrial revolution in Ta'al Model Library in Nasarawa State by the library staff on library staff was collected and subjected to analysis using Mean and Standard Deviation as presented in Table 3.

Table 2: Mean and Standard Deviation of the effect of the 5th industrial revolution on library staff of Ta'al Model Library in Nasarawa State

Table 2: Effects of Artificial Intelligence

S/N	Items Statement	Mean	Std. Dev	Remark
13	AI-powered search engines: improve search results and relevance	2.15	.77	Low Extent
14	Professional development: libraries can develop new skills to work effectively with 5IF technologies	2.21	.80	Low Extent
15	24/7 support: AI -powered chat -bots provide round-the-clock assistance	2.61	.83	High Extent
16	New services and programs: 5IF enable libraries to offer new services and programs, such as AI - powered research assistance	2.59	.81	High Extent
17	Improved efficiency: AI automate routine tasks, freeing up staff to focus on more complex activities	2.80	.80	High Extent
18	Content discovery: 5IF helps users discovered new resources and topics	3.21	.84	High Extent
19	Integration with emerging technologies: 5IF will likely be integrated with other technologies, such as blockchain and IoT	3.25	.80	High Extent
20	**Grand Mean**	**2.68**	**.56**	**High Extent**

Results in table 2 shows that, items 13 and 14 with mean values of 2.15 and 2.21 respectively on effect of the 5th Industrial revolution on library staff to a low extent, affected the Ta'al Modern Libraries in Nasarawa State as shown by the respondents. The table also indicated that items 15-20 with mean ranges from 2.59-3.88 to a high extent, positively affect the library staff of Ta'al Modern libraries in Nasarawa State. The table revealed high Standard Deviation values ranging from .77-.87 which showed that the respondents were homogeneous in their responses.

Research Question Three: What 5th industrial revolution challenges are encountered by staff of Ta'al Model Libraries in Nasarawa State?
To answer this research question, data on the challenges encountered on the 5th industrial revolution by staff of Ta'al Model Libraries in Nasarawa State were collected and analyzed as presented on table 3

Table 3: Mean and Standard Deviation of theChallenges faced by the 5th Industrial Revolution in Ta'al Model Library in Nasarawa State by the Library Staff

Table 2: Effects of Artificial Intelligence

S/N	Items Statement	Mean	Std. Dev	Remark
13	AI-powered search engines: improve search results and relevance	2.15	.77	Low Extent
14	Professional development: libraries can develop new skills to work effectively with 5IF technologies	2.21	.80	Low Extent
15	24/7 support: AI -powered chat -bots provide round-the-clock assistance	2.61	.83	High Extent
16	New services and programs: 5IF enable libraries to offer new services and programs, such as AI - powered research assistance	2.59	.81	High Extent
17	Improved efficiency: AI automate routine tasks, freeing up staff to focus on more complex activities	2.80	.80	High Extent
18	Content discovery: 5IF helps users discovered new resources and topics	3.21	.84	High Extent
19	Integration with emerging technologies: 5IF will likely be integrated with other technologies, such as blockchain and IoT	3.25	.80	High Extent
20	**Grand Mean**	**2.68**	**.56**	**High Extent**

Results in table 2 shows that, items 13 and 14 with mean values of 2.15 and 2.21 respectively on effect of the 5th Industrial revolution on library staff to a low extent, affected the Ta'al Modern Libraries in Nasarawa State as shown by the respondents. The table also indicated that items 15-20 with mean ranges from 2.59-3.88 to a high extent, positively affect the library staff of Ta'al Modern libraries in Nasarawa State. The table revealed high Standard Deviation values ranging from .77-.87 which showed that the respondents were homogeneous in their responses.

Research Question Three: What 5th industrial revolution challenges are encountered by staff of Ta'al Model Libraries in Nasarawa State?
To answer this research question, data on the challenges encountered on the 5th industrial revolution by staff of Ta'al Model Libraries in Nasarawa State were collected and analyzed as presented on table 3

Table 3: Mean and Standard Deviation of theChallenges faced by the 5th Industrial Revolution in Ta'al Model Library in Nasarawa State by the Library Staff

S/N	Items Statement	Mean	Std. Dev	Remark
21	Information overload: The 5IR may lead to an information overload, making it challenging for users to find relevant and reliable information.	3.01	.79	High Extent
22	Digital transformation: Adapting to new technologies and digital formats	3.32	.91	High Extent
23	Changing user needs: Meeting the evolving needs of users in a rapidly changing environment	3.41	.83	High Extent
24	Copyright and ownership: The 5IR may raise new questions about copyright and ownership, particularly in the context of digital content and AI-generated works	3.59	.81	High Extent
25	Digital divide: The 5IF may exacerbate existing digital divides, where some users have access to advanced technologies while others do not.	3.21	.82	High Extent
26	Job displacement: 5IF technologies like automation and AI may displace some library jobs, particularly those that can be integrated into library collections	3.25	.82	High Extent
27	Preserving digital heritage: Ensuring the long - term preservation of digital materials	3.00	.83	High Extent
28	Instability in price of gadgets: 5IF gadgets are high intensive that can be purchase with much money.	3.11	.78	High Extent
	Grand Mean	**3.24**	**.82**	**High Extent**

Results in table 5 shows that all the eight (8) items on the challenges faced by the 5th industrial revolution in Ta'al Model Library in Nasarawa State by the library staff to a high extent positively affects the management of public libraries in Nasarawa State as perceived by the respondents with Mean score ranges between 3.00-3.59 which are above the benchmark of 2.50. The table also revealed high Standard Deviation values ranging from .78-.91 which showed that the respondents were homogeneous in their responses. The grand mean of all the items was revealed to be 3.24 and SD= .82.

Research Question Four: What strategies can be used to advert the challenges posed by the 5th industrial revolution on staff of Ta'al Model Library in Nasarawa State by the library staff?
To answer this research question, data on the strategies to be used in adverting the challenges posed by 5th industrial revolution in Ta'al Model Library in Nasarawa State?

Table 4: Mean and Standard Deviation of theStrategies to be used in adverting the challenges posed by the 5th Industrial Revolution in Ta'al Model Library in Nasarawa State by the Library Staff

S/N	Items Statement	Mean	Std. Dev	Remark
1	Developing digital literacy: Providing training and support for users to develop digital skills	3.21	.90	High Extent

2	Curating digital collection: Selecting, preserving and providing access to digital materials	3.33	.83	High Extent
3	Fostering collaboration: Partnering with other libraries, institutions, and industries to share resources and expertise	3.19	.85	High Extent
4	Staying adaptable: Continuously monitoring and responding and responding to changes in the information landscape	3.25	.80	High Extent
5	Preserving digital heritage: Developing strategies for long -term preservation of digital materials	3.27	.94	High Extent
6	Digital scholarship: Supporting digital scholarship and research through services and resources	3.11	.80	High Extent
7	User engagement: Fostering user engagement and participation library services	3.28	.85	High Extent
	Grand Mean	**3.23**	**.86**	**High Extent**

Results in table 4 shows that all the seven (7) items on the strategies to be used in adverting the challenges posed by 5th industrial revolution in Ta'al Model Library in Nasarawa State by the library staff to a high extent positively affects the management of public libraries in Nasarawa State as perceived by the respondents with Mean score ranges between 3.11-3.33 which are above the benchmark of 2.50. The table also revealed high Standard Deviation values ranging from .80-.94 which showed that the respondents were homogeneous in their responses. The grand mean of all the items was revealed to be 3.23 and SD= .86.

Hypothesis One: Benefits of the 5th industrial revolution has no significant impact on the library staff in Ta'al Modern Library.

1. **Table 5: Chi-Square Test on the benefits of the 5th industrial revolution on staff of Ta'al Model Library in Nasarawa State.**

	Df		Sig	Alpha Level	Remark
Pearson Chi-Square	29	129.231	.000	.05	Significant
Number of Valid Cases		98			

P<.05

Table 5 shows the Chi-square calculated value of 129.231, degree of freedom df=29 and a sig (P-value=0.00) which is less than the alpha value (α=.05). Since P<.05, the result is significant, therefore the null hypothesis is rejected. This implied that, the 5th Industrial Revolution in Ta'al Modern Libraries of Nasarawa State, has positive significant benefits on library staff.

Discussion of Findings

It is revealed in the findings that Digital transformation: "Libraries can leverage 5IR technologies like AI Internet of Things (IoT) to enhanced digital services, improve resources discovery and increase accessibility" has the highest mean score of 3.35 on the benefits of the 5th Industrial Revolution on the library staff of Ta'al Modern Library in Nasarawa State. On the effects of the 5th Industrial Revolution on the

library staff of Ta'al Modern Library in Nasarawa State, "Integration with emerging technologies: 5IF will likely be integrated with other technologies, such as blockchain and IoT" score the highest mean of 3.25. Consequently, on the challenges of the 5th Industrial Revolution on the library staff of Ta'al Modern Library in Nasarawa State, the item on Copyright and ownership: The 5IR may raise new questions about copyright and ownership, particularly in the context of digital content and AI-generated works has the highest mean score of 3.59 while on the strategies to be used in adverting the challenges faced by the 5th Industrial Revolution on the library staff of Ta'al Modern Library in Nasarawa State is indicate with a mean score of 3.33 with this item "Curating digital collection: Selecting, preserving and providing access to digital materials". This is supported by Jha (2023) who pointed out that, there are still challenges in adapting to new technologies such as the 5th Industrial Revolution and their wearable devices, and library users' expectations have also changed because of technology

Further findings from the study revealed that, most libraries now focus on electronic resources and use technology like the 5th Industrial Revolution self-service machines, online databases, and mobile devices (Bagavathi 2023).

Conclusion and Recommendations

The study critically explored the 5th Industrial Revolution and the future of public libraries in Nigeria. The study also revealed the challenges that are faced by the 5th Industrial Revolution by the library staff. It is on this background that the following recommendations were put forward:

1. Libraries should totally embraced the implementation of the 5th Industrial Revolution in developing it services which are gears towards library profession in exploring its benefits for the future of public libraries.
2. To this end, the study recommends, among other things, that the 5th Industrial Revolution powered services should be embraced in all libraries in Nigeria irrespective of their status.
3. In addition to improved operational efficiency: The integration of 5th Industrial Revolution and automation can streamline library operations, allowing librarians to focus on more critical tasks and services.
4. The libraries should focus on the human centered technology applications that connect people with things that would eventually lead to IR 5.0.

References

Adeleke, R. T. (2023)."Personal Protection of Privacy in the Information Age." Library Philosophy and Practice: 1–15. https://www.proquest.com/openview/01879486fd5f5db90604161469aca324/1?pqorigsite=gscholar&cbl=54903 (accessed May 22, 2024). Aithal, P. S., and P. M. Kumar. 2016. "Innovations in Private Universities: A Case of Srinivas University." International Journal of Management, IT and Engineering 6 (1): 250–64. https://papers.ssrn.com/sol3/papers. cfm?abstract_id=2779173 (accessed May 22, 2024)

Ajani, Y. A., A. Tella, K. Y. Salawu, and F. Abdullahi. 2022. "Perspectives of Librarians on Awareness and Readiness of Academic Libraries to Integrate Artificial Intelligence for Library Operations and Services in Nigeria." Internet Reference Services Quarterly 26 (4): 213–30. https://doi.org/10.1080/10875301.2022.2086196.

Ajani, Y. A., R. T. Enakrire, B. D. Oladokun, and M. T. Bashorun. 2023. "Reincarnation of Libraries via Metaverse: A Pathway for a Sustainable Knowledge System in the Digital Age." Business Information Review 40 (4): 191–7. https://doi.org/10.1177/02663821231208044.

Ajani, Y. A., A. Tella, and R. T. Enakrire. 2024a."The Green Library Revolution: A Catalyst for Climate Change Action." Collection and Curation 43 (2): 60–7. https://doi.org/10.1108/CC-10-2023-0032.

Ajani, Y. A., A. O. Ahmed, and R. B. Muhammed. 2024b. "The Illusion of Reality in the Gaming World: Implications for Libraries."Library Hi Tech News 41 (2): 1–5. https://doi.org/10.1108/LHTN-06-2023-0099.

Ajani, Y. A., E. K. Adefila, S. A. Olarongbe, R. T. Enakrire, and N. Rabiu. 2024c. "Big Data and the Management of Libraries in the Era of the Fourth Industrial Revolution: Implications for Policymakers." Digital Library Perspectives 40 (2): 311–29. https://doi.org/10.1108/DLP-10-2023-0083.

Arici, H. E., N. Cakmakoglu Arıcı, and L. Altinay. 2023. "The Use of Big Data Analytics to Discover Customers' Perceptions of and Satisfaction with Green Hotel Service Quality." Current Issues in Tourism 26 (2): 270–88. https://doi.org/10.1080/13683500.2022.2029832.

Atif, S., S. Ahmed, M. Wasim, B. Zeb, Z. Pervez, and L. Quinn. 2021."Towards a Conceptual Development of Industry 4.0, Servitisation, and Circular Economy: A Systematic Literature Review." Sustainability 13 (11): 6501. https://doi.org/10.3390/su13116501.

Azizi, S., G. Nair, R. Rabiee, and T. Olofsson. 2020."Application of Internet of Things in Academic Buildings for Space Use Efficiency Using Occupancy and Booking Data." Building and Environment 186: 107355. https://doi.org/10.1016/j.buildenv.2020.107355.
Babu, C. S., and S. Das. 2023."Impact of Blockchain Technology on the Stock Market." In Revolutionizing Financial Services and Markets through FinTech and Blockchain, 44–59. Hershey, Pennsylvania: IGI Global.
Bagavathi, A. 2023. "Emerging Trends and Impact of Internet of Things in Academic Libraries." Library of Progress-Library Science, Information Technology & Computer 43 (1). https://doi.org/10.48165/bpas.2023.43. 1.1.
Balaska, V., Z. Adamidou, Z. Vryzas, and A. Gasteratos. 2023. "Sustainable Crop Protection via Robotics and Artificial Intelligence Solutions." Machines 11 (8): 774. https://doi.org/10.3390/machines11080774.
Bareh, C. K. 2022."Privacy Policy Analysis for Compliance and Readability of Library Vendors in India." The Serials Librarian 83 (2): 148–65. https:// doi.org/10.1080/0361526X.2022.2143467.
Berman, E. M., J. S. Bowman, J. P. West, and M. R. Van Wart. 2021. Human Resource Management in Public Service: Paradoxes, Processes, and Problems. Washington, D.C.: C Q Press. https://scholarship.miami.edu/ esploro/outputs/book/Human-resource-management-in-publicservice/991031716757702976 (accessed May 11, 2024).
Budhwar, P., S. Chowdhury, G. Wood, H. Aguinis, G.J. Bamber, J.R. Beltran, A. Varma, et al. 2023. "Human Resource Management in the Age of Generative Artificial Intelligence: Perspectives and Research Directions on ChatGPT." Human Resource Management Journal 33 (3): 606–59. https://doi.org/10.1111/1748-8583.12524.
Carrión, C. 2023. "Research Streams and Open Challenges in the Metaverse." The Journal of Supercomputing 80 (2): 1–42. https://doi. org/10.1007/s11227-023-05544-1.
Chytis, E., T. Kitsantas, and A. Vazakidis. 2019. "A Review of Blockchain Technology and Its Applications in the Business Environment." In International Conference on Enterprise, Systems, Accounting, Logistics & Management. https://www.researchgate.net/profile/EvangelosChytis/publication/334615432_A_Review_of_Blockchain_Technology_ and_Its_Applications_in_the_Business_Environment/links/5d96ff6492851c2f70e842a4/A-Review-of-Blockchain-Technologyand-Its-Applications- in-the-Business-Environment.pdf (accessed May 22, 2024).
Doğan, S., and İ. Z. Niyet. 2024. "Artificial Intelligence (AI) in Tourism." In Future Tourism Trends Volume 2: Technology Advancement, Trends and Innovations for the Future in Tourism, 3–21. Emerald Publishing Limited.
Doğaray, A. 2023. "Library as a Third Space." Master's Thesis, Abdullah Gül Üniversitesi. Fen Bilimleri Enstitüsü. http://openaccess.agu.edu.tr: 8080/xmlui/handle/20.500.12573/1805 (accessed May 22, 2024).
Dou, F., J. Ye, G. Yuan, Q. Lu, W. Niu, H. Sun, and W. Song. 2023. "Towards Artificial General Intelligence (AGI) in the Internet of Things (IoT): Opportunities and Challenges." arXiv preprint arXiv: 2309.07438. https://doi.org/10.48550/arXiv.2309.07438.
Enakrire, R. T., and B. D. Oladokun. 2023. "Artificial Intelligence as an Enabler of Future Library Services: How Prepared are Librarians in African University Libraries." Library Hi Tech News 41 (3): 1–5. https:// doi.org/10.1108/LHTN-09-2023-0173.
Farid, G., N. F. Warraich, and S. Iftikhar. 2023. "Digital Information Security Management Policy in Academic Libraries: A Systematic Review (2010–2022)." Journal of Information Science. https://doi.org/10.1177/ 01655515231160026.
Gaitanou, P., I. Andreou, M. A. Sicilia, and E. Garoufallou. 2024."Linked Data for Libraries: Creating a Global Knowledge Space, a Systematic Literature Review." Journal of Information Science 50 (1): 204–44. https://doi.org/10.1177/01655515221084645.
Green, A. 2023. "Academic Library Employees and Their Work Modality Options and Preferences." The Journal of Academic Librarianship 49 (5): 102764. https://doi.org/10.1016/j.acalib.2023.102764.
Greene, D., and M. Groenendyk. 2021. "An Environmental Scan of Virtual and Augmented Reality Services in Academic Libraries."Library Hi Tech 39 (1): 37–47. https://doi.org/10.1108/LHT-08-2019-0166.
Gul, S., and S. Bano. 2019. "Smart Libraries: An Emerging and Innovative Technological Habitat of 21st Century." The Electronic Library 37 (5): 764–83. https://doi.org/10.1108/EL-02-2019-0052.
Gupta, V., and C. Gupta. 2023. "Leveraging AI Technologies in Libraries through Experimentation-Driven Frameworks." Internet Reference Services Quarterly 27 (4): 211–22. https://doi.org/10.1080/10875301. 2023.2240773.

The 5th Industrial Revolution and the Role of Artificial Intelligence in Academic Libraries: A Review

By

[1]Yakubu Attahiru Liman, PhD [2]Jika, Saidu Muhammad PhD [3] Muhammad Modibbo Umar [4]Umar Shuaibu [5] Olusegun Victor Olaogun

Federal College of Education (Technical), Keana, Nasarawa State +2348061531042, yakubuattahiruliman@gmail.com[234] Department of Library and Information Science, Gombe State University modibbogombe@gmail.com 08070725039 babanfarukdazainab@gmail.commsaidujika@gmail.com[5]**Federal College of Complementary and Alternative Medicine of Nigeria, Federal Capital Territory, Abuja** shegevic@yahoo.com **Cell: 1+2348030422597,**

Abstract

The purpose of this paper is to examine the 5th industrial revolution and the role of Artificial Intelligence (AI) in Academic Libraries. The paper is a reflective piece examining 5th industrial revolution and advancement in the context of artificial intelligence in Academic Libraries. The paper argued that despite that the 5th industrial revolution has brought easy access of using digital technology services to connect cyber, virtual and physical space in advancing information service delivery in libraries. Various studies indicated that artificial intelligence is contributing significantly to global information provision and dissemination. The paper indicated that *the 5th industrial revolution and the role of artificial Intelligence (AI) has brought about significant transformation in the way academic libraries manage and provide access to information. Literature reviewed indicated that Artificial Intelligence (AI) is one of the emerging trends and applications of computing in academic libraries. The paper also focuses on the advantages of Artificial Intelligence which enhance information services delivery. Artificial Intelligence also improves library operations and services and upgrades and heightens the relevance of academic libraries in an ever-changing digital society. The paper concluded that despite the advancements brought by the 5th industrial revolution, challenges such as privacy concerns and algorithmic biases were still pertinent in AI which must be addressed to ensure responsible AI implementation. The paper suggested that there is need for academic libraries from developing countries especially Nigeria to* ***strengthened and priorities for*** *AI* ***to enhance research output in the delivery of information***

Keywords: *Artificial Intelligence, Digital Technologies, Internet of Things, Chatbots, Digital Preservation, Academic Libraries*

Introduction

The 5th Industrial revolution is making a remarkable strives with the role of digital technologies which currently influenced contemporary societies in all sectors of life; be it social, political, governance and economic development. Today, the 5th Industrial revolution has become pervasive, as it cuts across every government agency, organizations and professional bodies (UNESCO, 2024). The 5th Industrial Revolution and the role of Artificial Intelligence are currently transforming the global world. This is because the advent of artificial intelligence has revolutionized the way services are delivered for communication, information generation, access and dissemination.

The 5th Industrial revolution is characterized by digital revolutions and innovations. The 5th industrial revolution is connecting cyber, virtual and physical space with advancement in digital technology which has made communication, collaboration, information flow and work easier. For example, self-driving cars, online shopping and drone delivery services are digital technology systems that continue to solve some of the world's biggest problems faster with fewer errors and better results (Wani, & Bhat, 2023). The 5th industrial revolution also reflect and guide our way of life and thinking towards digital technology development for advancement in collection and processing of huge amount of information at an alarming rate (Okunlaya, Syed, Abdullah, & Alias, 2022).

Digital technologies such as robotic technology, artificial intelligence, cloud computing, big data, social media, smart phones, digital cameras, sensors and Internet of Things are contributing significantly in global information provision and dissemination (Anumula, Anumula, Anumula, & Damerla, 2024). The emergence of 5th Industrial revolution has opened opportunities for individuals, organizations, corporate bodies and nations to develop knowledge and competencies in artificial intelligence (Senthilkumar, Jagajeevan, & Sangeetha, 2024). For instance, in order for individuals and corporate institutions to exploit the 5th industrial revolution to its fullest potential, knowledge of Artificial Intelligence is fundamental.

Globally,Artificial Intelligence (AI)is dominating research and academic discussions in recent time. Its integration has extended across numerous fields, professions, and countries. Notably, sectors like agriculture, industrialization, economy, information technology, medicine, education, military, and business, along with nations such as the United States, the United Kingdom, the European Union, and China, are at the forefront of AI integration. Despite the critical role of Artificial Intelligence (AI) across the world, literature shows disparities between the developed and the developing countries (United Nations, 2023). While developed countries like Britain, the United States of America, Canada, France and Germany have harnessed the integration of Artificial Intelligence to foster development, developing countries like

Morocco, Liberia, South Sudan and Malawi still find it difficult to progress into a technology-driven environment, global economy and knowledge-based society (UNESCO, 2024). The benefits of AI are widely recognized, including enhanced efficiency, increased productivity, improved customer services, informed decision-making, personalized experiences, and reduced risks and errors (Owolabi et al., 2022; Oyetola et al., 2023).

Academic libraries, though slower in integrating AI, are gradually catching up (Oladokun et al., 2023).Academic libraries are pivotal contributors to the academic success of higher education, fostering intellectual growth, facilitating research endeavors, creativity, life-long learning and enhancing overall excellence by providing a diverse range of information resources and promoting information literacy (Hotsonyame 2023). Academic libraries serve as indispensable technological hubs that cater for the students, lecturers, researchers and other members' academic community for advancement in scholarship and educational excellence (Rodrigues & Mandrekar 2020). The global evolution of technological advancements has significantly reshaped and revolutionized various sectors, including academia. The integration of artificial intelligence (AI) technology into the educational landscape has elicited both commendation for its streamlining of traditional processes and criticism for its limitations (Gillespie et al. 2023). Over the years, academic libraries, mirroring other sectors, have undergone substantial transformations, transitioning from manual operations to embracing cutting-edge technologies to enhance library utilization and streamline service access. Notable advancements include the transition from traditional card catalogues to Online Public Access Catalogues (OPAC), simplifying information retrieval and eliminating the need for exhaustive manual searches (Eserada & Okolo 2019). Additionally, the accessibility of library services has significantly improved, enabling remote subject assistance without physical presence (Adetayo 2023). These technological strides have been instrumental in fostering improved library utilization, particularly pertinent in the context of the fourth and fifth industrial revolutions (Oke & Fernandes 2020). Despite proactive integration, particularly of AI, by academic libraries to reshape information service delivery and enhance paradigm shift, there remains an observable gap in comprehensive implementation (Wheatley & Hervieux 2019; Farag, Mahfouz & Alhajri 2021). While AI is being harnessed to leverage big data and data analytics for operational and service-oriented purposes, bridging this implementation gap remains crucial to fully exploit these technological advancements (Garoufallou & Gaitanou 2021; Luca, Narayan & Cox 2022). However, despite the acknowledged necessity and potential of Artificial Intelligence (AI), gaps still exist in the realization of AI in academic libraries in developing countries (Farag et al. 2021).

The idea of integrating AI into libraries has existed since at least 1985, but interest has surged in the last five years (Huang, Cox, & Cox, 2023). According to Li, Jiao, Zhang, and Xu (2019) in their report on the IFLA (International Federation of Library Associations and Institutions) 2017 Trend Report, AI's primary implications for libraries include speech recognition and machine translation for real-time multilingual support, complex identification of cloud services for web content, and next-generation browsers that go beyond simple keyword searches to incorporate semantic analysis. There is also significant potential for AI in academic libraries to improve user experiences, streamline operations, and enhance access to information in innovative ways (Nehra & Bansode, 2024). Presently, numerous studies explore AI in academic libraries, focusing on AI-based services, benefits, and challenges (Aslim, Arif, Rafiq, & Ahmad, 2023), strategies for AI adoption (Huang, Cox, & Cox, 2023), and the readiness of academic libraries to integrate AI into operations and services (Ajani, Tella, Salawu, & Ajani, 2022). Studies also examine librarians 'perceptions of AI technologies (Hervieux & Wheatley, 2021) and attitudes towards AI (Andrews, Ward, & Yoon, 2021). Consequently, a thorough investigation into these opportunities and challenges is necessary. The findings and baseline insights from this study can guide academic libraries in their efforts to adopt and implement AI technologies. Additionally, this analysis provides valuable knowledge and data for governments, higher institution administrations, library managers, practitioners, and AI developers to better understand the current state of AIintegration in academic libraries within the context of Nigeria.

Statement of the Problem

The 5th industrial revolution is characterized by digital transformation and innovations to advance research output in academic libraries worldwide (Oyetola et al., 2023). However, the inability for the academic libraries in developing countries to play to critical role with the use of Artificial Intelligence (AI) to deliver quality information service delivery is still a challenge (Owolabi et al., 2022). The central argument in various studies indicated that inability of artificial intelligence to transform digital content and services for effective library services as a result of lack of technical know-how to integrate artificial intelligence and lack of adequate funding to develop or procure artificial intelligence systems. (Yusuf, Adebayo, Bello & Kayode, 2022;Tella, 2023).**The argument also noted that** poor budgetary provisions to acquire digital hardware and software, high system development and maintenance cost of artificial intelligence systems , erratic power supply to power artificial intelligence, inherent complexities of expert/artificial intelligence systems' development, limited natural language capabilities and poor intelligent systems(Oyetola, Oladokun, Maxwell & Akor, 2023).**The question is, does academic libraries in Nigeria have the require artificial intelligence technologies to transform the services of libraries for effective quality information delivery? It is against this background the paper intends to** exploreintegration of artificial intelligence in academic libraries to bridge the prevailing information provision gaps in teaching, learning and research needs of the users.

Theoretical Perspectives

The objective of a theoretical framework in any study is to define a broad framework within which a researcher may work. The framework also enhances clarity of the research and helps the researcher to get through the research faster. There are numerous theories related to the diffusion, gratification, implementation, and adoption of information and communication technology (ICT) systems. These frameworks have been widely employed by scholars to explain how technology spreads across societies and how individuals, organizations, and communities respond to its adoption. Among these, the Technology Acceptance Model (TAM), developed by Davis (1989), remains the most popular and frequently cited. TAM is designed to predict and explain individual behavioral intentions to accept or reject the use of information technology, with its core constructs being perceived usefulness and perceived ease of use. Due to its broad applicability and reliability, TAM has been validated and extended through various studies, resulting in several derivatives over time. Other notable theories of behavioral intention include Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA), which links beliefs, attitudes, norms, intentions, and behaviors, as well as Ajzen's (1991) Theory of Planned Behavior, which emphasizes cognitive self-regulation. Venkatesh et al.'s (2003) Unified Theory of Acceptance and Use of Technology (UTAUT) also plays a key role in explaining user intentions toward ICT adoption, focusing on constructs such as performance expectancy, effort expectancy, social influence, and facilitating conditions. UTAUT is further moderated by variables like gender, age, experience, and voluntariness. In terms of organizational and community adoption of technology, Roger's Diffusion of Innovation (DOI) Theory (1983) is one of the most widely used models. DOI explains how communication channels and opinion leaders influence the spread of new technologies and ideas at both individual and organizational levels. Other key theories include the Technology-Organization-Environment (TOE) framework by Tornatzky and Fleischer (1990), the Institutional Theory by Scott and Christensen (1996) and Scott (2001), **Concern Based Adoption Model (CBAM) by Fuller (1969) and Technology Readiness Index (TRI) by Parasuraman (2000)** as well as the model by Lacovou et al. (1995), among others. Previous research has often combined these theories with other frameworks to better understand technology adoption in organizations. Given that artificial intelligence (AI) is being adopted across various professions, communities, and countries, **in this study, Diffusion of Information (DOI) propounded by Rogers (1996) was be adopted as a guide. The comprehensiveness of the DOI compared to other theories and models has allowed researchers to comprehend how innovations diffuse among sets of people from different dimensions.** it is clear that integration of AI in academic libraries in Nigeria would be better understood from multiple perspectives, incorporating insights from theory, practice, and scholarly discourse to provide a holistic understanding of the phenomenon.

Methodology

This paper used literature review as methodology. The purpose of adopting literature review is to convey to the readers the knowledge and ideas that have been established, gaps identified as well as strengths and weaknesses of previous studies. The literature review according to Jacobs and Walker (2014) is to show the readers the extent of previous studies and the connection of current and to fill the gap between previous and current studies. The use of literature review is to illustrate how the topic under investigation was previously studied as well as identify the gaps in previous research discover and articulate relationships (similarities and contradictions) between previous research and the current study (Creswell 2014). Therefore, this paper identified relevant literature on the 5th industrial revolution and the role of Artificial Intelligence in academic libraries with the view to closing gaps identified by the literature for effective information service delivery.

Literature Review

The Concept Artificial Intelligence in Academic Libraries

Despite the growing scholarly interest in the integration AI across various fields, professions, and occupations, perspectives on its implementation still vary among academics, governments, and communities (Kelly, Kaye, & Oviedo-Trespalacios, 2023). As with many complex, interdisciplinary, and multidimensional applied concepts, there is no universally accepted definition of "artificial intelligence." However, as Collins, Dennehy, Conboy, and Mikalef (2021) pointed out, this lack of consensus is not necessarily problematic. That said, efforts to provide a general definition of AI have been made by scholars and within reference works. For instance, the Online Dictionary of Library and Information Science (ODLIS) (2002) defines AI as "mechanical and electronic devices and applications designed to closely mimic the human ability to learn, reason, and make decisions," noting its use in voice recognition, expert systems, natural language processing, and robotics. AI also refers to the development of computer systems capable of performing tasks that typically require human intelligence, such as learning, reasoning, problem- solving, and understanding natural language. In the context of academic libraries, AI technologies are being leveraged to address longstanding challenges and to unlock new opportunities for libraries to deliver more personalized, efficient, and responsive services to their users (Ajani, Tella, Salawu, & Ajani, 2022). Various scholars have attempted to clarify the concept of AI. For example, Kelly, Kaye, and Oviedo-Trespalacios (2023) proposed a synthesized definition in their systematic review on AI acceptance, describing it as "an unnatural object or entity that possesses the ability and capacity to meet or exceed the

requirements of the task it is assigned when considering cultural and demographic circumstances." The interpretation and application of AI in academic libraries, however, have only recently begun to gain attention. Kramer (2022), referencing Hervieux and Wheatley (2022) in their book The Rise of AI: Implications and Applications of Artificial Intelligence in Academic Libraries, defines AI as "the development of machines to accomplish tasks and reproduce thought processes that are normally seen in humans; this simulation of intelligent behavior is distinct from other forms of automation because it requires the computer to use human reasoning or thinking to perform tasks" (p. 70). Within the field of library and information science, Asemi and Asemi (2018) define AI as the use of computers and their associated products and services to perform various tasks and deliver services within libraries. Integration of artificial intelligence in library system encompasses descriptive cataloguing, subject indexing, reference services, technical services, collection development, information retrieval system, and information management and information service delivery. These have gone beyond Natural Language Processing (NLP), and knowledge-based services. With the advancement in artificial intelligence programming, creating a smart library is not only a possibility but a matter of time. However, many academic libraries in Nigeria are still lagging behind in integrating Artificial Intelligence (AI) to provides library services due to poor facilities, poor knowledge and competencies and poor digital skills

The 5th Industrial Revolution and Role of Artificial Intelligence (AI) in Academic Libraries

The 5thindustrial revolution has brought significant transformation with AI in academic libraries to addresses effectiveness of information resource, improves information retrieval, streamlines knowledge organization, personalizes user services, thereby significantly improving library services (Barsha & Munshi 2023). With the advancement in Artificial Intelligence (AI) academic libraries have not demonstrated interaction and communication, exchange ideas and knowledge via email, teleconferencing and chatting to advance information service delivery. However, evidence from literature indicated that not all academic librarians have knowledge of digital competencies to make effective use of digital resources and other related technologies to provide

The justified that artificial intelligence played an important role in assisting academic libraries to develop new thinking and creativity toward digital technologies to support academic activities to achieve functional research, interactions and learning process (Ali, Naeem & Bhatti 2020). However, many academic libraries in developing countries especially in Nigeria still find it difficult to transform digital technologies to advance the library services to meet the dynamic and fast changing information needs of the users **(**Kaushal & Yadav 2022**).**

The 5thindustrial revolution is contributing to ease societal problems with fast and ease. Artificial intelligence is desirable and currently contributing significantly in global information provision and dissemination as well as changing the information landscape in our society. Wider access: AI can meet simultaneous access requests for a document by easily creating multiple instances or copies of the requested document. It can also meet the requirements of a larger population of users easily. Improved information sharing through the appropriate metadata and information exchange protocols, the digital libraries can easily share information with other similar digital libraries and provide enhanced access to users.

The diverse capabilities of AI, ranging from natural language processing to classifying books to enriching metadata, are redefining traditional library operations (Cox & Mazumdar 2022). By using modern technologies such as natural language processing and machine learning algorithms to automate the indexing and accurate classification of library collections, AI also enables the creation of customized recommendation systems that significantly improve the discoverability and accessibility of resources for library patrons (Suryawanshi 2024). The impact of AI goes beyond mere automation; it frees librarians from mundane tasks, as chatbots serve as a simple platform to reach out to target users such as students and researchers and can help them access the library's databases, allowing librarians to focus on more complex tasks (Aithal & Aithal 2023). By using AI systems based on radio frequency identification (RFID), libraries optimize the location of resources and work intelligently, enabling autonomous functions (Chhetri & Thakur 2019; Okunlaya, Syed Abdullah & Alias 2022). For users, AI simplifies the search for relevant research materials by using generative AI to streamline search procedures and save valuable time (IFLA 2023a). Librarians are freed from repetitive tasks and can spend their time getting to know and serve their clientele better (Chakarova & Trabert 2017) Innovation through AI extends further, transforming library operations such as self-checkout systems and enabling 24- hour services (IFLA 2023b). The tireless nature of AI systems ensures continuous library operation, freeing librarians from round-the-clock responsibilities (Omame & Alex-Nmecha 2020). AI-driven virtual reference assistants like Pixel or chatbots constructed using Hypertext Pre-processor (PHP) prove instrumental in delivering consistent and efficient 24/7 services, catering for users' need for instant and personalised information (Gujral, Shivarama & Choukimath 2019; Omame & Alex- Nmecha 2020). Libraries in developed countries, such as the University of Oklahoma Library in North America, Monash University Library in Australia, and San Jose State University Library in North America, are already successfully using these AI chatbots (De Sarkar 2023). However, in developing countries such as India, there are obstacles such as a lack of financial support and infrastructure that hinder the adoption of chatbots in libraries (Kaushal & Yadav 2022).

In an era characterised by information overload, the role of AI in academic libraries becomes indispensable (Hussain 2023). AI technology's ability to analyze extensive metadata associated with scientific collections

elevates indexing, reference services and information retrieval (Allal 2022). Ultimately, the integration of AI not only ensures accessibility and availability of library resources, but also equips library staff to adeptly navigate and harness AI's capabilities to address user inquiries (Abayomi et al. 2021)

Application of Artificial Intelligences in Academic Libraries in the Era of 5th Industrial Revolution

Artificial Intelligence (AI) holds immense potential to transform academic libraries by offering innovative solutions for information management, user engagement, and operational efficiency. Ajikaye (2022) provided the artificial intelligence applications in academic libraries as follows

1. ***Digital Preservation:*** AI assists in digital preservation efforts by automating processes like content identification, OCR (optical character recognition), and content restoration. This ensures the long-term accessibility and integrity of digital collections.
2. ***Virtual Assistants and Chatbots:*** academic libraries are deploying Al-driven virtual assistants and chatbots to provide instant support to users, answer reference inquiries, assist with circulation services, and offer _serialized recommendations based on user preferences.
3. ***User Analytics and Personalization:*** AI technologies analyze user data to gain insights into user behavior and preferences. This information is then used to personalize services, recommend relevant resources, and enhance overall user satisfaction.
4. ***Information Retrieval:*** academic libraries use artificial intelligence to provide powered search engines and utilize machine learning algorithms to improve the accuracy and relevance of search results. These systems can understand user intent, analyze patterns in search behavior, and adapt over time to deliver more precise information retrieval experiences.
5. ***Cataloging and Metadata Management:*** AI automates cataloging processes by automatically assigning metadata tags, classifications, and keywords to digital resources. This streamlines the organization of library collections and ensures consistency in metadata standards for easy, effective and efficient information search strategy.
6. ***Automation of Routine Tasks:*** AI automates repetitive tasks such as inventory management, interlibrary loan processing, and collection maintenance. By freeing up staff from mundane tasks, libraries can optimize resource allocation and focus on more strategic initiatives.

The Benefits of Artificial Intelligence in Academic Libraries

Artificial intelligence is installed in machines or computers to reduce human casualties in wars, hazardous work environments, car accidents, plane crash, fire explosion or disasters as a result of human error. Furthermore, artificial intelligence facilitates human work with greater speed, efficiency and effectiveness in work environments such as the library. According to Anumula, Anumula, Anumula and Damerla (2024), artificial intelligence and expert systems are used in classification, cataloging and indexing of library materials. Via the use of optical character recognition and neural network, the system is able to obtain the bibliographic records of books and classify them accordingly. Thus artificial intelligence holds great potentials for library and information service.

The benefits of artificial intelligence in academic libraries as summarized by Asim, Arif, Rafiq and Ahmad (2023) are as follows:

1. ***Improved Efficiency***: AI streamlines workflows, reduces manual effort, and optimizes resource allocation, leading to improved operational efficiency within libraries. According to Ex Libris (2019), artificial intelligence in libraries can make research more discoverable which can boost research productivity among faculty members,
2. ***Bridge in Time:*** Round the clock accessibility to information resources and services just in time.
3. ***Bridge in Space:*** The space occupied by piles of books, journals, bound newspapers and other information materials has been reduced by the introduction of digitization, electronic copies and use of robotic cranes that stores and retrieve books from a compact off-site storage location.
4. ***Maximization of Efficiency:*** This refers to efficiency in library operations: selection and acquisition of materials, technical services, circulation services, references services, serial management etc.
5. ***Enhanced User Experience:*** AI-driven personalized services enhance user satisfaction by delivering tailored recommendations and responsive support.
6. ***Data-Driven Decision Making:*** AI analytics provide valuable insights into user needs and behaviors, enabling libraries to make informed decisions about resource acquisition and service improvements.
7. ***Maximization of effectiveness***: AI enhances effectiveness in form of improves services delivery and elimination of human errors in library operations.
8. ***Minimization of Effort***: The effort expended by librarians in technical services, circulation services, references services, serial management etc, can been minimized by the use of artificial intelligence systems in libraries. 7. Enhanced and immersive user experience in library services delivery.
9. ***Innovation and Adaptation:*** AI fosters innovation in LIS by enabling libraries to adopt emerging technologies and respond effectively to changing information demands. AI-powered information retrieval refers to the use of Artificial Intelligence (AI) technologies to enhance the process of accessing and retrieving information from vast collections of data, particularly within the context of academic library

Challenges of Integrating Artificial Intelligence (AI) in Academic Libraries in 5th Industrial Revolution

The literature reveals the major challenges as follows:

1. Lack of technical know-how to use and operate artificial intelligence systems among the library staff.
2. Lack of adequate funding to develop or procure artificial intelligence systems in libraries. Since the budgets for hardware and software are frequently tight, there's always constrain to the type of system the library can purchase or develop.
3. High system development and maintenance cost of artificial intelligence systems in libraries. 4. Erratic power supply to power artificial intelligence systems in libraries especially in developing countries.
5. Inherent complexities of expert/artificial intelligence systems' development.
6. Limited natural language capabilities.
7. Intelligent systems lack that common base of human knowledge, severely constraining the types of functions that they can perform.
8. Level of effort and technical expertise needed to create artificial intelligence systems in libraries. The level and nature of effort that must be invested to develop an intelligent library system is directly proportional to the power and complexity of the system. This implies that, the more intelligent the system is, the more the effort that must be invested therein. Currently, the required skilled personnel with expensive development tools or techniques, needed to develop sophisticated intelligent system in libraries is lacking or costly, hence, the lack of such systems in libraries.
9. Limited amount of artificial intelligence experts among library automation vendors. The field of artificial intelligence is complex and thus, requires a specialized knowledge in that aspect far beyond the development of conventional library automation systems.

Consequently, this will require hiring new personnel in that area before any significant, widespread work can be done in the area of artificial intelligence systems in libraries.

Opportunities for Artificial Intelligence (AI) in academic libraries

The integration of AI within library system is crucial for increased efficiency in library services. In the contemporary era, academic libraries are positioned to educate library users about modern technologies, ensuring users are well-informed about new technologies and conducting regular orientation programmes to foster appreciation and utilization of these technologies (Kaushal & Yadav 2022; Srikanth & Kumar 2023). Embracing this responsibility by stakeholders enhances effective integration of AI in libraries. While budget considerations are vital for sustaining resources and services, the cost presents a significant obstacle to AI integration in libraries (Lo 2023; Srikanth & Kumar 2023). The pursuit of enhanced technology, services and user experiences necessitates libraries to seek additional funding, prompting the need for strategic investments (Onwueme & Nyemezu 2017). Practical solutions for developing countries to implement AI in library services include partnerships and infrastructure investments (Barsha & Munshi 2023). To address this financial challenge, libraries can explore diverse funding opportunities, such as technology grants and establishing partnerships with technology companies. Collaborative endeavors of this nature may present the prospect of reduced or cost-free access to AI tools in exchange for data sharing and cooperation (Lo 2023). Ajani et al. (2022) advocate that funding should ideally originate from government sources or the parent institutions of academic libraries, to prevent the misallocation of funds. Moreover, the integration of alternative power sources incorporating green technology concepts is essential to enhance AI integration and library usage. Library management plays a pivotal role in ensuring a consistent power supply using alternative sources such as solar energy and generators (Owolabi et al. 2022). Ajani et al. (2022) highlight the challenges developing countries face related to technologies such as electricity supply and recommend that academic libraries tackle this issue by deploying alternative power generation systems like solar energy and biofuels. By collectively addressing challenges associated with AI implementation, such as finance, power and training, there would be a substantial increase in its overall efficacy within academic libraries.

Conclusion

The paper review literature on the 5th industrial revolution and the role of artificial intelligence in academic libraries. Literature identified that AI provides improves relevant research materials**, enhance** search strategy, promote streamline search procedures and save valuable time with AI in academic libraries.The 5th industrial revolution and the role of AI in academic libraries is a revolutionary change that is redefining the landscape of library services with unprecedented levels of efficiency. This adoption holds immense potential to improve accessibility, accuracy, and personalized user experience. However, the realization of these promising prospects faces significant challenges; especially in underdeveloped countries where infrastructure, financial resources, expertise, and constant power supply are limited, posing major obstacles to the implementation of AI. To advance the integration of AI into academic library services, a comprehensive approach that considers both the potential and the obstacles is essential. Addressing these challenges requires a concerted effort to bridge the technology gap and ensure that libraries in developing countries are not left behind. Strategic alliances and partnerships between libraries, technology experts, policy makers and funding agencies can serve as a catalyst for progress. Crucially, the focus should be on knowledge sharing and capacity-building initiatives to equip library professionals with the skills they need to use AI effectively. In addition, developing adaptable and scalable AI models tailored to different resource

environments is critical to promoting inclusivity and equitable access to technological advances. By fostering a collaborative ecosystem and prioritizing adaptable strategies, the integration of AI into academic libraries becomes an achievable reality that enriches global scholarly work and ensures equitable access to transformative technological innovations in libraries worldwide.

The Way Forward

Based on the gaps established from the literature review, the following suggestions on the way forward were made:

1. There is need for academic librariesfrom developing countries especially Nigeria to **strengthened and priorities for**AI **to enhance research output in the delivery of information**
2. **There is also the need for academic libraries to improve on the AI to enhance search strategy** to transform library services as well as widen coverage of AI in effective information service delivery
3. There is need for academic libraries in Nigeria to strategize in the integration of AI to mitigate the challenges of digital transformation and innovations

References

Ajakaye, J. E. (2022). Applications of Artificial Intelligence (AI) in Libraries. In I. Ekoja, E. Ogbomo, & O. Okuonghae (Eds.), Handbook of Research on Emerging Trends and Technologies in Librarianship (pp. 73-90). IGI Global. https://doi.org/10.4018/978-1-7998-9094-2.ch006

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullah, F. (2022). Perspectives of librarians on awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services. Internet Reference Services Quarterly, DOI: 10.1080/10875301.2022.2086196

Alekseeva, L., Azar, J., Giné, M., Samila, S., & Taska, B. (2021). The demand for AI skills in the labor market. Labour Economics, 71:102002.

Allal, M. (2022). Artificial intelligence as a support for librarians who buy scientific documents: what factor do they take into account? Journal of Positive School Psychology, 6(5): 8765-8782.

Andrews, E., Ward, H., & Yoon, J. W. (2021). UTAUT as a model for understanding intention to adopt AI and related technologies among librarians. The Journal of academic Librarianship, 47(6), 102437.

Anumula, V. R. B., Anumula, K. R. V. S. S., Anumula, M., and Damerla, S. (2024). Artificial Intelligence Using Library Information Science Professionals. International Journal of Progressive Research in Engineering Management and Science, 4(1), 591-594. https://www.ijprems.com/uploadedfiles/paper/issue_1_january_2024/32611/final/fin_ijprems1706806420.pdf

Asemi, A., & Asemi, A. (2018). Artificial intelligence (AI) application in library systems in Iran: a taxonomy study. Library Philosophy and Practice (e-journal), 1840. https://digitalcommons.unl.edu/libphilprac/1840

Asim, M., Arif, M., Rafiq, M., and Ahmad, R. (2023). Investigating applications of Artificial Intelligence in university libraries of Pakistan: An empirical study. The Journal of Academic Librarianship, 49(6), 102803. https://doi.org/10.1016/j.acalib.2023.102803

Aslim, M., Arif, M., Rafiq, M., & Ahmad, R. (2023). Investigation application of artificial intelligence in University Libraries of Pakistan: An empirical study. The Journal of academic Librarianship, 48(6), 102803.

Balasubramanian, S., and Tamilselvan, N. (2023). Exploring the Potential of Artificial Intelligence in Library Services: A Systematic Review. International Journal of Library & Information Science (IJLIS), 12(1), 1-13. https://doi.org/10.17605/OSF.IO/S9RWD

Banerjee, M. S. (2022). Application, advantage, and disadvantage of artificial intelligence in library services. International Journal of Creative Research and Thoughts, 10(11): 723-729.

Barsha, S. and Munshi, S. A. (2023). Implementing artificial intelligence in library services: a review of current prospects and challenges of developing countries. Library Hi Tech News, 41(1): 7-10.

Barsha, S., & Munshi, S. A. (2023). Implementing artificial intelligence in library services: A review of current prospects and challenges of developing countries. Library Hi Tech News, 41(1), 7-10.

Borges, A. F. S., Laurindo, F. J. B., Spinola, M. M., Goncalves, R. F., & Mattos, C. A. (2021). The strategic use of artificial intelligence in the digital age: Systematic literature review and future research directions. International Journal of Information Management, 57:102225.

Chakarova, J. and Trabert, J. (2017). I–robot, to help you–librarian. [Online] https://library.ifla.org/id/eprint/2699/1/s08-2019- chakarova-en.pdf (21 September 2023).

Chen, J., Sun, J. and Wang, G. (2022). From unmanned systems to autonomous intelligent systems. Engineering, 12: 16- 19.

Chhetri, M. and Thakur, R. S. (2019). Implementation of RFID technology in libraries: a case study in UPES library. Library Philosophy and Practice, 2344. [Online] https://digitalcommons.unl.edu/libphilprac/2344/ (17 September 2023).

Collins, C., Denney, D., Conboy, K., & Mikalef, P. (2021). Artificial intelligence in information system research: A systematic literature review and research agenda. International Journal of Information Management, 60:102388.

Cox, A.M. and Mazumdar, S. (2022). Defining artificial intelligence for librarians. Journal of Librarianship

and Information Science, 00(0): 1-11.
Dorhetso, S.N. and Quarshie, B D. (2023). Ratings of driving factors for the adoption and implementation of artificial intelligence in the public sector. Open Access Library Journal, 10(5): 1-20.
Echedom, A.U. and Okuonghae, O. (2021). Transforming academic library operations in Africa with artificial intelligence: opportunities and challenges: a review paper. New Review of Academic Librarianship, 27(2): 243-255.
Eiriemiokhale, K. A., & Sulyman, A. S. (2023). Awareness and perceptions of artificial intelligence among librarians of university libraries in Kwara State, Nigeria. Indonesian Journal of Librarianship, 4(2), 107-118.
Emiri, O.T. (2023). Adoption and utilization of artificial intelligence by librarians in university libraries in southern Nigeria. Library Philosophy and Practice, 1-16.
Eserada, R.E. and Okolo, S.E. (2019). Use of online public access catalogue (Opac) in selected university libraries in South- South Nigeria. Library Philosophy and Practice, May: 1-23.
Farag, H.A., Mahfouz, S.N. and Alhajri, S. (2021). Artificial intelligence investing in academic libraries: reality and challenges. Library Philosophy and Practice, 1-34.
Garoufallou, E. and Gaitanou, P. (2021). Big data: opportunities and challenges in libraries, a systematic literature review. College & Research Libraries, 82(3): 410-435.
Gillespie, N., Lockey, S., Curtis, C., Pool, J. and Akbari, A. (2023). Trust in artificial intelligence: a global study. [Online]. https://assets.kpmg.com/content/dam/kpmg/au/pdf/2023/trust-in-ai-global-insights-2023.pdf (21 November 2023).
Gujral, G., Shivarama, J. and Choukimath, P.A. (2019). Perceptions and prospects of artificial intelligence technologies for academic libraries: an overview of global trends. 12th International CALIBER, 79-88.
Gupta, N. and Mangla, R. (2020). Artificial intelligence basics: a self-teaching introduction. Dulles, Virginia: Mercury Learning & Information. Gupta, V. and Gupta, C. 2023. Leveraging AI technologies in libraries through experimentation-driven frameworks. Internet Reference Services Quarterly, 27(4): 1-12.
Haque, A. (2023). Re: what is the goal of artificial intelligence? [Online] https://www.researchgate.net/post/What_is_the_goal_of_artificial_intelligence/644ef5ca5dd69ca7e5075a39/citation/d ownload (3 July 2023).
Hotsonyame, G.N. (2023). Significance of academic libraries in recent times: a review of articles. Library Philosophy and Practice, 7736. [Online]. https://www.researchgate.net/profile/George-Hotsonyame (3 October 2023).
Hussain, A. (2023). Use of artificial intelligence in the library services: prospects and challenges. Library Hi Tech News, 40(2): 15-17.
IFLA. (2020). IFLA statement on libraries and artificial intelligence. [Online] https://www.ifla.org/wp-content/uploads/2019/05/assets/faife/ifla_statement_ on_libraries_and_artificial_intelligence.pdf (20 September 2023).
IFLA. (2023a). ChatGPT in libraries? a discussion. Available: https://blogs.ifla.org/cpdwl/2023/05/14/chatgpt-in-libraries-a- discussion/ (Accessed 12 July 2023). IFLA. 2023b. Innovations are opportunities. [Online] https://www.ifla.org/news/innovations-are-opportunities/ (13 July 2023).
Jha, S. K. (2023). Application of artificial intelligence in libraries and information centers service: Prospects and challenges. Library Hi Tech New, 40(7), 1-5. https://doi.org/10.1108/LHTN.06-2023-0102.
Kaushal, V. and Yadav, R. (2022). The role of chatbots in academic libraries: an experience-based perspective. Journal of the Australian Library and Information Association, 71(3): 215-232.
Kelly, S., Kaye, S., & Oviedo-Trespalacios, O. (2023). What factors contribute to the acceptance of artificial intelligence? A systematic review. Telematics and Informatics, 77:101927.
Kim, B. (2020). Moving forward with digital disruption: what big data, IoT, synthetic biology, AI, blockchain, and platform businesses mean to libraries. Library Technology Report, 56(2): 5-32. Liao, Y., Loures, E.R., Deschamps, F., Brezinski, G. and Venâncio, A. 2018. The impact of the fourth industrial revolution: a cross-country/region comparison. Production, 28: p.e20180061.
Kramer, W. (2022). Review of the rise of AI: Implications and applications of artificial intelligence in academic libraries. Journal of New Librarianship, 7(2), 69-71. https://doi.org/10.33011/newlibs/12/12
Kumar, A. (2023). Empowering library system with AI: A roadmap of AI in Indian Academic libraries system. International Journal of Research Trends and Innovation, 8(10), 702-706.
Livberber, T., & Ayvaz, S. (2023). The impact of artificial intelligence in the academia: Views of Turkish academics on ChatGPT. Heliyon, 9:e19688
Lo, L.S. (2023). An initial interpretation of the US Department of Education's AI report: Implications and recommendations for academic libraries. The Journal of Academic Librarianship, 49(5): 102761.
Lowe, A. and Lawless, S. (2021). Artificial intelligence foundations: learning from experience. Newbridge Square: BCS Learning & Development Limited.
Luca, E., Narayan, B. and Cox, A. (2022). Artificial intelligence and robots for the library and information

professions. Journal of the Australian Library and Information Association, 71(3): 185-188.
Lund, B. D., & Wang, T. (2023). Chatting about ChatGPT: How may AI impact academia and libraries?
Marr, B. (2019). Artificial intelligence in practice: how 50 successful companies used AI and machine learning to solve problems. Chichester, West Sussex: John Wiley & Sons.
Mende, M., Grewal, D. & Parasuraman, A. (2022). The Fifth Industrial Revolution: how harmonious human– machine collaboration is triggering a retail and service [r] evolution. Journal of Retailing, 98: 199-208.
Mikalef, P., Islam, N., Parida, V., Singh, H., & Altwaijry, N. (2023). Artificial intelligence (AI) competencies for organizational performance: A B2B marketing capabilities perspective. Journal of Business Research, 164:113998.
Misau, A.Y. (2021). Application of artificial intelligence in academic libraries in Nigeria. Library Philosophy and Practice, 1-6. [Online] https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=12669&context=libphilprac/1000 (6 August 2023).
Mökander, J., Sheth, M., Watson, D.S. and Floridi, L. (2023). The switch, the ladder, and the matrix: models for classifying AI systems. Minds and Machines, 33(1): 221-248. Noble, S.M.,
Moorehouse, B. L., Yeo, M. A., & Wan, Y. (2023). Generative AI tools and assessment: Guidelines of the world's top-ranking universities. Computers and Education Open, 5:100151.
Nehra, S. S., & Bansode, S. Y. (2024). Exploring the Prospects and Perils of Integrating Artificial Intelligence and ChatGPT in Academic and Research Libraries (ARL): Challenges and Opportunity. Journal of Web Librarianship, 1-22.
Ogar, C.E. and Dushu, T.Y. (2018). Transforming library and information services delivery using innovation technologies. Library Philosophy and Practice, 2036.
Oke, A. and Fernandes, F.A.P. (2020). Innovations in teaching and learning: exploring the perceptions of the education sector on the 4th industrial revolution (4IR). Journal of Open Innovation: Technology, Market and Complexity, 6(2): 1-22.
Okunlaya, R.O., Syed Abdullah, N. and Alias, R.A. (2022). Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. Library Hi Tech, 40(6): 1869-1892.
Oladokun, B. D., Owolabi, A. K., Aboyade, M. A., Wiche, H. I., & Aboyade, W. A. (2023). Emergence of robotic technologies: implications for Nigerian academic libraries. Library Hi Tech News, 40(6), 15-18.
Omame, I.M. and Alex-Nmecha, J.C. (2020). Artificial intelligence in libraries. In Osuigwe, N.E. (ed.). Managing and adapting library information services for future users. Hershey, PA: IGI Global: 120-144.
Onwueme, G.A. and Nyemezu, C.O. (2017). Mentoring in academic librarianship: a necessity for unearthing tomorrow library leaders. In Tella, A. and Quadri, R.F. (eds.) Emotional intelligence and leadership in Nigeria library and information science. Nigerian Library Association: 43-50.
Owolabi, K. A., Okorie, N. C., Yemi-Peters, O. E., Oyetola, S. O., Bello, T. O., & Oladokun, B. D. (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. Library management, 43(3/4), 296-305.
Owolabi, K., Abayomi, A. O., Aderibigbe, N., Kemdi, O.M., Oluwaseun, O.A. and Okorie, C. (2022). Awareness and readiness of Nigerian polytechnic students towards adopting artificial intelligence in libraries. Journal of Information and Knowledge, 59(1): 15-24.
Oyetola, S.O., Oladokun, B.D., Maxwell, C.E. and Akor, S.O. (2023). Artificial intelligence in the library: gauging the potential application and implications for contemporary library services in Nigeria. Data & Metadata, 2(36): 1-6.
Srikanth, G. and Kumar, R. P. (2023). Utilization of library services in academic libraries through applications of artificial intelligence: an overview. International Journal of Advance and Applied Research, 10(3): 258-264.
Tella, A. (2023). Adoption of a quadratic usage framework for predicting blockchain use intention from the perspective of librarians in Southwest Nigerian universities. Journal of Librarianship and Information Science, Article ID: 1-18. [Online] https://doi.org/10.1177/09610006231173690 (17 January 2024)
Yusuf, T.I., Adebayo, O.A., Bello, L.A. and Kayode, J.O. (2022). Adoption of artificial intelligence for effective library service delivery in academic libraries in Nigeria. Library Philosophy and Practice, 6804.
Zhao, D., Zhang, W., Zhao, D. and Zhang, W. (2021). Opportunities, risks and breakdowns brought by AI to commercial banks. Artificial Financial Intelligence in China, 89-115.

The Future of Information Literacy: Preparing Users for the Challenges of the 5th Industrial Revolution

Gift Ihunanya Nwosu (CLN)
The College Library
Rivers State College of Health Science and Management Technology,
Oro-Owo, Rumueme, Port-Harcourt, Nigeria
giftnwosu.ozjn@gmail.com; nwosugift@rschst.edu.ng
and

Eberechi Ejuh
Department of Library and Information Science, Faculty of Education,
Rivers State University, Nporlu, Port-Harcourt, Nigeria
eberechi.ejuh@ust.edu.ng

Abstract

This study explores the future of information literacy, focusing on preparing users to meet the challenges of the 5th Industrial Revolution. A descriptive survey was adopted. The study populations were librarians, educators, students, and information professionals from public and academic libraries in Rivers State. A sample of 100 respondents which comprised of 10 librarians, 10 educators, 70 students, and 10 information professionals were selected using purposive sampling technique. Questionnaire was used for gathering quantitative data on participants' information literacy levels and perceptions of future challenges. The instrument was face validated by 3 experts and Cronbach Alpha was used to test the reliability which yielded a coefficient value of 0.78. The researchers employed the help of two research assistants in distributing and collecting the data. Data collected from the study were analyzed using mean scores. The findings reveal that information literacy remains a cornerstone for adapting to technological changes but is hindered by challenges such as digital inequality, the rapid evolution of AI, and a lack of interdisciplinary skill integration. Innovative strategies such as adaptive learning platforms, gamification, and AI-driven personalized education emerged as viable solutions. This study underscores the urgency of embedding advanced information literacy frameworks into curricula and professional development programs. It recommends that libraries should adopt smart technologies, such as AI-driven tools, to facilitate personalized learning experiences for users towards adapting a culture of lifelong learning and adaptability.

Keywords*: Information Literacy, 5th Industrial Revolution, Lifelong Learning, AI Integration*

INTRODUCTION

The 5th Industrial Revolution (5IR) is rapidly transforming the way information is accessed, used, and disseminated. This era, characterized by the convergence of human intelligence and advanced technologies like artificial intelligence (AI), big data, and the Internet of Things (IoT), presents both opportunities and challenges for information literacy (Mamabolo & Durodolu, 2025). As societies become increasingly reliant on digital information, the ability to effectively navigate, evaluate, and utilize this information is becoming more critical than ever. E-libraries, with their vast digital resources and potential to leverage 5IR technologies, play a crucial role in equipping individuals with the necessary information literacy skills to thrive in this evolving landscape. The development of these skills is essential for fostering informed decision-making, promoting lifelong learning, and ensuring equitable access to the benefits of the information age.

E-libraries are uniquely positioned to address the information literacy demands of the 5IR. Unlike traditional libraries, they offer 24/7 access to a wide range of digital resources, transcending geographical barriers and physical limitations. According to Lawal (2017), this accessibility is particularly important in developing countries, where disparities in access to information resources are often more pronounced. By leveraging 5IR technologies, e-libraries can enhance their services, offering personalized information retrieval, AI-powered research assistance, and immersive learning experiences (Agim, Abah & Ezejiofor, 2025). These advancements can empower individuals and communities, enabling them to participate more fully in the knowledge society and contribute to sustainable development. The focus is shifting from simply accessing information to effectively and ethically using it in a technology-driven world.

However, the 5IR also brings forth significant challenges to information literacy. According to Apriliyanti and Ilham (2022), the proliferation of misinformation, disinformation, and fake news, amplified by social media and AI-driven algorithms, makes it increasingly difficult for individuals to discern credible sources

from unreliable ones. The rapid pace of technological change requires users to continuously update their skills and adapt to new information formats and platforms. Moreover, the digital divide persists, with many individuals lacking access to the technology and digital literacy skills needed to effectively navigate the digital world (Azmar, 2018). E-libraries must address these challenges by providing targeted information literacy instruction that equips users with the critical thinking, evaluation, and digital skills necessary to thrive in the 5IR. The need to address these challenges gave rise to the motivation for this study which examined the future of information literacy: Preparing users for the challenges of the 5th industrial revolution

STATEMENT OF THE PROBLEM

Despite the crucial role of information literacy in the 5IR and the potential of e-libraries to address this need, several challenges hinder the effective preparation of users. A significant deficiency exists in the widespread implementation of comprehensive information literacy programs that keep pace with the rapid advancements in technology. Many individuals lack the critical skills necessary to evaluate the credibility and reliability of online information, making them vulnerable to misinformation and manipulation. Furthermore, there is a gap in understanding how to effectively integrate emerging technologies like AI into information literacy instruction. Research is needed to explore innovative pedagogical approaches and best practices for teaching information literacy in the 5IR, and to assess the impact of these approaches on user learning and behavior. This research therefore explores the future of information literacy towards preparing users for the challenges of the 5th industrial revolution

PURPOSE OF THE STUDY

The main purpose of this study is to investigate the future of information literacy: Preparing users for the challenges of the 5th industrial revolution. The specific objectives include to:

1. Examine the relevance of information literacy to the library users in the context of the 5th Industrial Revolution.
2. Identify innovative strategies for enhancing information literacy skills of library users to meet future demands
3. Analyze the emerging challenges posed by the 5th Industrial Revolution to users' information literacy and preparedness
4. Propose actionable frameworks for integrating advanced information literacy practices into educational and professional settings of the future users.

LITERATURE REVIEW

Conceptualize Information Literacy in the Digital Age

Information literacy in the digital age is no longer confined to the traditional skills of locating and accessing information; it has evolved into a multifaceted concept encompassing a range of abilities and dispositions necessary to navigate the complex information landscape of the 21st century. In this era, characterized by the proliferation of digital technologies and the exponential growth of online information, individuals must possess the skills to not only find information but also to critically evaluate its credibility, relevance, and purpose (Obiekwe & Agim, 2021). This includes the ability to discern misinformation, disinformation, and propaganda, which are increasingly prevalent in the digital sphere. Moreover, information literacy in the digital age involves the ethical use of information, including understanding issues related to copyright, plagiarism, and intellectual property.

The development of information literacy is crucial for effective participation in today's digital society. As technology continues to advance, individuals are constantly faced with new tools and platforms for accessing and sharing information. Information literacy empowers individuals to become informed and engaged citizens, enabling them to make sound decisions, participate in democratic processes, and contribute to knowledge creation (Abdulrahman, Ape & Egbe, 2019). It is also essential for lifelong learning, as individuals need to continually update their skills and knowledge to adapt to the changing information environment. Therefore, information literacy is not a one-time skill but an ongoing process of learning and adaptation that equips individuals to thrive in the digital age.

Understanding the 5th Industrial Revolution

The 5th Industrial Revolution (5IR) represents a paradigm shift where the focus moves beyond mere technological advancement to prioritize human-centered innovation alongside machine efficiency. Unlike the 4th Industrial Revolution (4IR), which emphasized automation, AI, and digital integration, the 5IR seeks to harmonize technology with human empathy, ethics, creativity, and well-being (Oladokun, Ayinde & Enakrire, 2024). Technologies such as Artificial Intelligence (AI), Blockchain, Internet of Things (IoT), and robotics continue to evolve but are increasingly being tailored to address broader societal needs rather than just economic efficiency (Nwobu, Dumbiri, Ibia & Oladokun, 2024). In this context, the 5IR promotes collaboration between humans and intelligent systems, fostering inclusiveness, sustainability, and personal empowerment. Moreover, industries including education, healthcare, and library services are witnessing

transformations where technological solutions are designed to enhance, not replace human capabilities (Adjei, 2023). Understanding the 5IR thus requires not only recognizing the convergence of emerging technologies but also appreciating how these tools can be aligned with humanistic goals for global development, including equitable access to information and lifelong learning.

In relation to information literacy, the 5th Industrial Revolution redefines the skills users need to thrive. Beyond basic digital proficiency, users must now develop competencies in critical thinking, data analysis, ethical reasoning, and adaptive learning to effectively engage with AI-driven and automated information systems (Lawal, 2017). The role of empathy, cultural sensitivity, and ethical data use becomes central as users interact with increasingly complex and personalized digital environments. As highlighted by Apriliyanti and Ilham (2022), technologies of the 5IR demand a symbiotic relationship where human creativity guides machine learning processes, ensuring that technological growth does not exacerbate inequalities but supports sustainable and inclusive development. Diverse forms of instructional assistive technologies that helps people with disabilities accomplish tasks which would have been naturally difficult or impossible should be integrated for special needs category of users as a boost to inclusive education (Nwosu, 2025). Therefore, the relationship between technology and human-centered values defines the essence of the 5IR, emphasizing that future literacy efforts must prepare users not just for navigating information systems but for critically and ethically shaping them. This shift has significant implications for how libraries, educational institutions, and governments design policies and programs that foster resilient, informed citizens equipped for the challenges and opportunities of the emerging era.

Changing Information Landscapes in the 5th Industrial Revolution

The 5th Industrial Revolution is reshaping the information landscape by creating a more interconnected, intelligent, and human-centered environment for knowledge production and dissemination. Unlike the data-driven focus of the 4th Industrial Revolution, the new era emphasizes the ethical, emotional, and contextual dimensions of information sharing (Mamabolo & Durodolu, 2025). With the integration of Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, and Extended Reality (XR), information is no longer static; it is dynamic, real-time, and tailored to individual users' needs (Kaushik & Kumar, 2013). Moreover, users now navigate ecosystems where machines and humans collaborate to create, curate, and validate information. This transformation challenges traditional notions of information authenticity, authority, and literacy, requiring individuals to critically engage with an overwhelming influx of personalized, algorithm-driven content. Consequently, the emerging information landscapes demand that users possess not only technical search skills but also heightened critical awareness and ethical sensitivity to navigate biases, misinformation, and privacy issues effectively.

Furthermore, the decentralization of information sources is a defining feature of the 5IR landscape. Technologies like blockchain promote transparency and peer-to-peer information verification, shifting power away from traditional gatekeepers such as libraries, publishers, and academic institutions (Majidah, 2018). However, while decentralization democratizes access, it also complicates information governance, authenticity, and accountability. As pointed out by Azmar (2018), the "infosphere" is expanding, merging virtual and physical realities and fundamentally altering how information is created, perceived, and controlled. The relationship between humans and information is thus becoming increasingly participatory and co-evolutionary: users are no longer passive recipients but active co-creators in information ecosystems. This shift underscores the urgent need to reframe information literacy curricula to prepare individuals to critically assess, ethically engage with, and creatively use information in diverse, rapidly evolving contexts of the 5IR.

Skills and Competencies Required for Information Literacy in the 5IR Era

The 5th Industrial Revolution (5IR) demands a profound evolution in the skills and competencies associated with information literacy. Traditional abilities such as searching, evaluating, and using information effectively remain important but are no longer sufficient. Instead, users must now integrate advanced digital literacy, critical thinking, data ethics, and emotional intelligence into their information practices (Agim, 2021). The ability to critically assess algorithmic biases, understand data provenance, and engage responsibly with AI-driven information systems is essential in a landscape saturated with both human and machine-generated content. Furthermore, collaboration skills are critical as information work increasingly occurs within human-machine teams, requiring users to understand not only human communication but also how AI systems process and deliver information (Dubicki, 2013). Thus, the 5IR era transforms information literacy from a purely cognitive skill set into a holistic, interdisciplinary competency integrating technical, ethical, and socio-emotional dimensions.

Moreover, information literacy in the 5IR context involves cultivating competencies for lifelong learning, adaptability, and resilience in dynamic digital ecosystems. As emphasized by Khatun (2013), users must be adept at managing information overload, distinguishing credible sources from misinformation, and applying information creatively to solve complex real-world problems. Digital resilience -the ability to recover from digital disruption and adapt to new information technologies - has become a critical component of information literacy (Lawal & Akintunde, 2014). Additionally, ethical reasoning and data

privacy awareness are now fundamental, as users are constantly exposed to AI systems that collect, analyze, and sometimes exploit personal information. Therefore, the relationship between skills development and information literacy in the 5IR is deeply symbiotic: as technological ecosystems evolve, so also is the competencies required to navigate them responsibly and effectively, emphasizing a lifelong commitment to continuous learning and ethical engagements with information technologies.

Challenges to Information Literacy in the 5th Industrial Revolution

One of the significant challenges to information literacy in the 5th Industrial Revolution (5IR) is the overwhelming complexity of emerging technologies and the rapid pace of technological change. Artificial intelligence, blockchain, augmented reality, and other innovations have reshaped information ecosystems, making it increasingly difficult for users to critically evaluate sources and interpret machine-generated content (Azmar, 2018). Moreover, the prevalence of misinformation, deepfakes, and algorithmically curated information bubbles exacerbates the difficulty of discerning credible information from falsehoods (Apriliyanti & Ilham, 2022). Users are now confronted not only with information overload but also with sophisticated disinformation tactics that exploit human cognitive biases. Additionally, disparities in access to digital tools and advanced technologies — often referred to as the "second digital divide" - further widen the gap between information-literate and information-vulnerable populations, particularly in developing regions (Lawal, 2017).

Another major challenge lies in the lack of updated educational frameworks that align with the demands of the 5IR. Many current information literacy programs still emphasize traditional research skills without adequately integrating critical digital literacy, data ethics, and AI literacy (Lawal & Akintunde, 2014). The limited preparedness of educators themselves to teach new literacies compounds this issue, creating a lag in equipping users with the skills needed to navigate complex digital environments. Furthermore, the emotional and psychological impact of interacting with pervasive, personalized information systems—such as the effects of algorithmic surveillance and digital manipulation—poses new ethical and cognitive challenges for information users (Majidah, 2018). These interconnected challenges illustrate that achieving information literacy in the 5IR requires a multidimensional strategy that addresses technological, educational, ethical, and psychological dimensions simultaneously.

METHODOLOGY

A descriptive survey was used to explore the current state of information literacy with deeper insights into emerging challenges and strategies. The study population were librarians, educators, students, and information professionals from public and academic libraries in rivers state. A sample of 100 respondents which comprised of 10 librarians, 10 educators, 70 students, and 10 information professionals were selected using purposive sampling technique. Questionnaire was used for gathering quantitative data on participants' information literacy levels and perceptions of future challenges. The instrument was face validated by 3 experts and Cronbach Alpha was used to test the reliability which yielded a coefficient value of 0.78. The researchers employed the help of two research assistants in distributing and collecting the data. Data collected from the study were analyzed using mean scores

RESULTS

Research question 1: What is the relevance of information literacy to the library users in the context of the 5th Industrial Revolution?

Table 1: Mean and Standard Deviation on the Relevance of Information Literacy to the library Users in the Context of the 5th Industrial Revolution

S/N	Items	Mean (x̄)	SD	Decision
1	Enhances users' ability to evaluate credible information sources	2.85	0.76	Agree
2	Prepares users for responsible use of AI and emerging technologies	3.25	0.68	Strongly Agree
3	Empowers users to manage and protect personal data	2.91	0.72	Agree
4	Supports ethical decision-making in information consumption	3.18	0.65	Strongly Agree
5	Facilitates lifelong learning among users	2.94	0.74	Agree
6	———	2.89	0.70	Agree
7	Equips users to navigate complex information ecosystems	3.12	0.63	Strongly Agree
8	Enhances critical thinking and problem-solving skills	3.33	0.59	Strongly Agree
9	Improves adaptability to technological changes	3.09	0.66	Strongly Agree
	Grand Mean	**3.06**		**Strongly Agree**

The result in Table 1 shows that librarians in academic libraries agreed on several roles of information literacy in the 5th Industrial Revolution, as reflected by the mean scores of items 1, 3, 5, and 6, ranging between 2.50 and 2.99. Specifically, they agreed that information literacy enhances users' ability to evaluate credible sources, empowers users to manage and protect personal data, facilitates lifelong learning, and strengthens digital collaboration. Furthermore, they strongly agreed on the relevance of information literacy in preparing users for responsible use of emerging technologies (Item 2), supporting ethical decision-making (Item 4), equipping users to navigate complex information ecosystems (Item 7), enhancing critical thinking and problem-solving skills (Item 8), and improving adaptability to technological changes (Item 9), all of which had mean scores ranging from 3.00 to 3.49.Overall, the findings suggest that information literacy is highly relevant to the library users in the 5th Industrial Revolution, as evidenced by the grand mean score of 3.06. The results affirm that information literacy plays a critical role not only in managing information but also in preparing users for technological adaptability, ethical reasoning, critical thinking, and lifelong learning-all essential for thriving in a rapidly evolving digital society.

The relevance of information literacy in the 5th Industrial Revolution has been confirmed by several empirical studies. For instance, Agim, Obiekwe & Eneh (2020) observed that information literacy is pivotal in helping users critically assess information and adapt to algorithm-driven environments. Similarly, early integration of digital literacy, including data protection and ethical use of information, significantly prepares users for future challenges posed by AI and IoT. Moreover, Lawal and Akintunde (2014) highlighted that fostering resilience through information literacy enables users to manage technological disruptions more effectively, making critical thinking and ethical reasoning indispensable skills. These studies strongly align with the findings of this study, underscoring the importance of robust information literacy education for library users navigating the complexities of the 5IR era.

Research Question 2: What are the innovative strategies for enhancing information literacy skills of library users to meet future demands?

Table 2: Mean and Standard Deviation on Innovative Strategies for Enhancing Information Literacy Skills of Library Users to Meet Future Demands

S/N	Items	Mean (x̄)	SD	Decision
1	Integration of AI-driven personalized learning tools	3.26	0.61	Strongly Agree
2	Offering modular and micro-credential programs in information literacy	2.92	0.75	Agree
3	Incorporating virtual and augmented reality experiences in information training	3.18	0.67	Strongly Agree
4	Embedding information literacy skills into all academic disciplines	2.85	0.73	Agree
5	Promoting gamification of information literacy instruction	3.12	0.70	Strongly Agree
6	Developing mobile apps for on-the-go information literacy learning	3.04	0.66	Strongly Agree
7	Facilitating peer-to-peer learning workshops for users	2.96	0.71	Agree
8	Creating multidisciplinary collaborations with tech experts	2.89	0.77	Agree
9	Organizing regular hackathons and innovation challenges around information skills	2.91	0.74	Agree
	Grand Mean	**3.02**		**Strongly Agree**

The result in Table 2 shows that librarians in academic libraries agreed on several innovative strategies for enhancing information literacy skills to meet future demands, as reflected by the mean scores of items 2, 4, 7, 8, and 9, which range from 2.50 to 2.99. These strategies include offering modular and micro-credential programs, embedding information literacy into academic disciplines, facilitating peer-to-peer learning workshops, collaborating with tech experts, and organizing hackathons around information skills. Furthermore, they strongly agreed with the integration of AI-driven personalized learning tools (Item 1), the incorporation of VR and AR experiences (Item 3), the promotion of gamified instruction (Item 5), and the development of mobile apps for information literacy learning (Item 6), which had mean scores between 3.00 and 3.49. These results highlight both traditional and emerging approaches to advancing users' skills for the challenges of the 5th Industrial Revolution. Overall, the findings indicate that librarians recognize the need to combine innovative digital solutions with traditional instructional strategies to enhance information literacy for future demands. The grand mean score of 3.02 reflects a general strong agreement toward the adoption of forward-thinking and technology-enhanced learning models to prepare library users for the complexities of the future information landscape.

The importance of innovative strategies for enhancing information literacy skills has been supported by several empirical studies. For instance, Khatun (2013) emphasized the effectiveness of gamification and mobile applications in boosting engagement and information literacy competencies among university students. The growing impact of embedding information literacy across academic disciplines and promoting micro-credential learning is also a way to meet the dynamic needs of future learners. Additionally, Majidah (2018) illustrated that integrating AI-driven personalized tools and VR/AR simulations significantly transforms users' learning experiences, making information literacy more adaptable and accessible in the digital age. These studies align with the present findings, reaffirming the crucial role of innovative, multidisciplinary strategies in future-proofing information literacy education.

Research Question 3: What are the emerging challenges posed by the 5th Industrial Revolution to users' information literacy and preparedness?

Table 3: Mean and Standard Deviation on Emerging Challenges Posed by the 5th Industrial Revolution to Users' Information Literacy and Preparedness

S/N	Items	Mean (x̄)	SD	Decision
1	Rapid technological changes outpacing users' ability to adapt	3.24	0.62	Strongly Agree
2	Increasing complexity of digital tools and platforms	2.91	0.70	Agree
3	Information overload from multiple sources	2.88	0.72	Agree
4	Greater risks of misinformation and disinformation	3.19	0.65	Strongly Agree
5	Limited critical thinking skills among users	2.92	0.74	Agree
6	Difficulty in ethical use and evaluation of AI-generated content	3.08	0.68	Strongly Agree
7	Socioeconomic disparities affecting access to digital resources	2.93	0.76	Agree
8	Privacy and data security concerns affecting users' trust	2.89	0.73	Agree
9	Resistance to lifelong learning culture among users	2.95	0.71	Agree
	Grand Mean	**3.00**		**Strongly Agree**

The result presented in Table 3 reveals that librarians agreed that several emerging challenges affect users' information literacy and preparedness in the 5th Industrial Revolution. Items 2, 3, 5, 7, 8, and 9, which include issues like increasing complexity of digital tools, information overload, limited critical thinking skills, socioeconomic disparities, privacy concerns, and resistance to lifelong learning, all had mean scores between 2.50 and 2.99. In contrast, items 1, 4, and 6, such as rapid technological changes, greater risks of misinformation, and challenges in ethical AI use, were strongly agreed upon with mean scores between 3.00 and 3.49. These findings suggest that both technical and human factors are significant barriers to effective information literacy in the era of the 5IR.The overall findings indicate that while librarians recognize a range of moderate challenges affecting users' information preparedness, they strongly highlight the

overwhelming pace of technological change, the spread of misinformation, and ethical issues around AI content as the most critical concerns. The grand mean of 3.00 reflects a general strong agreement that the 5th Industrial Revolution introduces substantial obstacles that must be urgently addressed to safeguard the future of information literacy education.

Several empirical studies align with these findings. For example, Oladokun, et al (2024) highlighted how rapid technological advancements and information overload complicate users' ability to critically engage with digital information, thus confirming the agreed challenges noted in the table. Similarly, Head et al. (2020) emphasized that misinformation and disinformation significantly erode users' trust and competence in navigating the information landscape, supporting the strong agreement on misinformation risks. Furthermore, Apriliyanti and Ilham (2022) observed that while users are increasingly exposed to advanced technologies like AI, their ability to ethically and critically assess AI-generated content remains inadequate, reinforcing the findings on ethical challenges and technological preparedness. These studies collectively demonstrate the real-world implications of the challenges identified by librarians in academic libraries.

Research question 4: What are the actionable frameworks for integrating advanced information literacy practices into educational and professional settings of the future library users?

Table 4: Mean and Standard Deviation on Actionable Frameworks for Integrating Advanced Information Literacy Practices into Educational and Professional Settings of Future Library Users

S/N	Items	Mean (x̄)	SD	Decision
1	Embedding information literacy across all academic curricula	2.92	0.68	Agree
2	Incorporating artificial intelligence literacy into information literacy programs	3.18	0.65	Strongly Agree
3	Promoting interdisciplinary approaches to information literacy education	3.15	0.63	Strongly Agree
4	Strengthening faculty-librarian partnerships for collaborative teaching	2.85	0.70	Agree
5	Designing problem-based learning modules for real-world information challenges	3.21	0.61	Strongly Agree
6	Establishing continuous professional development in emerging information technologies	2.90	0.66	Agree
7	Developing ethical frameworks for information evaluation and dissemination	3.10	0.64	Strongly Agree
8	Adopting personalized learning pathways for user-centered information literacy	3.07	0.69	Strongly Agree
9	Institutionalizing digital citizenship education for all users	3.13	0.67	Strongly Agree
	Grand Mean	**3.06**		**Strongly Agree**

Table 4 shows that librarians agreed on certain frameworks for integrating advanced information literacy practices into educational and professional settings. Items 1, 4, and 6, which include embedding information literacy across curricula, strengthening faculty-librarian collaborations, and continuous professional development in emerging technologies, were agreed upon with mean scores between 2.50 and 2.99. On the other hand, items 2, 3, 5, 7, 8, and 9, which emphasized AI literacy integration, interdisciplinary approaches, problem-based learning, ethical frameworks, personalized learning, and digital citizenship, were strongly agreed upon with mean scores ranging from 3.00 to 3.49. This interpretation reflects a consensus that while traditional frameworks remain important, future-oriented, innovative strategies must be prioritized to prepare users for evolving information environments. The findings summarized in Table 4 indicate that librarians strongly recognize the urgency of innovative frameworks such as AI integration, ethical practices, and personalized learning in future information literacy education. Although, traditional models such as curriculum embedding and professional development still hold relevance, the trend points towards the need for forward-thinking, adaptive strategies. The grand mean of 3.06 suggests that the population overall leans strongly towards embracing transformative frameworks for future readiness.

Several empirical studies support these results. For instance, Kaushik and Kumar (2013) emphasized the importance of integrating AI and machine learning concepts into information literacy education to align

with future professional and academic requirements, corroborating the strong agreement on AI literacy. Similarly, interdisciplinary teaching models significantly improve critical thinking and adaptability among students, supporting the emphasis on promoting interdisciplinary approaches and problem-based learning. Furthermore, Dubicki (2013) reported that digital citizenship and personalized learning are becoming essential components of information literacy programs to foster user empowerment and responsible digital behavior. These studies confirm that integrating innovative, interdisciplinary, and user-centered frameworks is key to advancing information literacy practices for the future.

CONCLUSION

The study concludes that information literacy is a cornerstone for preparing users to thrive in the 5th Industrial Revolution. As technologies become increasingly integrated into daily life, the ability to locate, evaluate, and ethically use information will become indispensable. Addressing identified challenges through innovative strategies will ensure that users remain adaptable and effective in this evolving landscape.

RECOMMENDATIONS

The following recommendations have been given:

i. Educational institutions should revise curricula to include advanced information literacy training, emphasizing emerging technologies and ethical considerations.
ii. Governments and organizations should invest in capacity-building programs for educators and information professionals to stay abreast of technological advancements.
iii. Libraries should adopt smart technologies, such as AI-driven tools, to facilitate personalized learning experiences for users.
iv. Continuous collaboration between academia, industry, and policymakers is necessary to ensure that information literacy initiatives align with the dynamic demands of the 5th Industrial Revolution

REFERENCES

Abdulrahman, A.B., Ape, R., & Egbe, N.G.E. (2019). Information literacy as a key to sustainable development in Nigeria. *Journal of Library Services and Technologies, 1*(1), 31-37

Adjei, N. D. (2023). The readiness in selected academic libraries towards the fourth industrial revolution: A comparative study between Ghana and South Africa.

Agim, E. C., Abah, A.T. & Ezejiofor, V.O. (2025). Availability and Utilization of AI-Powered Chatbots for Enhanced User Services in Academic Libraries in Anambra State.*Heartbeat Journal of Library and Information Science, 4*(1), 75-88

Agim, E.C. (2021).*Enhancing information literacy for sustainable development in the post Covid 19 era: The roles of librarians*. A paper presented at the Maiden Annual Symposium of the Nigerian Students Association (NISA), Turkey held from 29th to 30th September, 2021

Agim, E.C., Obiekwe, O.L, & Eneh, A.E. (2020) The Informative Roles of Librarians to their Patronsin the Covid-19 lockdown. *International Journal of Social Science and Humanities Reviews (IJSSHR), 10*(2), p.180-186

Apriliyanti, Merlin and M, Ilham, "Challenges of The Industrial Revolution Era 1.0 to 5.0 : University Digital Library In Indoensia" (2022). *Library Philosophy and Practice (e-journal). 6994*. https://digitalcommons.unl.edu/libphilprac/6994

Azmar, NJ. (2018). The future of the library as the industrial revolution develops 4.0: evaluate the role of the librarian. *Journal of Iqra,* 10(01): 35-37.

Dubicki, E. (2013). Faculty perceptions of students' information literacy skills competencies. *Journal of Information Literacy, 7*(2), 97-125.

Kaushik, A. & Kumar, A. (2013). Application of cloud computing in libraries. *International Journal of Information Dissemination and Technology, 3*(4), 270-273.

Khatun, M. (2013). Digital information literacy of Oslo public library professionals. (Masters thesis Oslo and Akershus College of Applied Sciences, Tallinn University, Norway). Retrieved from http://www.tlu.ee/~sirvir/DILL%20MA%20Thesis/Momena%20Khatun.%20Digital%20Information%20Literacy%20of%20the%20Oslo%20Public%20Library%20Professionals.%20MA%20Thesis

Lawal, V., & Akintunde, S. (2014). E-learning and information literacy at the University of Jos. *Library Management, 35*(8/9), 607-628

Lawal, V. (2017) Information Literacy and the Future of Digital Information Services at the University of Jos Library. *Library Philosophy and Practice (e-journal). 1674*. https://digitalcommons.unl.edu/libphilprac/1674

Majidah, T. (2018). Changes in the culture of access to information for librarians and users in the industrial

revolution 4.0, in the proceedings of the open society Conference 2018, 35-46. Downloaded from http://repository.ut.ac.id/7953/1/ocs-2018-3.pdf, 30 January 2019

Mamabolo, M. J. & Durodolu, O. O. (2025). Unlocking the advantages: Exploring the benefits of accessing digital libraries in the Fifth Industrial Revolution era. In S. Thanuskodi (Ed.), *Exploring Digital Metrics in Academic Libraries* (33-52). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-5807-8.ch002

Nwobu, B. K., Dumbiri, R., Ibia, M. J., & Oladokun, B. D., (2024). Libraries in the Fifth Industrial Revolution: Skills and knowledge required in preparing librarians for an uncertain future. In U. C. Udofot et al. (Eds.), *Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria*. (3 – 13). Port Harcourt: Chadick Printing Press

Nwosu, G. I. (2025). Promoting inclusive education for special needs students through adoption of assistive technologies in academic libraries in Nigeria. *Port –Harcourt Journal of Innovations in General Studies (PHAJIGS), 1*(1), 75-84

Obiekwe, O.L, &Agim, E.C., (2021) Enhancing information literacy during the Covid 19 pandemic: the roles of librarian. *International Journal of Library and Information Technology (IJLIT), 1* (1), 53-65

Oladokun, B. D., Ayinde, L., Enakrire, R. T. (2024) The fifth industrial revolution: Information professionals and skills. *Information Matters, 4*, 7. https://informationmatters.org/2024/07/the-fifth-industrial-revolution-information-professionals-andskills/

The Readiness of Libraries and Librarians for the 5th Industrial Revolution in Open and Distance Learning Environments

Smart Eromosele Ambrose
Department of Library and Information Science
Faculty of Education
National Open University of Nigeria, Abuja
esterogy@gmail.com/**sambrose@noun.edu.ng**
Phone 08055426760

Ifeoma Abigail Ajie
Department of Library and Information Science
Faculty of Education
National Open University of Nigeria, Abuja
iajie@noun.edu.ng
Phone 08022220090
Patricia Ngozi Ofodu
Department of Library and Information Science
Faculty of Education
National Open University of Nigeria, Abuja
pofodu@noun.edu.ng
Phone 08083969143

Abstract

The aim of this paper is to investigate the readiness of libraries and librarians for the 5th Industrial Revolution (5IR) within the context of open and distance learning (ODL). The 5th Industrial Revolution (5IR) is expected to revolutionize the educational system, especially in open and distance learning (ODL) environments. This study adopts a systematic approach, utilizing an extensive review of related literature and professional opinions to examine the readiness of libraries and librarians to adapt to the demands of 5IR,emphasizing technological improvements, shifting duties, and institutional preparation. An analytical review of secondary data was conducted using academic databases such as EBSCOhost, ProQuest, and ScienceDirect, focusing on English-language publications between 2017-2024 authored by Nigerian scholars on the 5IR, while excluding non-peer-reviewed materials and works on earlier industrial revolutions.. The key issues include the integration of cutting-edge technology into library services, such as artificial intelligence (AI), machine learning (ML), robots, virtual reality (VR), and augmented reality (AR), as well as the role of human-AI collaboration in the libraries. The review identified and discussed librarians' shifting roles, with a focus on the competences and ongoing professional development required for success in this era. It highlight the importance of infrastructure and intelligent technology for optimizing library operations. Furthermore, it explore building inclusive policies and guidelines in the adoption of AI in libraries, resistance to change in the adoption of AI in libraries, various strategies to guarantee accessibility and inclusion in online learning environments and also tackled challenges like technological limitations, financial constraints, resistance to change, and ethical considerations. The goal of the study is to identify learned lessons and future opportunities through a review of case studies, best practices, at educational institutions, technology vendors, and libraries. It was concluded with recommendations for training initiatives, and strategies for the sustainable and equitable deployment of 5IR technologies. These was given a road map for libraries to better their role in the evolving educational landscape.

Keywords: *5th Industrial Revolution (5IR), Libraries, Librarians, Open and Distance Learning (ODL)*

Introduction

In our rapidly evolving world, the concept of the "5th Industrial Revolution" serves as a guiding force, representing the ongoing and upcoming transformations across various industries and societies. This idea provides a framework for understanding the significant changes unfolding in today's landscape. The 5th Industrial Revolution marks the seamless integration of multiple technological domains (Noble et al., 2022), merging digital technologies such as the Internet of Things (IoT), cloud computing, and advanced big data analytics. It also encompasses innovations like artificial intelligence (AI), biotechnology, nanotechnology, and the vast potential of quantum computing (de Vries & Kroukamp, 2023). These technologies converge and enhance each other, driving unprecedented progress and opening new opportunities. In this revolution, data has emerged as a critical asset, fueling innovation and decision-making. Our interconnected world, filled with countless devices and sensors, generates vast amounts of

data (Sørensen & Lansing, 2023). Advanced AI and sophisticated analytics delve into this data to extract valuable insights, inform decisions, personalize experiences, and foster innovation across various sectors (Dou et al., 2023).

The 5th Industrial Revolution is intricately linked to libraries in the modern era, signaling a significant shift on how knowledge is preserved, created, accessed, and shared. This paradigm change combines advanced digital technologies, the transformative potential of new technologies, and the power of data innovation (Tella & Ajani, 2022). Traditionally seen as guardians of knowledge, libraries now find themselves at the center of a transformative period where their roles and functions must evolve to meet the demands of this digital shift (Tella & Ajani, 2022). The 5th Industrial Revolution adds a new dimension to the library's historical role as a repository of static knowledge, recognizing that information now flows continuously, across both physical and digital platforms. Libraries today are no longer passive protectors of knowledge but are becoming active participants in the knowledge ecosystem, driven by digital technology and AI (Oladokun et al., 2024). This significant transformation calls for libraries to reimagine themselves as dynamic hubs where digital technologies, AI algorithms, and data-driven innovations come together to address the changing needs of users. Essentially, libraries are evolving from static repositories to lively centers of knowledge, reshaping their structures and functions to align with the demands of the 5th Industrial Revolution (Attaran, 2023).

The aim of this study is to review related literature and discuss the Readiness of Libraries and Librarians for the 5th Industrial Revolution in Open and Distance Learning Environments, the key issues of cutting edge-technology in library services, the role of human-AI collaboration in the process of library services, the Importance of Infrastructure and Intelligent Technology for Optimizing Library Operations, Building Inclusive Policies and Guidelines in the Adoption of AI in Libraries, Resistance to change in the adoption of AI in libraries, an overview of the application of 5th IR in libraries, challenges, strategies and recommendations.

Methodology

This study employs a **conceptual and descriptive research design**, grounded in a critical review of existing literature and professional opinions related to the integration of emerging technologies in library services during the 5th Industrial Revolution (5IR), with a particular focus on Open and Distance Learning (ODL) environments. An extensive literature search was conducted using academic databases such as EBSCOHOST, ProQuest, Google scholar and ScienceDirect. The inclusion criteria for selecting sources were: publications written in English, published between 2017-2024, focused specifically on the 5th Industrial Revolution, authored by academic scholars, and peer-reviewed. Studies that were not peer-reviewed or that addressed the 1st, 2nd, 3rd, or 4th Industrial Revolutions were excluded. The study adopts an analytical approach by interpreting and synthesizing secondary data sources to construct arguments, identify emerging trends, highlight challenges and opportunities, and propose strategic recommendations for future practice. The paper ultimately offers an informed perspective on the transformative potential of emerging technologies in reshaping library services within the 5IR era.

Objectives of the study

The study was designed to achieve the following specific objectives and thus to:

1) Examine the potential of emerging technology in enhancing library services.
2) Examine the role of infrastructure and intelligent technology in optimizing library operations
3) Identify the challenges faced by libraries and librarians in Open and Distance Learning environments during the 5th Industrial Revolution.
4) Recommend strategies to guarantee accessibility and inclusion in online learning environment

REVIEW OF RELATED LITERATURE

Artificial Intelligence (AI) as a Technology in Library Services

Artificial Intelligence (AI) is revolutionizing library services by enhancing information retrieval, automating administrative tasks, and improving user experience. Modern libraries are integrating AI-powered technologies such as chatbots, machine learning algorithms, and natural language processing (NLP) to assist users in finding relevant resources efficiently. AI in libraries can improve services and provide patrons with access to trustworthy information, fostering growth and development in this information-driven era. By transforming how academic libraries deliver, organize, and search for information, AI makes their services more efficient and user-friendly (Akinyemi, 2023). AI enhances digital cataloging and metadata management by automating classification and indexing processes, thereby improving search accuracy and accessibility. Through AI-enabled virtual assistants, libraries can provide 24/7 support to users, answering queries and guiding them in research navigation, which significantly enhances user engagement and resource utilization.

Beyond user services, AI is also transforming library operations, making them more efficient and data-driven. Such as automating cataloguing, Libraries, assess user behavior, track borrowing patterns, Personalized recommendation systems, drawing on user behaviour and preferences, deliver tailored suggestions that enhance user engagement and optimize resource allocation Satheesh, et al. (2024). AI-driven plagiarism detection and research integrity tools are assisting librarians and researchers in maintaining academic honesty and credibility. As AI technology continues to evolve, libraries must address challenges such as data privacy, ethical concerns, and the need for continuous staff training to maximize the benefits of AI in library services.

Machine Learning (ML) as a Technology for Library Services

Machine Learning (ML) is transforming library services by enhancing information retrieval, automating cataloguing, and improving user experience through predictive analytics. ML algorithms analyse user behavior, search patterns, and borrowing histories to offer personalized recommendations, similar to how streaming platforms suggest content. As Alam (2025) noted, machine learning (ML) has transformed how libraries manage their extensive collections, streamlining cataloging processes to be more efficient and precise. ML enables the automation of metadata creation, book classification with appropriate numbers, and assignment of subject headings with minimal human involvement, thus cutting down the time and labor typically required for these tasks. Additionally, libraries use ML-powered chatbots and virtual assistants to offer real-time support, answering questions and directing users to relevant resources.

There are obviously many ML-driven operations and enhanced activities in the libraries that can not be over-emphasised.

Robots as a Technology for Library Services

Robots are increasingly being integrated into library services to enhance operational efficiency, automate routine tasks, and improve user engagement. Many academic and public libraries are utilizing robotic technologies for book retrieval, shelving, inventory management, and guiding patrons within library premises. The findings of Indraji, Satishkumar and Dominic (2024) expressed that robotics can help with standard maintenance duties like book retrieval and shelf organizing, freeing up human labour for more intricate and valuable work, by cutting down on wait times and streamline operations, and duties like book shelving, item check-in and check-out, and directing customers to particular sections. Machine learning (ML) can navigate library spaces, assist users in locating books, and even recommend relevant reading materials based on user queries; hence the users provide the right query. These robotic advancements help librarians focus on higher-level tasks such as research support and information literacy training while improving the overall efficiency of library operations.

Beyond physical assistance, robotic automation is also enhancing digital library services. Libraries are adopting robotic process automation (RPA) to streamline administrative tasks such as cataloguing, indexing, and managing interlibrary loans; hence robots are designed to think like humans, it is essential that the keywords used in describing the documents are simple enough for the robots to capture the relevant documents and materials easily (Lanre & Omeiza 2020). Some libraries have implemented robotic book sorters, which utilize barcode scanning and AI algorithms to efficiently organize and transport books to designated shelves.

Virtual Reality (VR) as a Technology for Library Services

Virtual reality (VR) enhances library services by offering immersive learning, virtual spaces, and improved access to cultural heritage. Libraries use VR for interactive education, such as virtual tours, 3D simulations, and STEM-focused learning environments (Lund & Wang (2029). VR also enables virtual library tours, assisting remote users in exploring collections and resources. It also preserves and provides access to rare materials through 3D renderings, ensuring broader accessibility while protecting originals. Moreso, barriers such as high costs, technical expertise requirements, and limited user familiarity pose challenges to VR adoption. Investments in infrastructure and training are essential for effective implementation.

Augmented Reality (AR) as a Technology for Library Services

Augmented reality (AR) is transforming library services by overlaying digital content onto the physical environment, enhancing user engagement and interaction. Libraries leverage AR to improve learning, resource discovery, and accessibility. AR enables libraries to create immersive learning tools, allowing users to interact with virtual content in real-world settings. Agwuna, Ejezie, & Nwankwo (2024) state that AR can significantly enhance information retrieval and Navigation in libraries by providing an interactive, immersive experience that bridges the gap between physical and digital resources.

They later stated that AR has a tracking mechanism comprising sensors and GPS technology that provide spatial awareness and location-based experiences. augmented reality components include display devices

with screens or lenses through which users view the augmented content, ranging from handheld devices to wearable augmented reality glasses. As AR assist for GPS, likewise, it enables library maps guide patrons to specific collections, study rooms, or facilities, enhancing the user experience. It provides virtual overlays of additional information for rare or fragile materials, such as historical manuscripts or artifacts, allowing users to explore enriched content without handling the originals.

Blockchain as a Technology for Library Services

Blockchain technology enhances library services by ensuring secure, transparent, and tamper-proof management of digital rights, transactions, and records. It facilitates digital rights management for e-resources, preventing copyright violations, and provides secure, immutable records. Fasola, Oyadeyi and Iyoro (2024) have it that blockchain technology can help libraries in managing their existing records in a secure framework and digital format, by storing the digital materials there permanently and is impossible to alter or hack, ensuring that these materials are saved for use by future generations and are accessible to anybody who has the required permits.

Blockchain also supports long-term digital preservation by ensuring data authenticity and integrity through decentralized storage. Challenges could come up, which include high costs, technical complexity, and energy demands, which require strategic investment and collaboration for successful implementation. Despite these barriers, blockchain can transform libraries by improving transparency, efficiency, and security.

The role of human-AI collaboration in the process of library services

The integration of Artificial Intelligence (AI) in library services has revolutionized information management, reference services, and user engagement. This review examines the role of AI-driven innovations on service delivery and future research directions. AI applications in library science offer new avenues for information organization, user interaction, and operational efficiency. The review reviews existing literature on AI role in libraries.Hanson and Okorie (2024) explored AI's role in automating library operations, discussing key functions such as virtual assistants, content digitization, and automated cataloging. Their study highlighted that AI enhances efficiency in metadata management, recommendation systems, and decision support. However, ethical concerns such as data privacy and algorithmic bias were also identified. The study emphasized the importance of training programs to equip library professionals with AI literacy skills to navigate these challenges effectively according to them the introduction of AI-powered cataloging and classification systems has streamlined resource organization and retrieval.

Tawalbeh, (2024)) analyzed AI's role in digital archives and found that machine learning algorithms improve metadata accuracy and retrieval efficiency. Similarly, Rahmani, (2023) investigated AI-assisted indexing and classification systems, revealing their effectiveness in handling large volumes of information with minimal human intervention.Libraries worldwide have adopted AI-driven cataloging systems, automated metadata generation, and predictive analytics for collection management (Gbadebo, 2024).Moreover, AI-powered virtual assistants have been deployed to enhance user interactions. Wagwu, etal (2024) studied AI chatbots in university libraries and found that they significantly reduce response time for routine inquiries. However, their study noted that chatbots are less effective in handling complex research questions, reinforcing the necessity for human librarians in knowledge-intensive tasks.

AI-driven recommendation systems are revolutionizing library operations by personalizing content discovery and streamlining processes. These systems use machine learning algorithms to efficiently classify and tag resources, reducing librarians' manual workload. AI-powered recommendation systems also personalize user experiences by suggesting relevant resources based on reading history and search patterns.

According to Al-Aamri and Osman (2022), AI is also integrating physical and digital resources, enhancing search functionalities, and linking video assistance with textual materials. Chatbots are increasingly used to provide instant responses to user queries, reducing response time and improving accessibility. (Yoon, Andrews, & Ward2021)

Virtual reference services powered by AI have improved remote library assistance, making information access more efficient. Voice recognition and natural language processing enable seamless communication between users and digital library systems.Ankamah, Vidza and Addo. (2024). supports this view, showing that AI-driven search engines provide more relevant and contextualized search results compared to traditional keyword-based searches. However, concerns about data security and job displacement necessitate clear ethical frameworks and policies for AI adoption in libraries. (Enakrire, & Oladokun, 2024)

According to Suleiman, Akanbi and Ibidunni, (2024)), AI can help university libraries simplify research services, automate repetitive tasks, and improve knowledge management. Their study identified several barriers to AI adoption, including resistance to change, a lack of technical understanding, and concerns about librarians' job security. While many librarians recognise the benefits of AI, its implementation is hampered by a lack of training and institutional support,

Ankamah, Vidza, and Addo's (2024) study examines the impact of artificial intelligence on African university libraries. They used tools like MS Excel, Harzing's Publish or Perish, and VOSviewer to analyze 616 datasets from Scopus. The results show an increasing trend of AI-related publications, with Nigeria, India, China, and the United States being the leading contributors. The study highlights the growing importance of AI in cataloguing, digital resource management, user engagement, predictive analytics, and library services. However, the study acknowledges challenges such as limited resources and inconsistent AI implementation. The report advises lawmakers and library administrators to improve AI usage and conduct further research on AI application in library services across Africa.

Subaveerapandiyan,(2023) emphasised the importance of librarians actively participating in the development of AI technologies that match library values and user demands. This strategy ensures that AI apps improve library services rather than rendering them obsolete. According to research, artificial intelligence (AI) has the potential to significantly improve library services by making them more accessible, efficient, and personalised. To fully exploit its promise, however, challenges such as user resistance, unreadiness, and ethical concerns must be overcome. According to Akinola, (2023), libraries may maintain user-centred and morally decent services by collaborating and employing AI to supplement rather than replace human expertise. And also future research should look into the long-term effects of AI on library service delivery and how librarians can improve their AI skills.

The Importance of Infrastructure and Intelligent Technology for Optimizing Library Operations

Physical and Digital Infrastructure:Libraries require well-designed physical spaces to support various activities, such as studying, collaborative learning, and accessing digital tools. The application of information technology as a digital infrastructure in the library and information sector has made significant advancements globally. It not only impacts the technical services of libraries but also influences the types of services libraries offer to the public (Lakshmipathi and Senthilkumar, 2021). A strong infrastructure enhances accessibility and operational efficiency. Furthermore, libraries around the world have been exploring new technologies to provide quicker and improved access to vast information resources, delivering more efficient information services to users and thereby achieving higher levels of efficiency, productivity, and excellence in the services they offer.

Connectivity and Access:High-speed internet and digital connectivity are essential components of library infrastructure, especially in the context of online and distance learning. These tools enable users to access e-resources, such as e-books, online journals, and digital archives, from remote locations. Libraries must invest in scalable and reliable networks to support these functions (Neerari, Naik, & Machado 2023).

Intelligent Technology for Optimizing Library Operations:- Intelligent technology, such as artificial intelligence (AI), machine learning (ML), Internet of Things (IoT), and blockchain, is transforming library operations by streamlining workflows, enhancing resource management, and improving user engagement.

Automation and Workflow Optimization: Intelligent technologies automate repetitive tasks, such as cataloguing, acquisitions, and circulation AI-powered cataloguing systems analyse resources and generate metadata automatically, reducing human error and saving time. The findings of Midde (2024) inferred that AI transforms and revolutionizes the entire methodology of cataloguing in contemporary libraries by carrying out the process of automating repetitive tasks involved in data and record maintenance, which makes it possible for libraries to process thousands of information in a heartbeat and cut down the time needed to catalog new acquisitions. Self-checkout kiosks and RFID-enabled inventory systems also enhance user convenience and free staff to focus on more complex tasks, such as research assistance.

Personalized Services: Machine learning algorithms and data analytics enable libraries to deliver personalized services based on user preferences and behaviour. Recommendation systems analyse borrowing patterns to suggest relevant books or articles, creating a tailored experience for each patron (Li, 2024).

Data Management and Security: Blockchain technology ensures secure management of user and library data by creating immutable, tamper-proof records. This is particularly valuable for managing interlibrary loans, digital rights, and user authentication processes. Libraries can optimize operations by ensuring data integrity and transparency (Persadha, *et al*. (2024).

Enhancing User Accessibility: IoT devices and intelligent tools improve accessibility for users with disabilities. Examples include voice-activated search tools, AI-powered text-to-speech applications, and augmented reality (AR) navigation tools that guide users through library spaces. Panda and Kaur (2023) suggested that the integration of these technologies allows digital libraries to not only preserve extensive knowledge collections but also present information in engaging and accessible formats, particularly for specialized users. These technologies help ensure that libraries remain inclusive and accessible to everyone.

IIntegration and Investment: Integrating infrastructure with intelligent technologies requires strategic planning, training, and financial investment. Libraries must prioritize staff training to enhance digital literacy and ensure efficient use of new technologies. However, Yelwa (2024). opted for collaboration with technology providers and government agencies can facilitate access to funding for modernizing library systems.

Bridging the Digital Divide: Investments in infrastructure also help address the digital divide, particularly in underserved communities. By expanding access to technology, libraries can empower users with tools and resources that support education, research, and lifelong learning (Johson, 2025).

Sustainability:Modernizing infrastructure with energy-efficient designs and sustainable technologies reduces environmental impact. On that note, Wogu, *et al*. 2024 empasised that those libraries adopting smart building technologies,such as smart lighting, heating, ventilation, air conditioning systems such as IoT-enabled climate control systems, demonstrate a commitment to sustainability while optimizing costs.

The Indispensable Role of Libraries and Librarians

Libraries have long been esteemed as sanctuaries of knowledge, serving as guardians of wisdom and repositories of cultural heritage. Their role within knowledge systems is dynamic, constantly evolving to address society's changing needs. Drawing from diverse scholarly perspectives, libraries contribute in numerous ways, with a central mission of preserving cultural heritage. They safeguard an extensive array of books, manuscripts, and historical records, ensuring that the narratives, literature, and wisdom of past civilizations remain accessible for future generations (Doğaray, 2023).

By upholding principles of intellectual freedom and unrestricted access to information, libraries provide safe spaces for diverse voices and perspectives. They resist censorship and ensure the free exchange of ideas. Adapting to technological advancements, libraries integrate digital catalogs, e-books, and online databases, ensuring their continued relevance in an increasingly digital world (Khan & Basir, 2023).

Libraries are also critical drivers of research and innovation. Academic and research libraries offer scholars access to extensive collections of specialized and scholarly literature, accelerating discovery and fostering advancements across various disciplines (Rossman, 2023). Additionally, in a digital age, libraries play a crucial role in bridging the digital divide by offering free access to technology and digital resources, ensuring equitable educational and developmental opportunities for all, regardless of socioeconomic status.

Additionally, libraries play a pivotal role in promoting information literacy. They educate users on critically evaluating information, distinguishing credible sources from misinformation, and navigating the complexities of the modern information landscape (Warkade, 2023)

Beyond preserving the past, libraries serve as centers of lifelong learning, providing resources for individuals of all ages to pursue intellectual growth and personal development. Through printed materials, digital archives, and educational programs, libraries empower communities with the tools to expand their knowledge and skills (Ashikuzzaman, 2023).

Libraries thus emerge as foundational pillars of intellectual heritage, catalysts of continuous learning, and indispensable components of knowledge systems. Their impact extends beyond physical spaces, embracing digital frontiers and fostering community engagement. As society progresses, libraries steadfastly uphold their mission to preserve, disseminate, and democratize knowledge, ensuring that the light of wisdom continues to guide future generations (Ajani, 2024).

Challenges TO libraries and librarians for the 5th IR in ODL environments

1. Integration of Emerging Technologies

A variety of AI and machine learning technologies often rely on different standards, data formats, and communication protocols, creating a considerable technical challenge in achieving smooth integration with existing library systems and ensuring compatibility within a diverse technological environment (Taherdoost et al., 2023).

2. Digital Skills and Competency Gaps

The changing role of librarians introduces a dynamic challenge. With AI systems taking over routine tasks, librarians are increasingly required to focus on specialized, user-centered services. This shift demands a continuous commitment to professional growth and the development of new skills to adapt successfully to the evolving library environment (Sousa-Zomer, 2020)

3. Data Privacy and Security Issues

Another significant challenge involves the ethical considerations of incorporating AI and machine learning into intelligent libraries. As AI-powered algorithms are employed to curate content, provide resource recommendations, and personalize user experiences, concerns arise regarding data privacy and the potential biases present in AI systems. Budhwar et al., 2023).Data security and privacy remain ongoing challenges for intelligent libraries, as the collection and storage of extensive patron data make them attractive targets for cyberattacks. Protecting this sensitive information is crucial to ensuring patron safety and preserving the integrity of library systems (Bareh, 2020).

4. Cultural Adaptation & Adapting to New Users Expectations

Implementing intelligent libraries frequently requires a cultural shift among both library staff and user communities. Embracing these changes is crucial for the successful adoption of AI and machine learning within libraries (Gupta & Gupta, 2023). Taking a proactive and holistic approach to addressing these challenges is vital for libraries to transition effectively into intelligent, user-focused, and ethically responsible institutions in the digital era.

5. Balancing Traditional and Modern Role

Singh (2024), emphasized the use of virtual library system (VLS) which is a tool in 5th IR technology seeks to connect traditional and digital libraries by leveraging advanced technologies and, addressing the changing demands of contemporary users. This system delivers a seamless and interactive user experience, featuring capabilities like online cataloging, digital resource management, user authentication, and collaborative tools.

6. Funding and Resource Limitation

Additionally, financial challenges pose a considerable obstacle. Implementing and maintaining intelligent library systems requires significant investment, including the procurement of advanced technologies and the continuous training and support of staff. Since libraries often function within limited budgets, careful financial planning and strategic resource allocation are essential to address these fiscal constraints effectively (Berman et al., 2021).

Resistance to Change in AI Adoption in libraries

The adoption of Artificial Intelligence (AI) in libraries has the potential to revolutionize information services, but resistance to change remains a significant barrier. Resistance stems from various factors, including fear of job displacement, lack of technical skills, ethical concerns, and organizational inertia (Rahman et al, 2025). Understanding the reasons behind this resistance is crucial for facilitating successful AI integration in libraries.Resistance to change is a common barrier to the successful implementation of AI in library services. According toLapointe and Rivard, (2005), resistance to change stems from fear of the unknown, perceived threats to job security, and reluctance to adopt new technologies. In the context of libraries, staff members may resist AI adoption due to concerns over job displacement and the learning curve associated with AI systems (Hanson & Okorie, 2024).

Factors Contributing to Resistance One of the primary reasons for resistance to AI adoption in libraries is fear of job displacement. Studies have shown that librarians perceive AI as a threat to their roles, fearing automation will replace traditional tasks such as cataloging and reference services (Mahmud 2024). However, the research conducted by Manju J. (2023), suggests that AI should be viewed as an augmentation tool rather than a replacement. Another major factor is the lack of technical skills among library professionals. Many librarians have not received formal training in AI technologies, making them hesitant to adopt AI-driven tools (Shahzad et al 2020). As AI applications become more prevalent, continuous professional development programs are necessary to equip library staff with the required competencies (Billiot 2023),.

Several ways have been proposed to minimise resistance. Workshops and training courses assist librarians gain confidence in using new technologies and become AI savvy. Including library personnel in AI implementation decisions reduces anxiety and increases ownership (Parker & Davis, 2024). The use of phased artificial intelligence is another effective method. Rather than making abrupt changes, incremental rollout allows employees to acclimatise and become familiar with AI capabilities. Furthermore, transparent communication about how artificial intelligence enhances rather than replaces library services helps to minimise concern (Ibrahim & Okpala, 2024).

Li,(2024) suggests that effective change management strategies, including participatory decision-making and continuous professional development, can help mitigate resistance. When librarians are actively involved in AI adoption and receive proper training, they are more likely to embrace technological advancements rather than resist them (Rahmani, 2023)

Suleiman, Akanbi and Ibidunni. (2024)also highlight the role of organizational culture in shaping attitudes toward AI. Institutions that foster a culture of innovation and digital literacy tend to experience lower

resistance to AI adoption. Conversely, libraries with rigid hierarchical structures and limited technological exposure face greater challenges in implementing AI-driven systems.
Ethical concerns also contribute to resistance. Issues such as data privacy, algorithmic bias, and user trust are frequently cited in the literature (Arora, Thota, & Gupta,2024). Libraries, as institutions that uphold intellectual freedom and user confidentiality, must address these concerns to gain staff and user acceptance
Organizational inertia further hinders AI adoption. Institutions with rigid hierarchical structures and traditional workflows often struggle to integrate new technologies effectively (Misra et al 2023). Successful implementation requires strong leadership, clear AI policies, and a culture of innovation (Ikwuanusi, Adepoju & Odionu, 2023)

Strategies to guarantee accessibility and inclusion in online learning environments

1. **Adopting Advanced Technologies**

In order to fully utilize the revolutionary potential of AI in open and distant learning environments, there is need to adopt tools such as automated transcription, voice-to-text applications and haptic technology for both the visually and hearing-impaired users. Gupta (2024), opined It is essential to strategically embrace new technologies, guided by experimentation, collaboration, and knowledge sharing in order to develop accessible virtual library environments that accommodate users with diverse abilities.

2. **Ensure User-Friendly Interface**

According to Kang et al (2021), paperless libraries align with the trend of 5th IR by adopting digital formats and platforms that seamlessly connect users to a wealth of information resources. These technologies play a crucial role in transforming cataloging, information retrieval, and user engagement.AI-driven virtual assistants, chatbots, and recommendation algorithms are enhancing user experiences by providing personalized and efficient library services (Chaturvedi & Verma, 2023).

3. **Training Librarians for 5th IR Skills**

In support of the 5th IR mandate , (Elife and Baki, 2023) opined that 5th IR enables the librarians to have a continuous skill development, training, re-training and knowledge in order to keep up with the trends in librarianship as there are a vast array of resources to use and they need to be skilled in those areas.

4. **Providing Reliable access to Resources and Infrastructure**

The primary objective is to go beyond mere convenience and efficiency in paperless libraries which aims to authentically cater to the needs of every community member, irrespective of their capabilities, origins, or geographical situations with reliable access to resources and infrastructure Enakrire et al.,2024). By using these digital technologies, librarians are able to provide access to various resources as well as the required infrastructure to meet the needs of the users.

5. **Leveraging Big Data Analytics**

Actual reality (AR), Machine learning (ML), Block chain, Artificial intelligence and Virtual reality (VR) technologies are transforming the ways libraries interact with their patrons. Libraries are utilizing AR and VR to develop engaging educational content and seamlessly connect physical and digital library spaces which enhances user involvement. These immersive tools facilitate virtual library tours, dynamic learning experiences, and creative storytelling in libraries Zhang, et al.,2020).

Building Inclusive Policies and Guidelines in the Adoption of AI in Libraries

Artificial intelligence (AI) is revolutionising numerous industries, including education, healthcare, government, and business. Nonetheless, the use of artificial intelligence necessitates comprehensive policies and regulations to ensure that its acceptance is inclusive and does not assist the marginalisation of vulnerable groups or the reinforcement of existing prejudices (Floridi & Cowls, 2019). Ekwueme et al. (2024) say that the 5th Industrial Revolution (5IR) is made up of human-centered approaches, automation, and artificial intelligence (AI) in education, mainly in Open and Distance Learning (ODL) settings. This transition from the Fourth Industrial Revolution (4IR) to the Fifth Industrial Revolution (5IR) emphasises inclusion, human-technology interaction, and personalised learning experiences. Inclusive policies and guidelines must promote equal access to education for all students, including those with disabilities and underprivileged groups. (Ojetunde, 2024)
Policies advancing inclusive artificial intelligence, according to Jobin, Ienca, and Vayena (2019), seek to guarantee fair access, moral use, and the elimination of AI application biases. Regulations pertaining to artificial intelligence can overlook inclusivity, especially for under-represented groups. According to Kulal et al,(2024) Closing the digital divide, meeting different learning needs, and advancing educational equity are the three primary objectives of the 5IR's inclusivity effort. Inclusive policies in online and distance learning (ODL) must solve accessibility, cultural diversity, and digital literacy if we are to guarantee a fair learning environment for every student. Moreover, new technologies such as artificial intelligence-driven adaptive learning systems and blockchain for safe credentialing might greatly increase inclusivity. (Wulandari, Firdaus& Saifulloh, 2024)

Floridi and Cowls (2019) argue that encouraging inclusion in ODL environments is entirely dependent on having a well-organised policy framework. Several strategies have been proposed to improve inclusive learning, including Universal Design for Learning (UDL), which promotes accessibility through a variety of representational, interactive, and expressive ways. ODL institutions may decide to use Universal Design for Learning (UDL) in order to more comfortable accept students from diverse backgrounds. Policies on digital equity should ensure that every student has access to assistive technologies, an internet connection, and digital resources. Data-driven, effective decision-making can help to tailor inclusion strategies. (Gottschalk & Weise, 2023)

Several frameworks have been proposed to guide the development of inclusive AI policies, including Floridi and Cowls' (2019) framework based on openness, responsibility, and justice, Bryson and Winfield's (2017) framework prioritizing social well-being and human values, and Whittlestone et al.'s (2019) emphasis on including affected communities, technologists, and legislators in AI governance.

Inclusive policies in open and distance institutions face challenges like the digital gap, AI bias, ethical concerns, resistance to change, and data privacy implications. To improve learning, best practices include increasing accessibility, establishing standards, improving faculty training, using assistive technologies, and strengthening student support systems. However, challenges like biases in AI algorithms, regulatory gaps, and under-representation of marginalized groups limit effective implementation. (Morris, 2012)

To create rules and standards for 5IR that work for both open and distance learning, Espada-Chavarria et al. (2023) say we need a comprehensive plan that combines technological progress with human-centered teaching methods. Frameworks like Universal Design for Learning (UDL), which promotes digital justice and talks about AI ethics, can help ODL institutions make learning spaces that are welcoming and follow the 5IR principles. To ensure AI's inclusive acceptance, it's crucial to use diverse datasets, use open-source AI models, align AI policies with human rights, and involve communities in debates. Ethical considerations, stakeholder involvement, and continuous evaluation of social impact are essential. Addressing algorithmic biases, legal loopholes, and a lack of diverse representation are crucial steps towards ensuring AI serves all sectors of society. (Shams, Zowghi & Bano, 2025).

An Overview of the application of 5th Industrial Revolution by librarians

Adigun et al. (2024) examined the concept of Intelligent Libraries: Innovation for a Sustainable Knowledge System in the Fifth Industrial Revolution. The study highlights that, despite some challenges, libraries are positioned to remain essential pillars of education, research, and community engagement by strategically adopting technology to redefine their roles and broaden their influence within evolving knowledge systems. Enakrire et al. (2024) explored "paperless libraries: The trending approach in the fifth industrial revolution." Their findings show that technological advancements have facilitated the rise of paperless libraries, with on-screen reading becoming more common, rapid development supported by mobile computing, software, and internet/Wi-Fi connections, and diverse electronic information retrieval methods. Additionally, the study emphasized the significance of paperless libraries in the 5IR. The research concludes that, as libraries and librarians adapt to this transformative era, the rise of paperless libraries symbolizes the seamless integration of technological capability and human aspirations, envisioning human-machine interactions, especially with the importance of AI and human-centered innovation.

Ekwueme et al., (2024) presented a study on empowering librarians in the fifth industrial revolution: Navigating skills, challenges and strategies for effective library services in open and distant learning in Nigeria. They found out that librarians exhibit collaborative and digital skills which are essential for working with both people and machines in delivering library services to learners. They suggested that librarians should embrace advanced technologies and collaborative approaches through training and retraining in order to acquire the necessary skill in navigating the changes that come along with open and distant learning environment. Modiba (2024) carried out a study on “Application of conversational generative pre-trained transformer for improvement of information services in academic libraries”. The study revealed that ChatGPT can effectively provide information services in academic libraries in the 5IR which enables smooth interaction between the patrons and the library. In addition, it can provide information services around the clock effectively and efficiently without interruption.

Ajani, Tella, A., & Oladokun (2024) carried out a study on “social innovation in Nigerian public libraries: a roadmap for navigating the challenges and opportunities on inclusivity and diversity in 5IR era”. The study underscores the vital role of social innovation in Nigerian public libraries for promoting inclusivity, diversity, and positive societal change during the 5IR era by embracing innovation, fostering collaboration, and demonstrating a commitment to community service. Ekwueme et al (2024) examined “Awareness, Perception, and Skills of Librarians for the Implementation of 5th IR in Academic Libraries: Implications on Open and Distant Learning”. The study reveals a high awareness of 5IR technologies among librarians, with robotics being the most recognized. The study also suggests that while NOUN librarians are well-aware of and positive about 5IR technologies, there is a need for improved skills and competencies.

Nwobu (2024), investigated "Libraries in the Fifth Industrial Revolution: Skills and Knowledge Required in Preparing Librarians for an Uncertain Future". The study highlights continuous learning, technological integration, collaboration and networking as some of the different approaches to ensure librarians readiness to adopt the new tools and methodologies of the 5th industrial revolution.

Conclusion

The 5th Industrial Revolution (5IR) is poised to reshape the educational landscape, particularly in open and distance learning (ODL) environments. Libraries and librarians are at the forefront of this transformation, necessitating readiness in terms of technological advancements, evolving roles, and institutional preparedness. This study has explored the integration of cutting-edge technologies such as artificial intelligence (AI), machine learning (ML), robotics, virtual reality (VR), augmented reality (AR), and blockchain into library services and the essential role of human-AI collaboration in this process. Libraries must transition from passive knowledge repositories to active knowledge ecosystems that leverage digital innovations to enhance service delivery. AI-driven automation, recommendation systems, and digital preservation techniques are revolutionizing resource management, while ML algorithms improve cataloging, accessibility, and user engagement. Robotics, VR, and AR offer innovative solutions for library operations, user assistance, and immersive learning experiences, although challenges such as cost, technical expertise, and user adaptation persist. Infrastructure development and investment in intelligent technology are crucial for optimizing library operations in 5IR-driven ODL environments. High-speed internet, cloud-based platforms, and AI-powered tools facilitate seamless resource accessibility, support research and innovation, and ensure libraries remain relevant in an increasingly digital world. However, financial constraints, resistance to change, and ethical concerns surrounding AI adoption pose significant barriers. Addressing these challenges requires strategic investment, digital literacy training for librarians, and collaborative partnerships with technology providers and educational institutions. Libraries remain critical to bridging the digital divide, fostering lifelong learning, and ensuring equitable access to information. By embracing the transformative potential of 5IR, libraries can enhance user experiences, streamline operations, and uphold their mission of knowledge dissemination. Moving forward, sustainable policies, ethical AI implementation, and continuous professional development for librarians will be essential to navigating the challenges and opportunities of this digital revolution. In doing so, libraries will not only adapt to the demands of 5IR but also shape the future of knowledge access and learning in ODL environments.

Recommendations

To effectively address the challenges and leverage the opportunities presented by the Fifth Industrial Revolution, libraries should adopt the following recommendations: Here are four recommendations based on the challenges faced by libraries and librarians in the 5th Industrial Revolution (IR) within Open and Distance Learning (ODL) environments:

1. Libraries should invest in developing and adopting standardized frameworks that ensure compatibility across diverse systems and platforms. Collaboration with technology providers and other libraries can help create shared standards and protocols, making it easier to integrate new technologies into existing library infrastructures. Libraries should also prioritize interoperability when selecting new systems to reduce the complexity of integration.
2. Libraries must emphasize continuous professional development to address digital skills and competency gaps. This can be achieved by offering regular training programs on emerging technologies, data privacy, and user-centered service models. Librarians should also be encouraged to pursue certifications and specializations in areas like data analytics, AI, and information security, ensuring they remain at the forefront of technology-driven library management.
3. Libraries should implement robust data protection policies and advanced cybersecurity measures. This includes encrypting user data, using secure communication protocols, and conducting regular audits of data management systems. Libraries must also ensure compliance with relevant data privacy laws and best practices to protect user information and build trust with patrons. Additionally, training staff on privacy and ethical considerations regarding AI-powered systems will ensure responsible use of technologies.
4. Libraries should create a supportive environment that encourages experimentation with AI and machine learning technologies. Involving staff and users in the process of implementing these technologies through workshops, feedback sessions, and pilot programs can help ease the transition. Libraries should actively promote a culture of innovation where both staff and users feel empowered to embrace new technologies that enhance the learning experience in a user-focused and ethically responsible manner.

References

Adetayo, A., Abwage, K., & Oduola, T. (2023). Robots and Human Librarians for Delivering Library Services to Patrons. The Reference Librarian, 64(2–4), 69–84. https://doi.org/10.1080/02763877.2023.2183303

Adigun, G. O., Ajani, Y. A., & Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) Industrial Revolution. Libri, 74(3), 211-223. https://www.degruyter.com/document/doi/10.1515/libri-2023-0111/html

Agwuna, O., Ejezie, J. K. & Nwankwo, N. G. (2024). Application of augmented reality in library services: Challenges and prospects. Journal of Library Services and Technologies, 6(3). DOI: http://doi.org/10.47524/jlst.v6i3.82

Ajani, Y. A., Tella, A., & Oladokun, B. D. (2024). Social innovation in Nigerian public libraries: A roadmap for navigating the challenges and opportunities of inclusivity and diversity in the 5IR era. Business Information Review, 02663821241289845. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Social+innovation+in+Nigerian+public+libraries%3A+A+roadmap+for+navigating+the+challenges+and+opportunities+of+inclusivity+and+diversity+in+the+5IR+era.&btnG=

Ajani, Y., & Oladokun, B. (2024). Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution. Folia Toruniensia, 24, 29-51. Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution

Akinola, S. A. (2023). Capabilities and Apparent Implications of Artificial Intelligence (AI) Adoption in Nigerian Academic Libraries. University Library at a New Stage of Social Communications Development, (8), 283–289. https://doi.org/10.15802/unilib/2023_293813

Akinyemi, O. E. (2023). Enhancing academic library service delivery using Artificial Intelligence (AI). Library Philosophy and Practice(e-journal).https://digitalcommons.unl.edu/libphilprac/8042

Al-Aamri, J., & Osman, N. E. (2022). The Role of Artificial Intelligence Abilities in Library Services. The International Arab Journal of Information Technology, 19(3A). https://doi.org/10.34028/iajit/19/3a/16

Alam, S. (2025). Redefining Library Services: The Role of Artificial Intelligence and Machine Learning in modern libraries. DOI: https://doi.org/10.48165/bapas.2024.44.2.1

Ankamah, S., Vidza, P. Y., & Addo, B. N. (2024). The role of Artificial Intelligence in enhancing library services in universities: a bibliometric analysis. Ghana Library Journal, 29(2), 1-65. DOI:10.33168/JSMS.2024.0628

Ashikuzzaman, M. D. (2023). Empowering Lifelong Learning: The Vital Role of Libraries in Today's Society. LIS education Network. Empowering Lifelong Learning: The Vital Role of Libraries in Today's Society - Library & Information Science Education Network

Attaran, M. (2023). The impact of 5G on the evolution of intelligent automation and industry digitization. Journal of ambient intelligence and humanized computing, 14(5), 5977–5993. https://link.springer.com/article/10.1007/s12652-020-02521-x

Arora, S., Thota, S. R., & Gupta, S. (2024, August). Data mining and processing in the age of big data and artificial intelligence - Issues, privacy, and ethical considerations. 2024 4th Asian Conference on Innovation in Technology (ASIANCON). https://doi.org/10.1109/ASIANCON62057.2024.10838087

Bareh, C. K. (2022). Privacy Policy Analysis for Compliance and Readability of Library Vendors in India. The Serials Librarian, 83(2), 148–165. https://www.tandfonline.com/doi/abs/10.1080/0361526X.2022.2143467

Berman, E. M., Bowman, J. S., West, J. P., & Van Wart, M. R. (2021). Human resource management in public service: Paradoxes, processes, and problems. CQ Press. https://books.google.com.tj/books?id=aUvwbSAmZ4MC&printsec=frontcover#v=onepage&q&f=false

Billiot, T. (2023), "Continuous learning and advancing technologies: a framework for professional development and training in artificial intelligence", Development and Learning in Organizations, Vol. 37 No. 3, pp. 28-31. https://doi.org/10.1108/DLO-04-2022-0064

Bryson, J., & Winfield, A. (2017). Standardizing Ethical Design for Artificial Intelligence and Autonomous Systems. Computer, 50(5), 116–119. https://doi.org/10.1109/mc.2017.154

Budhwar, P., Chowdhury, S., Wood, G., Aguinis, H., Bamber, G. J., Beltran, J. R., ... & Varma, A. (2023). Human resource management in the age of generative artificial intelligence: Perspectives and research directions on Chat GPT. Human Resource Management Journal, 33(3), 606–659. https://onlinelibrary.wiley.com/doi/full/10.1111/1748-8583.12524

Chaturvedi, R., & Verma, S. (2023). Opportunities and Challenges of AI-Driven Customer Service. Artificial Intelligence in Customer Service: The Next Frontier for Personalized Engagement, 33–71. Opportunities and Challenges of AI-Driven Customer Service | SpringerLink

de Vries, M. S., & Kroukamp, H. (2023). Decision-making skills in the fourth industrial revolution. Teaching Public Administration, 41(3), 389–407. https://journals.sagepub.com/doi/abs/10.1177/01447394221119087

Doğaray, A. (2023). Library as a third space (Master's thesis, Abdullah Gül Üniver sitesi, Fen Bilimleri Enstitüsü). http://acikerisim.agu.edu.tr/xmlui/handle/20.500.12573/1805?locale-attribute=en

Dou, F., Ye, J., Yuan, G., Lu, Q., Niu, W., Sun, H., ... & Song, W. (2023). Towards Artificial General Intelligence (AGI) in the Internet of Things (IoT): Opportu nities and Challenges. https://ar5iv.labs.arxiv.org/html/2309.07438

Elife, K., & Baki, A. E. (2023). New technologies and labor market: a look into the future of jobs and employment. Социология науки и технологий, 14(2), 194-208. New Technologies and Labor Market: A Look into the Future of Jobs and Employment – тема научной статьи по социологическим наукам читайте бесплатно текст научно-исследовательской работы в электронной библиотеке КиберЛенинка

Ekwueme, L. O., Oluwaseun, B. O., Ajie, I. A., Ofodu, P. N., & Ambrose, S. E. (2024). The impact of 5th industrial revolution technologies on academic libraries: Improving diversity and inclusive services in open and distance learning. Indonesian Journal of Library and Information Science, 5(2), 100–108. https://doi.org/10.22373/ijlis.v5i2.6048

Ekwueme, L. O., Oluwaseun, B. O., Ajie, A.I., Ofodu, P. N. & Ambrose, S. A. (2024). Awareness, perception, and skills of librarians for the implementation of 5th IR in academic libraries: Implications on open and distant learning. ATBU Journal of Science, Technology and Education,12(2). 702 – 713. ISSN: 2277-0011. https://www.atbuftejoste.com.ng/index.php/joste/article/view/2145

Enakrire, R. T., Oladokun, B. D., Nsirim, O., & Gaitanou, P. (2024). Paperless libraries: The trending way to go in the fifth industrial revolution. Business Information Review, 41(4), 164-173. https://doi.org/10.1177/02663821241289793

Enakrire, R. T., & Oladokun, B. D. (2024). Artificial intelligence as enabler of future library services: How prepared are librarians in African university libraries. Library Hi Tech News, 41(3), 1-5.

Espada-Chavarria, R., González-Montesino, R. H., López-Bastías, J. L., & Díaz-Vega, M. (2023). Universal Design for Learning and Instruction: Effective Strategies for Inclusive Higher Education. Education Sciences, 13(6), 620. https://doi.org/10.3390/educsci13060620

Fasola, O. S., Oyadeyi, A. E. & Iyoro, A. O. (2024). Awareness, acceptance and readiness to use blockchain technology for library services in academic libraries in Nigeria. Communicate: Journal of Library and Information Science, 26(1). https://www.cjolis.org/

Floridi, L., & Cowls, J. (2019). A Unified Framework of Five Principles for AI in Society. SSRN Electronic Journal, 1(1). https://doi.org/10.2139/ssrn.3831321

Gbadebo, A. D. (2024). Application of artificial intelligence and machine learning in academic libraries. International Journal of Social and Educational Innovation (IJSEIro), 184-201.

Gottschalk, F., & Weise, C. (2023). Digital equity and inclusion in education: An overview of practice and policy in OECD countries (OECD Education Working Paper No. 299). OECD Publishing. https://doi.org/10.1787/7cb15030-en

Gupta, V. (2024), "From hype to strategy: navigating the reality of experimental strategic adoption of AI technologies in libraries", Reference Services Review, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/RSR-08-2024-0042

Gupta, V., & Gupta, C. (2023). Leveraging AI technologies in libraries through ex perimentation-driven frameworks. Internet Reference Services Quarterly, 27(4), 211–222.

https://doi.org/10.1080/10875301.2023.2240773.
Hanson, E. D., Okorie, U. U., & Nsit, A. (2024). The roles of Artificial Intelligence in library automation: The prospects and challenges. Erudite Compendiums in Education, 13-23..

Ibrahim, H., & Okpala, A. E. (2024). Exploring the Integration of Artificial Intelligence in Nigeria Library Services. International Journal of Knowledge Dissemination (IJKD), 5(1), 55–65. Retrieved from https://ijkd.uniabuja.edu.ng/index.php/ijkd/article/view/98

Ikwuanusi, U. F., Adepoju, P. A., & Odionu, C. S. (2023). Advancing ethical AI practices to solve data privacy issues in library systems. International Journal of Multidisciplinary Research Updates, 6(1), 33-44. https://doi.org/10.53430/ijmru.2023.6.1.0063

Indraji, C, Satishkumar, N, & Dominic, J (2024) Use of robotics and Artificial Intelligence for enhancing library services. Library Progress International, 44(3). www.bpasiournals.com

Jobin, A., Ienca, M., & Vayena, E. (2019). The Global Landscape of AI Ethics Guidelines. Nature Machine Intelligence, 1(9), 389–399. https://doi.org/10.1038/s42256-019-0088-2

Johson, C. A. (2025). Bridging the Digital Divide: Enhancing Connectivity and Digital Literacy in Underserved Communities. Negotiating with Donors: The Art of the Deal.https://www.fundsforngos.org/proposals/bridging-the-digital-divide-enhancing-connectivity-and-digital-literacy-in-underserved-communities/
Kang Q, Lu J, Hu J (2021). Is e-reading environmentally more sustainable than conventional reading? Evidence from a systematic literature review. Library & Information Science Research 43(3),101–105. Is e-reading environmentally more sustainable than conventional reading? Evidence from a systematic literature review - ScienceDirect
Khan, G., & Basir, M. (2023). Copyright literacy of library and information science professionals in Pakistan. IFLA Journal. https://journals.sagepub.com/doi/abs/10.1177/03400352231172800
Kulal, A., Dinesh, S., Abhishek, N. and Anchan, A. (2024), "Digital access and learning outcomes: a study of equity and inclusivity in distance education", International Journal of Educational Management, Vol. 38 No. 5, pp. 1391-1423. https://doi.org/10.1108/IJEM-03-2024-0166
Lakshmipathi, K. N. & Senthilkumar, R. (2021). Availability and usage of digital infrastructure services and facilities in University Libraries of Karnataka and Andhra Pradesh: A comparative study. Library Philosophy and Practice (e-journal). https://digitalcommons.unl.edu/libphilprac/6013

Lanre, F. A. & Omeiza, M. E. (2020). Application of artificial intelligence and robotics in libraries: A Review of Literature. ILIS Journal of Librarianship and Informatics, 3(2). https://www.researchgate.net/publication/350783802_Application_of_Artificial_Intelligence_and_Robotics_in_Libraries_A_Review_of_Literature

Lapointe, L., & Rivard, S. (2005). A multilevel model of resistance to information technology implementation. MIS quarterly, 461-491.

Li, F. (2024). Critically Unveiling Resistance: Strategies for Effective Change Management in Organizations. Deleted Journal, 7(3), 157–160. https://doi.org/10.54097/y3ycxb90

Li, J (2024). Design and optimization of library information recommendation system based on user behavior. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5010597
Lund, B. D. & Wang, T. (2019) "Effect of virtual reality on learning motivation and academic performance: What Value May VR Have for Library Instruction?" Kansas Library Association College and University Libraries Section Proceedings: 9(1) https://doi.org/10.4148/2160-942X.1073
Mahmud, M.R. (2024), "AI in automating library cataloging and classification", Library Hi Tech News, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/LHTN-07-2024-0114

Manju J. (2023). AI (Artificial Intelligence) as a tool for transforming library services: transition of traditional library services into AI powered library services in Academic libraries. International Journal of Humanities and Education Research, 5(2), 20–23. https://doi.org/10.33545/26649799.2023.v5.i2a.52

Midde, R. (2024). Artificial Intelligence and its impact on cataloguing practices in modern

libraries. International Journal of Creative Research Thoughts (IJCRT), 12(12). https://ijcrt.org/papers/IJCRT2412195.pdf

Misra, S. K., Sharma, S. K., Gupta, S., & Das, S. (2023). A framework to overcome challenges to the adoption of artificial intelligence in Indian government organizations. Technological Forecasting and Social Change, 194, 122721. https://doi.org/10.1016/j.techfore.2023.122721

Modiba, M. (2024). Application of Conversational Generative Pre-trained Transformer for improvement of information services in academic libraries. South African Journal of Libraries and Information Science, 90(1), 1-8. https://sajlis.journals.ac.za/pub/article/view/2384

Morris, N. (2012). Teaching as a Design Science: Building Pedagogical Patterns for Learning and Technology. By Diana Laurillard. British Journal of Educational Studies, 60(4), 448–450. https://doi.org/10.1080/00071005.2012.742279

Neerari, S., Naik, U., & Machado, S. (2023). Remote library platforms for accessing electronic resources. In book: From Dewey to Digital: Evolution of libraries in the information age. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4706148

Noble, S. M., Mende, M., Grewal, D., & Parasuraman, A. (2022). The Fifth Indus trial Revolution: How harmonious human–machine collaboration is triggering a retail and service [r] evolution. Journal of Retailing, 98(2), 199–208. https://www.sciencedirect.com/science/article/pii/S0022435922000288

Nwobu, B. K., Dumbiri, R., Ibia, M. J., & Oladokun, B. D., (2024). Libraries in the Fifth Industrial Revolution: Skills and Knowledge Required in Preparing Librarians for an Uncertain Future. In U. C. Udofot et al. (Eds.), Digital Technologies and Library Management in Higher Institutions of Learning in Nigeria. (3 – 13). Port Harcourt: Chadick Printing Press. https://www.researchgate.net/publication/380783871_Libraries_in_the_Fifth_Industrial_Revolution_Skills_and_Knowledge_Required_in_Preparing_Librarians_for_an_Uncertain_Future

Ojetunde, S. M. (2024). Left-behind learners: Exclusion-inclusion paradox of 4IR/5IR education technology. E-Learning and Digital Media, 0(0). https://doi.org/10.1177/20427530241239407

Oladokun, B. D., Durodolu, O. O., Tella, A., Ajani, Y. A., & Owolabi, A. K. (2024b). Metaverse decline, growth in online videos increases: implications to libraries. Library Hi Tech News. https://www.emerald.com/insight/content/doi/10.1108/lhtn-03-2024-0046/full/html

Panda, S. &Kaur, N. (2023). Enhancing user experience and accessibility in digital libraries through emerging technologies. Digital libraries: Sustainable Development in Education (DLSDE). DOI: 10.5281/zenodo.10211088

Pushpendra Singh (2024). Design and implementation of a virtual library system: An overview. IP Indian Journal of Library Science and Information Technology. https://www.ijlsit.org/html-article/20761

Rahman, M. H., Ghazali, A. B. M., & Sawal, M. Z. H. B. M. (2025). The Influence of Social Factors on Resistance to Technology Adoption in University Libraries in Bangladesh. Science & Technology Libraries, 1-15

Rahmani, M. (2023). Exploring the Integration of AI in Public Library Services. 1(4), 33–39. https://doi.org/10.61838/kman.aitech.1.4.6

Satheesh, S. N. Antony, V. A., Anantharaman, S. & Ashraf, R. C. (2024). Artificial Intelligence in library services: Enhancing access, operational efficiency, and user experience. Library Progress International, 44(3). www.bpasjournals.com

Shahzad, K., Khan, S. A., Iqbal, A., Ahmed, S., Javeed, A. M. D., & Mohamed, O. (2025). Factors influencing the adoption of artificial intelligence in libraries: A systematicliterature review. Information Development, 0(0). https://doi.org/10.1177/02666669241313368

Shams, R. A., Zowghi, D., & Bano, M. (2025). AI and the quest for diversity and inclusion: A systematic literature review. AI & Ethics, 5, 411–438. https://doi.org/10.1007/s43681-023-00362-w

Sousa-Zomer, T. T., Neely, A., & Martinez, V. (2020). Digital transforming ca pability and performance: a micro foundational perspective. International Journal of Operations & Production Management, 40(8), 1095–1128. https://www.emerald.com/insight/content/doi/10.1108/ijopm-06-2019-0444/full/html

Sørensen, V., & Lansing, J. S. (2023). Art, technology and the Internet of Living Things. AI & society, 1–17. https://link.springer.com/article/10.1007/s00146-023-01667-4

Subaveerapandiyan, A. (2023). Application of Artificial Intelligence (AI) In Libraries and Its Impact on Library Operations Review. Library Philosophy & Practice.

Suleiman, Y., Akanbi, I. M., & Ibidunni, S. A. . (2024). Leveraging Artificial Intelligence (AI) for library services in Nigerian universities: Ethical consideration and potential benefits. International Journal of Intellectual Discourse, 7(4). Retrieved from https://ijidjournal.org/index.php/ijid/article/view/642

Suleiman, Y., Akanbi, I. M., & Ibidunni, S. A. (2024). Leveraging Artificial Intelligence (AI) for library services in Nigerian universities: Ethical consideration and potential benefits. International Journal of Intellectual Discourse, 7(4).https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Leveraging+artificial+intelligence+for+library+services+in+Nigerian+universities%3A+Ethical+considerations+and+potential+benefits.+International+Journal+of+Digital+Information%2C&btnG=#d=gs_cit&t=1740315855339&u=%2Fscholar%3Fq%3Dinfo%3A_HQui74SAugJ%3Ascholar.google.com%2F%26output%3Dcite%26scirp%3D0%26hl%3Den

Taherdoost, H. (2023). An overview of trends in information systems: emerging technologies that transform the information technology industry. Cloud Computing and Data Science, 1-16. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4626736

Tawalbeh,A.K (2024), The Role of AI in Improving Digital Archiving in University Libraries. . Journal of System and Management Sciences, 14(6). https://doi.org/10.33168/jsms.2024.0628

Tella, A., Ajani, Y. A., & Ailaku, U.V. (2023), Libraries in the metaverse: the need for meta literacy for digital librarians and digital age library users, Library Hi Tech News, 40(8) https://doi.org/10.1108/LHTN-06-2023-0094. https://www.emerald.com/insight/content/doi/10.1108/lhtn-06-2023-0094/full/html

Warkade, P.T. (2023). The role of libraries in promoting information literacy and digital citizenship. International Research Journal of Human Resource and Social Sciences, 10(9). 4fSPtriRBzJErKK.pdf.

Wagwu, V., Okpala, A. E., Maxwell, C. E., & Oladokun, B. D. (2024). AI-Driven Chatbots for Library Services towards Transforming Patrons' Engagement in Nigerian University Libraries. Communicate: Journal of Library and Information Science, 26(1), 89-98.

Whittlestone, J., Nyrup, R., Alexandrova, A., & Cave, S. (2019). The Role and Limits of Principles in AI Ethics. Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society. https://doi.org/10.1145/3306618.3314289

Wogu, D. C. Anthony, O. Otuonuyo, G. & Adenubi, F. (2024). Benefits of a smart building design in public library facilities, Lagos State, Nigeria. BUAD Journal of Engineering and Applied Sciences (AJEAS). DOI: 10.53982/ajeas.2024.0201.13-j

Wulandari, C. E., Firdaus, F. A., & Saifulloh, F. (2024). Promoting Inclusivity Through Technology: A Literature Review in Educational Settings. Journal of Learning and Technology, 3(1), 19–28. https://doi.org/10.33830/jlt.v3i1.9731

Yelwa, A. S. (2024). The role of libraries in harnessing technology for promoting digital inclusion in Nigeria. Rima International Journal of Education (RIJE), 3 (2). https://rijessu.com/wp-content/uploads/2024/07/020-RIJE-2024-V3-030.pdf

Yoon, J., Andrews, J. E., & Ward, H. L. (2021). Perceptions on adopting artificial intelligence and related technologies in libraries: public and academic librarians in North America. Library Hi Tech, ahead-of-print(ahead-of-print). https://doi.org/10.1108/lht-07-2021-0229

Zhang, H., Cui, Y., Shan, H., Qu, Z., Zhang, W., Tu, L., & Wang, Y. (2020, June). Hotspots and trends of virtual reality, augmented reality and mixed reality in education field. In 2020 6th International Conference of the Immersive Learning Research Network (iLRN) (pp. 215–219). IEEE. Hotspots and Trends of Virtual Reality, Augmented Reality and Mixed Reality in Education Field | IEEE Conference Publication | IEEE Xplore

The Rise of Robots in Library and Information Service Delivery: Essential Skills and Knowledge for Librarians in the Era of Industry 5.0

Lawal Umar[1], Bolaji David Oladokun[2] & Charity Ezinne Maxwell[3]
[1]Department of Library and Information Science, Umaru Musa Yar'adua University, Katsina
lawal.umar@umyu.edu.ng
[2]Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom State, Nigeria / Bolaji.oladokun@yahoo.com
[3]Department of Library and Information Technology, Federal University of Technology, Ikot Abasi, Akwa Ibom State, Nigeria / Maxwell.charity@gmail.com

Abstract

This study explores the intersection of robotics, librarianship, and human-centric technology within the context of the Fifth Industrial Revolution (Industry 5.0). The research was guided by four key objectives: to identify the types of robotic technologies currently adopted in libraries; to examine the essential technical and soft skills required by librarians; to assess librarians' knowledge and preparedness for robotic collaboration; and to explore the challenges associated with robotic integration in library environments. Employing a systematic review design, the study analysed and synthesized findings from 27 peer-reviewed journal articles published between 2020 and 2025. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework guided the literature search, screening, and inclusion process. The findings revealed that libraries, particularly academic ones, are integrating various robotic systems, including RFID-enabled sorters, humanoid service bots, and AI-driven reference assistants. The study also found that librarians require a hybrid skillset combining technical proficiency in robotics and artificial intelligence with soft skills such as adaptability, ethical reasoning, and digital empathy. However, knowledge and preparedness levels vary significantly across regions, with many librarians facing training and infrastructural gaps. Additionally, several challenges such as funding limitations, ethical concerns, and institutional resistance were identified as barriers to robotic adoption. The study concludes that for libraries to thrive in the Fifth Industrial Revolution (5IR) era, proactive investments in training, infrastructure, and inclusive policy frameworks are advocated.

***Keywords**: Industry 5.0, Robots in Libraries, Librarian Skills, Human-Robot Collaboration, Digital Literacy*

Introduction

The convergence of robotics, artificial intelligence (AI), and human-centered design under the banner of Industry 5.0 has emerged with tremendous revolutions for libraries and other walks of life. Moving beyond the automation-centered focus of the Fourth Industrial Revolution (4IR), Industry 5.0 emphasizes human-machine collaboration, personalization, sustainability, and resilience (Ashiq, 2024; Ayinde, Ajayi & Adedeji, 2025). Interestingly, the deployment of robotic systems for information service delivery, cataloging, user assistance, and circulation management has become increasingly prevalent (Basumatary et al., 2025; Luca, Narayan & Cox, 2022). This shift necessitates a reconceptualization of librarians' roles, skills, and knowledge requirements to ensure their continued relevance and efficacy in a digital-first, yet human-centric, information landscape.

Robots in libraries are no longer a futuristic concept but a present reality, as evidenced by their implementation in institutions across Asia, Europe, and increasingly in Africa (Oladokun et al., 2023; Wójcik, 2024). These machines perform a variety of functions—from wayfinding and book retrieval to answering reference queries through embedded AI algorithms (Adetayo, Abwage & Oduola, 2023). However, the rise of these technologies does not signal the obsolescence or the extinction of human librarians. Rather, it highlights the need for a hybrid model of librarianship where both robotic and human intelligences synergize to deliver high-quality, responsive, and inclusive library services (Shubha, 2023; Moonasar & Ngoepe, 2023).

In the face of this technological evolution, the critical question becomes: *What essential skills and knowledge must librarians possess to function effectively in this new information ecosystem?* This study seeks to explore this question by examining the implications of robotic adoption within the framework of Industry 5.0, which is characterized by a paradigm shift towards customization, human-centric design, and co-working between people and intelligent machines (Oyedokun, 2024). Librarians must now cultivate technical competencies such as programming literacy, robotics operation, data analytics, and AI integration, alongside traditional library science skills (Hanson et al., 2024; Wu, 2024). At the same time, soft skills—including adaptability, problem-solving, emotional intelligence, and ethical judgment—are increasingly indispensable in managing both machines and the nuanced needs of diverse library users (Tait & Pierson, 2022; Karina Lira Da Silva et al., 2024).

Scholars have emphasized the urgency of equipping librarians for this transition. For instance, Tella (2020) posed a vital question: *Are librarians ready to accommodate robots?* The question remains relevant today, particularly in developing contexts like Nigeria, where infrastructural limitations and skill gaps may impede the effective adoption of robotics in library services (Owolabi et al., 2022; Oladokun et al.,2024). Nonetheless, recent studies show growing enthusiasm and awareness among information professionals about the potential of robotics to improve efficiency, enhance user experiences, and extend the reach of library services (Ajani et al., 2024; Hodonu-Wusu, 2024).

The adoption of robotic technologies comes with several challenges. These include technological infrastructure deficits, ethical concerns, user acceptance, cost barriers, and lack of institutional readiness (Shahzad, Khan & Iqbal, 2024; Ahmat & Hanipah, 2018). Furthermore, librarians must navigate ethical dilemmas involving surveillance, data privacy, and equitable access in AI-augmented environments (Hodonu-Wusu, 2024). The role of continuous professional development and curriculum redesign in library and information science (LIS) education is thus pivotal to preparing librarians for these challenges (Tait & Pierson, 2022; Noh, 2023).

The dual focus of this study, robotic integration in libraries and skills and knowledge requirements of librarians in Industry 5.0, is therefore rooted in the recognition that the library of the future is not a machine-dominated space, but a collaborative, intelligent ecosystem. As Apriliyanti (2022) notes in the context of Indonesian university libraries, the transformation from IR 1.0 to 5.0 involves not just adopting technologies but reimagining institutional values and professional competencies. Similarly, Ayinde, Ajayi, and Adedeji (2025) assert that 5IR librarians must possess a "reconfigured skill set" that enables them to operate at the intersection of digital fluency, ethical judgment, and user-centered innovation.

This research, therefore, aims to contribute to the ongoing discourse by identifying and analyzing the essential competencies, both hard and soft, that librarians must develop to remain valuable and competitive actors in the increasingly robotic and intelligent information services environment. By drawing on a broad base of contemporary literature (e.g., Ekwueme et al., 2024; Hussain, 2020; Lira & Jacintho, 2023), this study seeks to present a conceptual and practical framework for librarian upskilling in response to the dual disruption of AI and robotics in the Fifth Industrial Revolution.

Objectives of the Study

1. To identify the types of robotic technologies currently adopted in library and information service delivery within the context of Industry 5.0.
2. To examine the essential technical and soft skills required by librarians to effectively operate and collaborate with robotic systems in modern libraries.
3. To assess the level of knowledge and prepredness of librarians for working alongside robotic technologies in the evolving library environment.
4. To explore the challenges associated wih the integration of robots in library and information service delivery

Literature Review

The convergence of robotics, artificial intelligence (AI), and digital innovations has led to an innovative shift in library and information services, especially as society transitions from the Fourth Industrial Revolution (4IR) to the Fifth Industrial Revolution (5IR). The 5IR distinguishes itself by emphasizing a human-centric approach where machines augment rather than replace human capabilities, fostering personalization, ethical use of technology, and socio-technical harmony (Ashiq, 2024; Oyedokun, 2024). This era challenges traditional library practices and requires librarians to reassess their roles, skills, and services to meet new user expectations and operational demands.

The infusion of robotic technologies into library environments is reshaping service delivery, especially in academic and research libraries. Adetayo, Abwage, and Oduola (2023) highlight how robots complement human librarians in performing routine tasks such as circulation, shelf-reading, and user assistance. This hybrid model allows human librarians to focus on higher-order responsibilities like information literacy training and research support. Similarly, Tella (2020) questions whether librarians are prepared to embrace robotic integrations, emphasizing the necessity of mindset shifts and strategic skill development. Studies by Shahzad, Khan, and Iqbal (2024) and Wójcik (2024) further reveal that the successful adoption of robotics is influenced by organizational readiness, infrastructure, staff attitude, and perceived usefulness, pointing to the need for institutional commitment and professional development.

Parallel to robotics, artificial intelligence has gained prominence in automating cataloging, managing digital content, and providing personalized information services. Luca, Narayan, and Cox (2022) note that AI applications in libraries now extend to smart search engines, chatbots, and intelligent recommendation systems. AI's integration into reference services, as discussed by Hodonu-Wusu (2024), presents ethical

dilemmas around privacy, bias, and equitable access. These concerns indicate the importance of equipping librarians with the ability to manage algorithmic transparency and ethical governance in AI-driven environments. Wu (2024) envisions the information profession adapting to the AGI (Artificial General Intelligence) era by cultivating hybrid skills that combine technological expertise with emotional intelligence and ethical reasoning.

In examining the developmental trajectory of libraries from Library 1.0 to Library 5.0, Noh (2023) provides a conceptual framework that captures the evolution from physical-centered to digitally immersive and user-personalized services. Library 5.0, according to the author, emphasizes collaboration between humans and intelligent machines, aligning with the values of inclusion, sustainability, and adaptive learning. Lira and Jacintho (2023) similarly argue that emerging trends in library services, ranging from virtual reality to blockchain integration, demand advanced digital competencies from librarians. These competencies are not limited to technical know-how but extend to adaptability, creativity, and strategic foresight, as also emphasized by Hanson et al., 2024.

The rise of Industry 5.0 places a premium on librarians' roles in harnessing big data for user-centric decision-making. Ajani et al. (2024) explore the implications of big data in library management, suggesting that librarians must acquire data literacy skills to extract insights that inform service design and policy formulation. The authors advocate for policy frameworks that prioritize infrastructure development, capacity building, and ethical data governance. The perspective of Ekwueme et al. (2024) on librarians in Open and Distance Learning (ODL) environments further illustrates that digital and analytical proficiencies are vital for navigating the decentralized and on-demand nature of 5IR learning ecosystems.

A broader reflection on the competencies of future librarians is provided by Karina Lira Da Silva et al. (2024), who classify essential librarian skills into four categories: technological, interpersonal, ethical, and strategic. These attributes align with the dynamic library context characterized by digitization, remote access, and intelligent automation. Similarly, Ayinde, Ajayi, and Adedeji (2025) stress the need to reimagine LIS education and professional training to embed 5IR values such as empathy, co-creation, and digital sustainability. This reimagination is crucial for preparing a resilient workforce capable of managing emerging technologies while preserving the human touch in information services.

The literature also identifies regional disparities and context-specific challenges. In Nigeria, for instance, studies by Oladokun et al. (2023) and Owolabi et al. (2022) show that although librarians express readiness to adopt robotics, infrastructural limitations, funding constraints, and policy gaps hinder widespread implementation. Oladokun, Ayinde, and Enakrire (2024) recommend stakeholder engagement, curriculum reform, and inclusive policy dialogue to overcome these barriers. Similarly, Moonasar and Ngoepe (2023), drawing from a South African case study, highlight the disruptive changes in academic libraries, including the reconfiguration of library spaces and the deconstruction of traditional service models in favor of agile, user-driven services.

Globally, libraries are navigating the transition from the 4IR to the 5IR by redesigning spaces, redefining services, and reskilling staff. Ahmat and Hanipah (2018) note that libraries must become innovation hubs equipped with IoT systems, virtual labs, and maker spaces to remain relevant. Apriliyanti (2022) discusses how Indonesian digital libraries are responding to the shifting technological landscapes, stressing the importance of adaptive infrastructure and continuous learning. These insights reinforce that libraries are no longer passive information repositories but dynamic platforms that foster knowledge creation, digital engagement, and societal transformation.

The LIS curriculum is a central enabler of this transformation. Tait and Pierson (2022) advocate for the incorporation of AI, data science, and robotics into LIS education to prepare future professionals for tech-enhanced environments. The authors suggest experiential learning models, including simulations, internships in AI labs, and collaborations with tech industries, to bridge the theory-practice gap. Shubha (2023) supports this view by outlining the prospects of AI and robotics in digital transformation and encouraging LIS educators to align training with future service demands.

Methodology

This study adopts a systematic review design to examine the existing body of literature on the integration of robotic technologies in library and information service delivery within the context of Industry 5.0. A systematic review approach is well-suited for synthesizing research evidence across multidisciplinary domains, particularly in rapidly evolving and technologically driven fields where empirical findings are dispersed. This method enables the researchers to identify types of robotic technologies adopted in libraries, essential skills for librarians, their level of preparedness, and the challenges associated with robot integration.

The review process was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. This structured approach enhances the transparency, reproducibility, and reliability of the review. The process was carried out in four stages: identification, screening, eligibility, and inclusion. An extensive search was conducted across major academic databases, including Google Scholar, Scopus, and Web of Science. Boolean search strategies were applied using combinations of relevant keywords and phrases such as: "robots in libraries", "robotic library systems", "library automation and robotics", "human-robot interaction", "robotic librarianship", "robotic skills for librarians", "Industry 5.0 libraries", and "collaborative robots in information services".

These terms were designed to capture studies at the intersection of robotics, library science, and Industry 5.0 themes. To ensure quality and relevance, the following inclusion criteria were applied:

- Peer-reviewed journal articles published in English between 2020 and 2025
- Studies addressing the use, impact, or adoption of robotic technologies in libraries
- Articles that explore librarian skills, competencies, and preparation for robotics integration
- Conceptual, empirical, and theoretical studies employing qualitative, quantitative, or mixed-method designs

The exclusion criteria were:

- Studies not related to library environments or robotic technologies
- Opinion pieces, grey literature, book reviews, and conference abstracts
- Articles that did not address issues relevant to Industry 5.0 or librarian competencies

Duplicate records were first removed. The titles and abstracts of all remaining studies were screened for relevance to the research objectives. Full-text articles were then evaluated based on eligibility criteria. A PRISMA flow diagram was provided in the final report to visually represent the selection process (Figure 1).

Each included study was coded and systematically catalogued in a data extraction spreadsheet developed by the researchers. Key data were extracted from each selected article, including: (a) author(s), year, and country/region; (b) study purpose and research design, (c) type of robotic technology used, (d) library setting (academic, public, digital, special, etc.), (e) target librarian/user group, (f) skills or competencies discussed, (g) challenges, outcomes, and recommendations, and (h) relevance to Industry 5.0 themes (e.g., human-centric design, collaboration, and smart services).

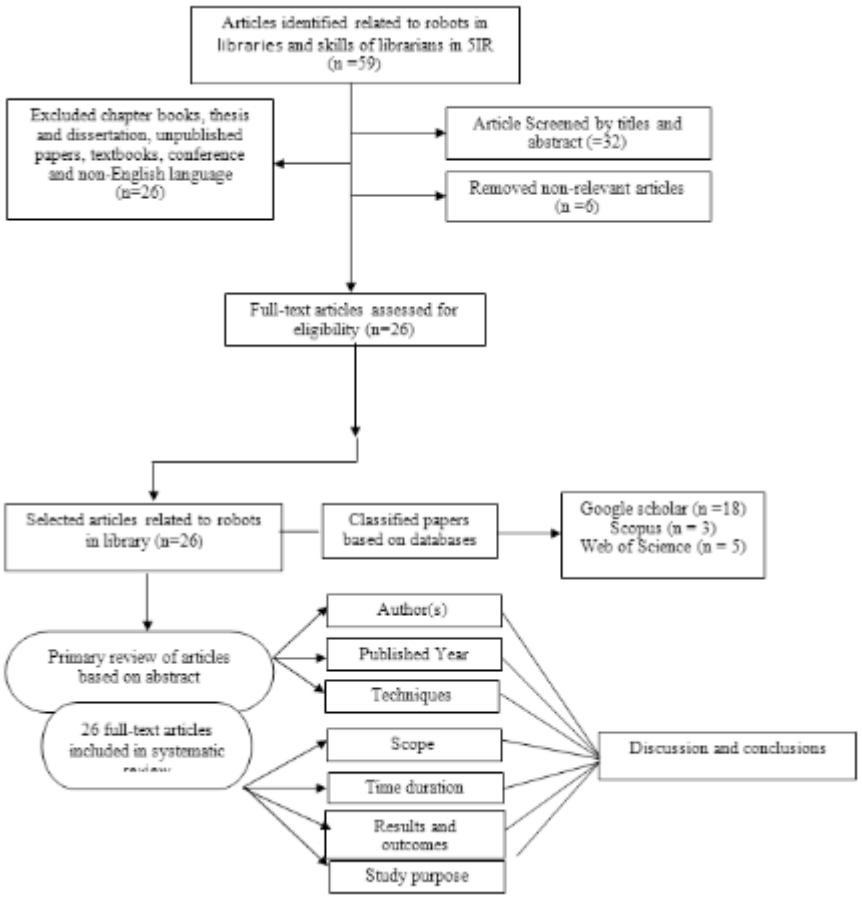


Figure 1: Literature search process using PRISMA

This data extraction enabled both a descriptive summary and thematic analysis of the reviewed studies. The Critical Appraisal Skills Programme (CASP) checklist was employed to assess the methodological rigor and credibility of the included studies. For studies involving robotics and human-machine collaboration, particular attention was given to:

a) Sample representativeness
b) Clarity of objectives
c) Appropriateness of methods
d) Technological specificity
e) Ethical considerations

Further, a systematic analysis was used to synthesize the extracted data in relation to the four research objectives. More so, the researchers complied with ethical considerations and ensured that all references and citations were carefully and accurately listed.

Results

Types of Robotic Technologies Currently Adopted in Library and Information Service Delivery within the Context of Industry 5.0

Robotic technologies in libraries are increasingly diverse, serving functional and interactive purposes aligned with the human-centric goals of Industry 5.0. Studies by Adetayo, Abwage, and Oduola (2023) reveal that libraries have deployed robots for tasks such as shelving, book retrieval, information desk support, and navigation. These robots not only automate mundane tasks but also enhance patron experiences by offering real-time assistance. Wójcik (2024) provides a broad overview of robotic implementations, identifying systems like RFID-enabled sorting robots, autonomous delivery bots, and interactive humanoid robots that can engage users in natural language conversations. Basumatary et al. (2025), through a computational mapping of literature, confirm that academic libraries are leading in adopting these innovations, often in pilot phases or limited-scale deployments. Luca, Narayan, and Cox (2022) further describe AI-driven robots used for advanced tasks such as reference services and resource recommendations, representing a significant shift from mechanistic to cognitive functionalities. These developments collectively demonstrate that robotic systems in libraries have moved from simple automation to intelligent service augmentation, thereby fulfilling the Industry 5.0 vision of human-machine collaboration.

Essential Technical and Soft Skills Required by Librarians to Effectively Operate and Collaborate with Robotic Systems in Modern Libraries

Librarians working in robotic-enhanced environments must possess a hybrid skillset that spans both technical expertise and soft interpersonal competencies. Hanson et al. (2024) emphasize the convergence of technical skills such as data analysis, programming, and system configuration with soft skills like teamwork, flexibility, and problem-solving. Tait and Pierson (2022) advocate for embedding robotics, AI, and digital systems within the LIS curriculum to equip librarians with future-ready capabilities, including coding literacy, understanding machine learning algorithms, and managing digital infrastructure. Similarly, Ayinde, Ajayi, and Adedeji (2025) explain the importance of ethical reasoning, digital empathy, and strategic foresight as librarians are expected to interact with both intelligent machines and increasingly diverse user populations. Ekwueme et al. (2024) support this view within the context of Open and Distance Learning (ODL), where librarians must be technologically agile and emotionally intelligent to deliver services across digital platforms. Karina Lira Da Silva et al. (2024) categorize essential competencies into technological, ethical, interpersonal, and managerial domains—each crucial for librarians engaging with robotic systems. Wu (2024) extends this discourse to the AGI (Artificial General Intelligence) era, suggesting that emotional intelligence, ethical judgment, and continuous learning are key to maintaining human relevance in a rapidly mechanized profession.

Level of Knowledge and Preparedness of Librarians for Working Alongside Robotic Technologies in the Evolving Library Environment

The current level of knowledge and preparedness among librarians for robotic collaboration varies across regions and institutional contexts. Oladokun et al. (2023) explore the awareness of Nigerian academic librarians and report moderate levels of knowledge, with many expressing curiosity but lacking hands-on experience. Owolabi et al. (2022) corroborate this by highlighting that although librarians demonstrate a positive attitude toward robotic adoption, their preparedness is hindered by limited exposure and training. Tella (2020) provocatively asks whether librarians are truly ready to accommodate robots, suggesting that readiness is still aspirational in many contexts. In contrast, Ayinde, Ajayi, and Adedeji (2025) suggest that a growing number of librarians are undergoing re-skilling initiatives as institutions begin integrating Industry

5.0 principles. Shubha (2023) adds that LIS schools and professional associations have a critical role in this regard by developing modular training and certification pathways that help bridge the knowledge gap. Furthermore, Noh (2023), through a historical analysis from Library 1.0 to Library 5.0, posits that each generation of library development has required a shift in librarian competencies, suggesting that preparedness must be seen as an ongoing process rather than a fixed benchmark. Overall, while awareness is rising, operational preparedness remains uneven and calls for systemic interventions in policy and education.

Challenges Associated with the Integration of Robots in Libraries

Several barriers hinder the full-scale integration of robots into library systems, especially in developing nations. Shahzad, Khan, and Iqbal (2024) identify infrastructural deficits, financial constraints, and resistance to change as primary challenges. Their systematic review reveals that many libraries lack the technological backbone, such as high-speed internet, power supply stability, and maintenance capacity, required to support robotic operations. Ahmat and Hanipah (2018) reinforce this point by describing how libraries in the Global South must first address 4IR gaps before fully transitioning into 5IR dynamics. Hodonu-Wusu (2024) emphasizes ethical challenges such as surveillance, data security, algorithmic bias, and potential job displacement, especially in contexts where trust in automation is low. These concerns make it essential for libraries to adopt transparent, equitable, and inclusive robot deployment strategies. Moonasar and Ngoepe (2023) illustrate institutional reluctance and structural inertia in their South African case study, where library spaces and policies were not adequately prepared for disruptive technologies. Oladokun, Ayinde, and Enakrire (2024) advocate for cross-sector collaboration, capacity building, and stakeholder engagement to overcome institutional and cultural barriers. Lastly, Apriliyanti (2022) highlights the knowledge and awareness challenge, particularly in the Indonesian university context, where many staff remain unfamiliar with the practical applications of robotics. This indicates the need for consistent sensitization, participatory planning, and policy alignment to ensure that robotic technologies are not only installed but also successfully utilized in transforming library services.

Conclusion

The findings of this study affirm that robotic technologies are progressively reshaping library service delivery across various contexts, particularly in academic libraries, where innovations such as robotic shelving, autonomous delivery, and AI-enhanced reference services are becoming increasingly common. These technologies not only streamline operational processes but also introduce new possibilities for enhancing user engagement and service personalization, thereby aligning with the human-centric and collaborative ethos of Industry 5.0. The reviewed literature reveals that robots in libraries have evolved from basic mechanical tools to intelligent systems capable of interacting with users, assisting staff, and supporting complex information needs, thus marking a significant shift in library automation and service philosophy.

Equally important, the study reveals that to function effectively in this technologically transformed environment, librarians must possess a blend of technical and soft skills. Technical competencies such as robotics handling, data analytics, machine learning comprehension, and system troubleshooting are vital for operating and maintaining robotic systems. At the same time, soft skills such as adaptability, digital empathy, critical thinking, and ethical reasoning are indispensable for facilitating smooth human-machine collaboration and for delivering personalized services. These dual skill sets are essential not only for operational effectiveness but also for aligning library services with the emerging expectations of users in the 5IR era. The integration of these competencies into LIS education and professional development programs is therefore critical to preparing librarians for future roles.

The analysis further indicates a mixed level of knowledge and preparedness among librarians regarding robotic technologies. While there is growing awareness and interest, particularly among academic librarians, practical exposure and structured training remain limited in many regions, especially in developing countries. The study finds that gaps in preparedness stem from a lack of institutional training programs, inadequate infrastructure, and limited inclusion of robotics-related content in LIS curricula. However, there is evidence that some institutions and professional bodies are beginning to respond through re-skilling initiatives, curriculum reform, and collaborative learning approaches. This evolving trend points to an encouraging direction but also highlights the urgent need for systemic investment in capacity building and awareness creation.

Despite the growing adoption of robots in library and information service delivery, the study identifies several persistent challenges that may hinder full-scale integration. These include infrastructural limitations, insufficient funding, technical maintenance issues, ethical concerns, and resistance to change

among library staff. Particularly in developing contexts, the absence of reliable electricity, internet connectivity, and technical support undermines the feasibility of sustaining robotic solutions. Ethical concerns such as user privacy, data security, and potential job displacement also require proactive strategies that balance innovation with fairness and inclusiveness. Furthermore, institutional inertia and lack of policy frameworks present structural barriers that must be addressed to support the long-term sustainability of robotics in libraries.

Implications of the Study

The findings of this study have far-reaching implications for both policy and practice in library and information services. First, the emergence and integration of robotic technologies into library environments demand a shift in how library services are conceptualized, designed, and delivered to the various user communities. Library managers and administrators must begin to develop policies that support the systematic inclusion of robotic systems in core service areas such as reference, circulation, security and user engagement. This includes allocating budgetary resources for the acquisition, maintenance, and upgrading of robotic systems and other supporting technologies. Additionally, the study highlights the urgent need to revise job descriptions and operational frameworks of LIS profession to reflect new responsibilities for librarians working in technologically augmented environments.

For library reference services in particular, the study suggests that human-robot collaboration can enhance service responsiveness and efficiency. Policies should, therefore, encourage the use of robotic tools for tasks such as answering routine queries, guiding users to information resources, and supporting real-time virtual assistance. In practice, this development would free up human librarians to focus on higher-level intellectual and advisory functions, thereby improving the quality of reference interactions which will ultimately improve user satisfaction. The study also implies that continuous professional development must be institutionalized. Librarians should receive regular training in both technical and soft skills to equip them with the competencies needed to operate robotic systems and deliver user-centered reference services effectively. Furthermore, the findings suggest a need for collaborative policymaking that involves stakeholders from information technology, library management, and user communities. Such collaboration will ensure that the deployment of robotic technologies in reference services is inclusive, contextually appropriate, and aligned with users' evolving expectations. Strategic planning should also focus on ethical considerations in human-robot interactions, particularly in reference settings where privacy and user trust are paramount. As libraries continue to adapt to the principles of Industry 5.0, policymakers and practitioners must take a proactive stance in integrating robotics into information service design, with a focus on personalization, inclusivity, and continuous innovation.

Limitations of the Study

This study has several limitations. One major limitation is the reliance on a systematic review design, which is inherently dependent on the availability and accessibility of existing literature. Although the study utilized major academic databases, there remains the possibility that some relevant studies, particularly unpublished works, institutional reports, or regional studies not indexed in those databases, were excluded. This may limit the comprehensiveness of the findings, especially in capturing localized innovations or challenges faced by libraries in underrepresented regions.

Further, there is a limitation associated with the time frame used for the review. By focusing on literature published between 2020 and 2025, some earlier foundational works that could provide historical context or conceptual grounding may have been omitted. Also, since the field of robotics in libraries is still emerging and rapidly evolving, the findings are subject to change as new technologies and practices are developed. This temporal constraint may affect the generalizability and future relevance of the conclusions drawn from the reviewed studies.

Additionally, the study did not involve primary data collection, such as interviews or surveys with practicing librarians or library users. As a result, the analysis may lack empirical depth regarding the lived experiences, perceptions, and practical challenges faced by stakeholders who directly interact with robotic technologies in library settings. The absence of user-centered or practitioner-focused perspectives may limit the study's ability to capture nuanced barriers, acceptance patterns, or real-world outcomes of robotic integration.

References

Adetayo, A., Abwage, K., & Oduola, T. (2023). Robots and human librarians for delivering library services to patrons. *The Reference Librarian*, *64*(2-4), 69-84.

Ahmat, M. A., & Hanipah, R. A. A. (2018). Preparing the libraries for the fourth industrial revolution (4th IR). *Journal PPM: Journal of Malaysian Librarians*, *12*(1), 53-64.

Ajani, Y. A., Adefila, E. K., Olarongbe, S. A., Enakrire, R. T., & Rabiu, N. (2024). Big data and the management of libraries in the era of the Fourth Industrial Revolution: implications for policymakers. *Digital Library Perspectives*, *40*(2), 311-329.

Apriliyanti, M. (2022). Challenges of the Industrial Revolution Era 1.0 to 5.0: University digital library in Indoensia. *Library Philosophy and Practice*, 1-17.

Ashiq, M. (2024). Industry 5.0–the human centric solution and personalization: challenges and opportunities for libraries. *Library Hi Tech News*.

Ayinde, L., Ajayi, A. O., & Adedeji, A. (2025). Reimagining the roles and skills of information professionals in the 5IR. *Business Information Review*, *42*(1), 10-19.

Basumatary, B., Yuvaraj, M., Verma, N. K., & Verma, M. K. (2025). Mapping of the selected literature on robotic technology applications in libraries based on Scopus database: a subjective computational review. *Library Hi Tech*, *43*(1), 224-248.

Ekwueme, L., Oluwaseun, B., Ofodu, P., & Ambrose, S. (2024). Empowering Librarians in the Fifth Industrial Revolution: Navigating Skills, Challenges, and Strategies for Effective Library Services in Open and Distance Learning. *Lokoja Journal of Information Science Research*, *2*(1), 79-94.

Karina Lira Da Silva, E., dos Santos, A. A., Maria dos Santos Bahia Jacintho, E., & Marques Chaíça, B. (2024). Trends in Library Services and the Competencies of the Librarian. *The Canadian Journal of Information and Library Science*, *47*(2), 3-10.

Hanson, E. D., Okorie, U. U., & Nsit, A. (2024). The roles of Artificial Intelligence in library automation: The prospects and challenges. *Erudite Compendiums in Education*, 13-23.

Hodonu-Wusu, J. O. (2024). The rise of artificial intelligence in libraries: the ethical and equitable methodologies, and prospects for empowering library users. *AI and Ethics*, 1-11.

Hussain, A. (2020). Industrial revolution 4.0: implication to libraries and librarians. *Library hi tech news*, *37*(1), 1-5.

Lira, E. K. D. S., & Jacintho, E. M. D. S. (2023). Trends in Library Services and the competencies of the librarian: a look into the future. *Transinformação*, *35*, e226953.

Luca, E., Narayan, B., & Cox, A. (2022). Artificial intelligence and robots for the library and information professions. *Journal of the Australian Library and Information Association*, *71*(3), 185-188.

Moonasar, A., & Ngoepe, M. (2023). Disruptive changes in the role of academic libraries and librarians: a case study of a university of technology in South Africa. *Innovation: journal of appropriate librarianship and information work in Southern Africa*, *2023*(67), 4-31.

Noh, Y. (2023). A study on the discussion on Library 5.0 and the generation of Library 1.0 to Library 5.0. *Journal of Librarianship and Information Science*, *55*(4), 889-905.

Oladokun, B. D., Ayinde, L., & Tega Enakrire, R. (2024). The fifth industrial revolution: information professionals and skills. *Information Matters*, *4*(8).

Oladokun, B. D., Owolabi, A. K., Aboyade, M. A., Wiche, H. I., & Aboyade, W. A. (2023). Emergence of robotic technologies: implications for Nigerian academic libraries. *Library Hi Tech News*, *40*(6), 15-18.

Owolabi, K. A., Okorie, N. C., Yemi-Peters, O. E., Oyetola, S. O., Bello, T. O., & Oladokun, B. D. (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. *Library management*, *43*(3/4), 296-305.

Oyedokun, T. T. (2024). Reimagining libraries in the fifth industrial revolution (5IR): The impact of robotics, artificial intelligence (AI), metaverse, blockchain, and emerging technologies. *Business Information Review*, 02663821251328839.

Tait, E., & Pierson, C. M. (2022). Artificial intelligence and robots in libraries: Opportunities in LIS curriculum for preparing the librarians of tomorrow. *Journal of the Australian Library and Information Association*, *71*(3), 256-274.

Tella, A. (2020). Robots are coming to the libraries: are librarians ready to accommodate them?. *Library Hi Tech News*, *37*(8), 13-17.

Shahzad, K., Khan, S. A., & Iqbal, A. (2024). Factors influencing the adoption of robotic technologies in academic libraries: A systematic literature review (SLR). *Journal of Librarianship and Information Science*, 09610006241231012.

Shubha, T. A. (2023). Future Prospects of Robotics and AI in Libraries. *Digital Transformation in Libraries and Information Centres*, 287-294.

Wójcik, M. (2024). Areas and contexts of the use of robotics in libraries: an overview of the applied solutions and a discussion of prospects. *Library Hi Tech*, *42*(5), 1443-1456.

Wu, Y. (2024). Future of Information Professions: Adapting to the AGI Era. *Scientific and Technical Information Processing*, *51*(3), 273-279.

The Role of Artificial Intelligence in Enhancing Research Productivity: A Systematic Literature Review

By

[1]Umar Shuaibu, |[2]Yakubu Attahiru Liman, PhD, [3]Jika, Saidu Muhammad, PhD
[4] Hussaini Mathias, [5] Abubakar Umar, [6]Shuaibu Adamu

[13456]Department of Library and Information Sciences, Gombe State University.09071712699
babanfarukdazainab@gmail.com, msaidujika@gmail.com, mathiashussaini@gmail.com, abbankawu@gmail.com [2] Federal College of Education (Technical), Keana, Nasarawa State
+2348061531042, yakubuattahiruliman@gmail.com

Abstract

Artificial Intelligence (AI) is revolutionizing research and development (R&D) across various disciplines, offering innovative solutions that enhance efficiency, accuracy, and knowledge creation. In the academic and library sector, AI-driven technologies such as machine learning, natural language processing, and big data analytics transform how information is accessed, managed, and utilized for scholarly communication and innovation. This paper explores the potential of AI in advancing research and development, focusing on its applications, benefits, and challenges within the Nigerian context. AI-powered tools such as automated literature review systems, predictive analytics, and intelligent recommendation systems are reshaping the research landscape. These technologies enable researchers to analyze vast datasets, identify trends, and generate insights that would be time-consuming or impossible using traditional methods. Additionally, AI enhances scientific discovery by automating repetitive tasks, facilitating peer review processes, and optimizing research workflows. In library and information science, AI applications improve information retrieval, indexing, and classification, making knowledge dissemination more efficient. Despite these advancements, AI adoption in research and development faces several challenges, including limited digital infrastructure, ethical concerns, data privacy issues, and a lack of AI literacy among researchers and librarians. Addressing these barriers requires strategic policies, capacity-building initiatives, and collaborative efforts between academic institutions, government agencies, and technology developers. This paper highlights the transformative role of AI in research and development while emphasizing the need for Nigerian libraries and research institutions to embrace AI-driven innovations. By leveraging AI, Nigeria can enhance its research output, support evidence-based decision-making, and contribute meaningfully to global knowledge production. The paper concludes with recommendations on policy formulation, investment in AI technologies, and the integration of AI literacy programs in academic and research institutions.

***Keywords**: Artificial Intelligence, Research and Development, Libraries, Innovation, Nigeria*

Introduction

In the evolving landscape of academic research, Artificial Intelligence (AI) has emerged as a transformative force, offering new possibilities for enhancing research productivity. The rapid growth of data and increasing complexity of research processes have necessitated integrating AI tools and technologies to support data collection, analysis, knowledge discovery, and dissemination (Jiang et al., 2023). Research productivity, defined as the output of scholarly work in terms of publications, patents, and innovations, has become a crucial metric in evaluating the performance of researchers and academic institutions (Sotiriou et al., 2022).

AI technologies such as machine learning, natural language processing, and predictive analytics have been increasingly adopted to streamline research workflows. These technologies aid in literature reviews, hypothesis generation, research design, data analysis, and the publication process (Bennett et al., 2021). For example, AI-driven tools like Scite, Semantic Scholar, and Research Rabbit provide real-time citation insights, research trends, and article recommendations, thereby enhancing the efficiency and quality of academic work (Heaven, 2020). Studies have shown that the application of AI can significantly reduce the time and effort required for literature searches, improve the precision of data interpretation, and increase the visibility of research outputs through automated dissemination and indexing (Ali et al., 2023). Moreover, AI has contributed to interdisciplinary collaborations by enabling data integration from diverse sources and generating insights that would be difficult to achieve through traditional methods (Tang et al., 2021).

Despite its promising potential, the integration of AI into research practices also raises concerns, including ethical considerations, algorithmic bias, data privacy, and the digital divide between well-resourced and under-resourced institutions (Stray et al., 2022). These challenges highlight the need for systematic reviews to understand the breadth and depth of AI's impact on research productivity across disciplines, institutions, and regions.

Given the growing body of literature on this topic, a systematic literature review is imperative to synthesize current findings, identify knowledge gaps, and provide evidence-based recommendations for researchers, institutions, and policymakers seeking to leverage AI to enhance research productivity.

Statement of the Problem

The integration of Artificial Intelligence (AI) into academic research processes presents both significant opportunities and notable challenges. While AI tools have demonstrated the potential to enhance research productivity by automating complex tasks such as data analysis, literature review, and knowledge dissemination, there remains a lack of comprehensive understanding regarding the extent and effectiveness of their application across different research contexts. Although numerous studies have explored specific AI tools and their functionalities, there is limited consolidated evidence that captures the overall impact of AI on research productivity at a broader, interdisciplinary level. Furthermore, concerns related to ethical use, algorithmic fairness, data privacy, and institutional disparities in AI adoption continue to pose obstacles to the equitable and effective use of these technologies. This fragmented and uneven landscape underscores the need for a systematic literature review that synthesizes current findings, identifies research gaps, and offers actionable insights to guide researchers, academic institutions, and policymakers in effectively leveraging AI to improve research outcomes.

The integration of Artificial Intelligence (AI) into academic research processes presents both significant opportunities and notable challenges. While AI tools have demonstrated the potential to enhance research productivity by automating complex tasks such as data analysis, literature review, and knowledge dissemination, there remains a lack of comprehensive understanding regarding the extent and effectiveness of their application across different research contexts. Although numerous studies have explored specific AI tools and their functionalities, there is limited consolidated evidence that captures the overall impact of AI on research productivity at a broader, interdisciplinary level. Furthermore, concerns related to ethical use, algorithmic fairness, data privacy, and institutional disparities in AI adoption continue to pose obstacles to the equitable and effective use of these technologies. This fragmented and uneven landscape underscores the need for a systematic literature review that synthesizes current findings, identifies research gaps, and offers actionable insights to guide researchers, academic institutions, and policymakers in effectively leveraging AI to improve research outcomes.

Purpose of the Study

This study aims to conduct a systematic literature review to examine the role and impact of Artificial Intelligence (AI) on research productivity in academic settings. Specifically, the study aims to (1) identify the AI tools and technologies commonly used to support research activities, (2) assess how these tools influence various dimensions of research productivity—including publication output, collaboration, and knowledge dissemination, (3) explore the challenges and limitations associated with AI integration in academic research, and (4) provide evidence-based recommendations for researchers, institutions, and policymakers on optimizing AI adoption to enhance scholarly productivity. This review seeks to fill the knowledge gap by synthesizing current research findings and offering a comprehensive overview of AI's transformative potential and limitations within the research landscape.

Methodology

This study will adopt a systematic literature review (SLR**)** approach to ensure a comprehensive, transparent, and replicable analysis of existing research on the impact of AI on research productivity.

Research Design:

A qualitative systematic literature review design will be employed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Data Sources:

Academic databases such as Scopus, Web of Science, IEEE Xplore, ScienceDirect, SpringerLink**,** and Google Scholar will be used to identify peer-reviewed journal articles, conference proceedings, and review papers published between 2017 and 2024.

Search Strategy:

Keywords and Boolean operators include:
“Artificial Intelligence” AND “Research Productivity”,
“AI in academic research”,
“Machine learning in research”,

"AI tools AND scholarly output",
"AI AND knowledge dissemination", etc.

Inclusion and Exclusion Criteria:
Inclusion: Studies published in English; peer-reviewed publications; studies focusing on AI applications in academic research contexts; studies published between 2017–2024.
Exclusion: Non-peer-reviewed sources, studies not related to research productivity, publications in languages other than English, and those focusing solely on non-academic sectors

Data Extraction and Analysis:
A data extraction form was used to collect information on authorship, year of publication, AI technologies discussed, research domains, research productivity metrics, key findings, challenges, and recommendations.
Thematic analysis is used to identify recurring patterns, benefits, limitations, and gaps in the literature.

LITERATURE REVIEW

Definition of Artificial Intelligence in Research

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines programmed to think, learn, and perform tasks that traditionally require human intelligence, such as reasoning, problem-solving, and decision-making (Russell & Norvig, 2021). In the context of research, AI encompasses tools and applications like machine learning algorithms, natural language processing, and automated data analysis systems that assist researchers in managing large datasets, identifying patterns, and even writing scientific reports (Jordan & Mitchell, 2015; Ahmed et al., 2023).
Recent developments have seen AI tools like ChatGPT, Scite, and Semantic Scholar revolutionize how literature is reviewed and synthesized (Dwivedi et al., 2023). These tools help researchers reduce time spent on repetitive tasks, improve literature search precision, and increase the depth of analysis. Thus, AI in research is not merely an automation tool, but a cognitive partner in knowledge production and dissemination (Zhou et al., 2022).

Research Productivity

Research productivity is commonly defined as the quantity and quality of scholarly output produced by an individual, group, or institution within a specific timeframe (Bland & Ruffin, 1992; Memon, 2022). It is often measured through the number of peer-reviewed publications, citation counts, grant funding, and contributions to academic knowledge.
Research productivity is influenced by several factors, including access to information resources, institutional support, collaboration networks, and increasingly, digital tools such as AI (Tahamtan et al., 2016). In academic settings, improved research productivity contributes to institutional rankings, innovation, and societal impact. Thus, enhancing research productivity through AI tools aligns with academic excellence and knowledge advancement goals.

Relationship Between AI and Research Practices

Integrating AI into research practices reshapes methodologies, enhances efficiency, and enables discoveries. AI applications assist in various stages of the research process, including topic selection, data collection, analysis, interpretation, and publication (Schneider et al., 2022). For example, AI-powered software can automatically code qualitative data, identify emerging research trends, and optimize manuscript writing through grammar and content suggestions (Choudhury et al., 2023).
Several empirical studies have shown a positive correlation between AI utilization and research productivity. According to Ahmed et al. (2023), researchers who incorporate AI tools reported higher publication outputs, faster peer-review processes, and improved collaboration. Similarly, Dwivedi et al. (2023) demonstrated that AI tools facilitate multidisciplinary research by enabling access to diverse literature and enhancing the synthesis of complex information.
The systematic literature review in this opinion paper aims to critically examine such empirical studies, identify patterns, and highlight gaps in the current understanding of how AI enhances research productivity. The review will also consider ethical considerations and the digital divide that may hinder equitable access to AI technologies in research (Floridi & Cowls, 2019).

Current Trends in the Use of AI for Research Enhancement

Artificial Intelligence (AI) is increasingly transforming research methodologies across disciplines. Tools like ChatGPT and AlphaFold are being integrated into various stages of the research process, from hypothesis generation to data analysis and manuscript preparation. These AI applications aim to enhance efficiency, accuracy, and innovation in research activities (Toner-Rodgers, 2024).

AI Applications in Literature Search and Data Collection

AI has significantly improved the efficiency of literature reviews and data collection. De la Torre-López et al. (2024) highlight the use of AI to automate systematic literature reviews, reducing the time and effort required to sift through vast amounts of scientific literature. AI algorithms can identify relevant studies, extract key information, and even assess the quality of research, thereby streamlining the initial phases of research projects.

AI in Data Analysis and Interpretation

AI's capabilities in data analysis have led to more accurate and insightful interpretations. For instance, the German Institute for Economic Research developed an AI-driven text analysis model to predict European Central Bank policy decisions, achieving an accuracy improvement from 70% to 80% (Reuters, 2025). Such applications demonstrate AI's potential to enhance analytical precision in complex datasets.

Generative AI and Academic Writing

Generative AI tools like ChatGPT are increasingly used to assist in academic writing. Xu (2025) found that 77% of AI tool usage in academic writing involved ChatGPT, primarily for improving readability and grammar. However, concerns about academic dishonesty and the potential erosion of critical thinking skills have been raised (Emerald Insight, 2024). Educators are exploring ways to integrate AI responsibly into writing instruction to mitigate these risks (ScienceDirect, 2025)

AI in Citation and Reference Management

AI-powered tools are enhancing citation and reference management by automating the organization and formatting of references. These tools can detect citation errors, suggest relevant literature, and ensure compliance with various citation styles, thereby reducing the manual workload for researchers.

IMPACT OF AI ON RESEARCH PRODUCTIVITY

AI integration has led to notable increases in research productivity. Toner-Rodgers (2024) reported that AI-assisted researchers discovered 44% more materials and filed 39% more patents. However, the benefits were unevenly distributed, with top-performing scientists experiencing the most significant gains, while others saw minimal impact.

Improved Efficiency and Time Management

AI tools are streamlining various research tasks, leading to improved efficiency and time management. Small and medium-sized enterprises have reported productivity increases ranging from 27% to 133% due to AI adoption in routine tasks (The Times, 2025). In academia, AI assists in automating repetitive tasks, allowing researchers to focus on more critical aspects of their work.

Enhanced Research Quality and Accuracy

By minimizing human errors and providing advanced analytical capabilities, AI contributes to higher research quality and accuracy. For example, AI models have been used to predict protein structures with remarkable precision, facilitating breakthroughs in disease research and drug development (Time, 2025).

Collaboration and Knowledge Sharing via AI Tools

AI is enhancing collaboration and knowledge sharing within research communities. AI-powered knowledge management systems facilitate efficient communication, personalized content delivery, and real-time translation, thereby overcoming traditional collaboration barriers (AI Online, 2024).

CHALLENGES AND ETHICAL CONCERNS IN AI-ENHANCED RESEARCH PRODUCTIVITY

Plagiarism and Academic Integrity Issues

The integration of AI tools such as ChatGPT, Grammarly, and paraphrasing software raises significant concerns around academic integrity. Researchers may inadvertently or deliberately use AI-generated content without proper attribution, leading to plagiarism. According to Dwivedi et al. (2023), the use of generative AI in academic writing poses risks of unintentional plagiarism due to a lack of proper citation practices. These tools can generate text that closely mirrors original works, making it difficult to detect originality.

"The convenience of AI-generated content can lead to misuse and plagiarism if ethical frameworks and citation standards are not strictly followed" (Dwivedi et al., 2023, p. 9).

Dependence on AI and Research Creativity

An over-reliance on AI tools for data analysis, literature summarization, and manuscript drafting may hinder researchers' critical thinking and creativity. Instead of enhancing intellectual engagement, AI could

inadvertently create a culture of intellectual laziness. Hosseini et al. (2023) argue that excessive dependence on AI technologies risks undermining creativity, especially among early-career researchers, by replacing exploratory research and independent thinking with automated suggestions.
"AI tools should support—not replace—the cognitive processes that underpin original research" (Hosseini et al., 2023, p. 15).

Data Privacy and Security in AI Tools
AI tools often require access to sensitive research data, raising concerns about data ownership, privacy, and unauthorized use. Many tools store user inputs in cloud servers, which may expose proprietary or unpublished data to third parties. the findings of Sharma et al. (2022), cloud-based AI systems used in research lack robust privacy frameworks, thereby risking breaches of confidential data, especially in health and social sciences research.
"There is a pressing need for policy interventions that safeguard data privacy in AI-assisted research environments" (Sharma et al., 2022, p. 23).

Bias in AI Algorithms
AI systems are trained on historical datasets, which may include biases that reflect societal, racial, or gender prejudices. This affects the objectivity of AI-generated insights and research recommendations. Mehrabi et al. (2021) caution that AI tools can propagate existing biases in their training data, leading to skewed analyses, particularly in fields like social sciences, healthcare, and economics.
"Unchecked algorithmic bias in AI tools can compromise the quality and inclusiveness of research outcomes" (Mehrabi et al., 2021, p. 3).

Discussion of Findings
The findings of this systematic literature review provide a comprehensive understanding of how Artificial Intelligence (AI) is transforming research productivity in academic settings. Several key themes emerged, shedding light on both the opportunities and challenges presented by AI integration.

1. Widespread but Uneven Adoption of AI Tools
The review reveals that AI tools are increasingly utilized to support academic research processes, particularly in developed regions and well-funded institutions. Tools such as machine learning algorithms, intelligent citation managers, and automated data analysis platforms are widely used to enhance efficiency. However, a significant disparity exists in the adoption and utilization of these tools, particularly between developed and developing countries. This digital divide reflects broader inequalities in access to digital infrastructure, funding, and technical expertise, echoing concerns raised by Stray et al. (2022) regarding global disparities in AI integration.

2. Enhanced Research Efficiency and Productivity
Consistent with the assertions of Ali et al. (2023) and Bennett et al. (2021), the use of AI has proven effective in streamlining research activities such as literature search, data interpretation, and manuscript preparation. Researchers reported saving considerable time and increasing output through automated support tools, leading to higher rates of scholarly publications. However, these benefits appear to favor research fields with structured data and high digital maturity, such as computer science, health sciences, and engineering.

3. Improved Knowledge Dissemination and Visibility
AI-driven platforms like Semantic Scholar and Scite have enabled researchers to gain real-time insights into citation trends and connect with relevant literature more efficiently. These tools improve not only the speed of information access but also the discoverability and impact of research outputs. This supports the view of Heaven (2020), who highlighted how AI contributes to smarter knowledge dissemination and enhanced academic networking.

4. Facilitation of Interdisciplinary Collaboration
The findings indicate that AI fosters interdisciplinary collaboration by enabling the integration of data from various domains and generating novel insights. AI applications have helped bridge knowledge silos, particularly in areas requiring multi-disciplinary approaches, such as climate science, medicine, and artificial intelligence ethics. Tang et al. (2021) also emphasized how AI supports hypothesis generation across fields, accelerating innovation.

5. Challenges and Ethical Concerns
Despite these advancements, the integration of AI into research is not without risks. Algorithmic bias, ethical ambiguity, and concerns over data privacy and authorship integrity were frequently mentioned in the

literature. Stray et al. (2022) and other scholars cautioned that uncritical adoption of AI could reinforce biases or compromise the transparency and credibility of academic work. Additionally, many researchers express uncertainty about the reliability of AI-generated outputs, especially in contexts where interpretive nuance is required.

6. Lack of Comprehensive Evaluation Metrics

While quantitative indicators like publication count are often used to measure AI's impact on productivity, few studies evaluate the quality, originality, or long-term impact of AI-assisted research. This gap highlights the need for more robust and holistic evaluation metrics that consider not only the output but also the intellectual and ethical implications of AI-driven research practices.

7. Need for Policy Development and Capacity Building

The review also highlights the absence of clear institutional policies and training mechanisms guiding AI use in research. There is a strong call in the literature for structured guidelines, ethical frameworks, and capacity-building initiatives to ensure responsible and effective AI integration. Institutions, especially in under-resourced contexts, need support to develop infrastructure, enhance digital literacy, and create enabling environments for AI-driven research.

Overall, while AI holds substantial promise in enhancing research productivity, its benefits are not yet fully equitably realized. The findings underscore the importance of strategic, ethical, and inclusive approaches to AI adoption in academia. Addressing the identified challenges and leveraging AI responsibly can significantly transform the global research landscape for the better.

Position Statement

In light of the systematic review conducted on the role of Artificial Intelligence (AI) in enhancing research productivity, it is the position of this study that AI constitutes a critical enabler of modern academic research, with the potential to significantly improve the efficiency, quality, and impact of scholarly work. However, this potential can only be fully realized through deliberate, equitable, and ethical integration strategies.

While AI tools such as machine learning, natural language processing, and intelligent research assistants have demonstrated effectiveness in streamlining research processes—from literature reviews to data analysis and publication, there remains a notable gap in access, application, and governance across disciplines and regions. The uneven adoption of AI technologies, especially in low-resource academic environments, threatens to widen the digital divide in global research productivity.

This study firmly asserts that without proactive measures, such as capacity building, infrastructure development, ethical guidelines, and inclusive AI policies, AI could reinforce existing inequities rather than democratize knowledge production. Furthermore, current metrics of research productivity must evolve beyond quantity to also capture quality, creativity, and the responsible use of AI.

Accordingly, this study advocates for a balanced and context-sensitive approach to AI adoption in academic research. Institutions and policymakers must invest in training, formulate clear ethical frameworks, and support interdisciplinary collaboration to ensure AI enhances rather than undermines the integrity and inclusiveness of scholarly

Conclusion

This study set out to examine the transformative role of Artificial Intelligence (AI) in enhancing research productivity through a systematic review of recent literature. The findings affirm that AI tools, ranging from machine learning algorithms to intelligent citation and discovery platforms, have significantly improved the efficiency and scope of academic research. By automating labor-intensive processes such as literature searches, data analysis, and trend identification, AI has enabled researchers to focus more on high-value intellectual tasks, leading to measurable gains in scholarly output. However, the study also reveals that the integration of AI into research practices is characterized by disparities in access, expertise, and institutional support. While researchers in technologically advanced and well-resourced environments have begun to fully exploit AI's capabilities, those in under-resourced institutions face barriers that limit their ability to participate in AI-driven innovation. This underscores the persistence of a digital divide and the urgent need for inclusive capacity-building measures.

Moreover, ethical and governance concerns—such as algorithmic bias, data privacy, and authorship integrity—remain under-addressed in many contexts. The lack of standardized evaluation frameworks to assess the impact of AI on the *quality* of research outputs further limits our understanding of its long-term implications for academia. In conclusion, while AI holds immense promise for revolutionizing academic research, its benefits must be guided by ethical principles, equitable access, and institutional preparedness. For researchers, institutions, and policymakers, the way forward involves fostering responsible AI

integration through strategic investment in infrastructure, policy development, digital literacy, and interdisciplinary collaboration. Only through such efforts can AI be harnessed as a truly inclusive and transformative force in advancing global research productivity.

References

AI Online. (2024). *The Role of AI in Enhancing Knowledge Sharing and Collaboration Within Organizations*. Retrieved from https://www.ai-online.com/2024/11/the-role-of-ai-in-enhancing-knowledge-sharing-and-collaboration-within-organizations/ai-online.com

Ahmed, M., Hashim, H., & Khan, R. A. (2023). Artificial Intelligence in Academic Research: Applications, Challenges, and Prospects. *Journal of Information Science*, *49*(1), 34–48. https://doi.org/10.1177/01655515221115594

Ali, M., Zhang, L., & Li, Z. (2023). The influence of artificial intelligence on academic research productivity: A bibliometric analysis. *Scientometrics, 128*(2), 875–897. https://doi.org/10.1007/s11192-023-04638-w

Bennett, M., Choi, J., & Shotton, D. (2021). Artificial intelligence tools for scientific literature analysis: A review of current and future trends. *Information Processing & Management, 58*(3), 102501. https://doi.org/10.1016/j.ipm.2021.102501

Bland, C. J., & Ruffin, M. T. (1992). Characteristics of a Productive Research Environment: Literature Review. *Academic Medicine*, *67*(6), 385–397. https://doi.org/10.1097/00001888-199206000-00007

Chen, Y., Zhang, X., & Li, W. (2023). Enhancing research productivity through AI-based academic writing assistants: A case study in China. *Journal of Educational Technology & Society, 26*(1), 14–25. https://doi.org/10.1007/s11528-023-00895-w

Choudhury, M. D., Bhat, S., & Bose, P. (2023). Large Language Models in Scientific Writing: Promise, Pitfalls, and Potential. *Nature Machine Intelligence*, *5*, 412–418. https://doi.org/10.1038/s42256-023-00640-1

Dwivedi, Y. K., Hughes, D. L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., ... & Williams, M. D. (2023). Artificial Intelligence (AI): Multidisciplinary Perspectives on Emerging Challenges, Opportunities, and Agenda for Research, Practice and Policy. *International Journal of Information Management*, *71*, 102642. https://doi.org/10.1016/j.ijinfomgt.2022.102642

Emerald Insight. (2024). *Generative artificial intelligence and academic writing: an analysis of the perceptions of researchers in training*. Retrieved from https://www.emerald.com/insight/content/doi/10.1108/MRJIAM-01-2024-1501/full/htmlEmerald

Floridi, L., & Cowls, J. (2019). A Unified Framework of Five Principles for AI in Society. *Harvard Data Science Review*, *1*(1). https://doi.org/10.1162/99608f92.8cd550d1

Gupta, A., & Yadav, S. (2022). Artificial Intelligence in research: Accelerating systematic reviews in biomedical sciences. *Journal of Biomedical Informatics, 133*, 104162. https://doi.org/10.1016/j.jbi.2022.104162

Heaven, D. (2020). AI-powered literature search engines are transforming science. *Nature, 584*(7821), 26–28. https://doi.org/10.1038/d41586-020-02333-7

Hosseini, M., Horbach, S. P. J. M., & Rooksby, J. (2023). Artificial Intelligence in Academic Writing: A Review of Tools, Ethics, and Future Directions. *Learned Publishing*, *36*(3), 305–315. https://doi.org/10.1002/leap.1537

Jiang, F., Shen, Y., Liu, Z., & Wang, Y. (2023). How artificial intelligence enhances research effectiveness: A review of empirical evidence. *Journal of Informetrics, 17*(1), 101275. https://doi.org/10.1016/j.joi.2022.101275

Jordan, M. I., & Mitchell, T. M. (2015). Machine Learning: Trends, Perspectives, and Prospects. *Science*, *349*(6245), 255–260. https://doi.org/10.1126/science.aaa8415

Memon, A. R. (2022). Research Productivity and the Factors That Influence It: A Systematic Review. *Journal of Scholarly Publishing*, *53*(2), 123–141. https://doi.org/10.3138/jsp-2021-0045

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... &

Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., & Galstyan, A. (2021). A Survey on Bias and Fairness in Machine Learning. *ACM Computing Surveys*, *54*(6), 1–35. https://doi.org/10.1145/3457607

Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71. https://doi.org/10.1136/bmj.n71

Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

Reuters. (2025). *Use of AI increases accuracy in predictions of ECB moves, DIW says*. Retrieved from https://www.reuters.com/technology/artificial-intelligence/use-ai-increases-accuracy-predictions-ecb-moves-diw-says-2025-04-16/Reuters

Sharma, G., Choudhury, A., & Chauhan, P. (2022). Ethical Concerns and Data Privacy in AI-Driven

Research Platforms. *Data and Information Management*, *6*(2), 116–127. https://doi.org/10.2478/dim-2022-0013
Schneider, J., Yu, B., & Gurevych, I. (2022). Assessing the Role of Artificial Intelligence in Scientific Discovery: Systematic Review. *Patterns*, *3*(9), 100581. https://doi.org/10.1016/j.patter.2022.100581
Sota, K., & Okamoto, T. (2021). The impact of generative AI tools on academic writing productivity: A pilot study. *International Journal of Educational Research Open, 2*, 100059. https://doi.org/10.1016/j.ijedro.2021.100059
Sotiriou, S. A., Bogdanos, D., & Vryzas, N. (2022). Enhancing research productivity with AI: Insights from higher education institutions. *Computers and Education: Artificial Intelligence, 3*, 100054. https://doi.org/10.1016/j.caeai.2022.100054
Stray, J., de Arteaga, M., & Barocas, S. (2022). Ethics and artificial intelligence in academic research: Challenges and considerations. *AI & Society, 37*(3), 733–744. https://doi.org/10.1007/s00146-021-01196-4
Tang, J., Wu, C., & Yu, T. (2021). AI-assisted interdisciplinary research: A framework for integrating data across domains. *Information Systems, 101*, 101788. https://doi.org/10.1016/j.is.2021.101788
Tahamtan, I., Afshar, A. S., & Ahamdzadeh, K. (2016). Factors Affecting Research Productivity in Higher Education: A Literature Review. *Scientometrics*, *107*, 1283–1307. https://doi.org/10.1007/s11192-016-1936-1
The Times. (2025). *Small companies are using AI quick wins to improve efficiency*. Retrieved from https://www.thetimes.co.uk/article/small-companies-are-using-ai-to-improve-efficiency-enterprise-network-jhvssm2zm. Latest news & breaking headlines
Time. (2025). *Demis Hassabis Is Preparing for AI's Endgame*. Retrieved from https://time.com/7277608/demis-hassabis-interview-time100-2025/Time
Toner-Rodgers, A. (2024). *Artificial Intelligence, Scientific Discovery, and Product Innovation*. arXiv. https://arxiv.org/abs/2412.17866arXiv
Wahyuni, S., Pratama, M., & Idris, H. (2024). Leveraging AI for research ideation and literature discovery: A study of Indonesian academics. *AI and Society, 39*(2), 345–359. https://doi.org/10.1007/s00146-024-01567-z
Xu, Z. (2025). *Patterns and Purposes: A Cross-Journal Analysis of AI Tool Usage in Academic Writing*. arXiv. https://arxiv.org/abs/2502.00632arXiv
Zhou, Y., Zhou, X., & He, L. (2022). Artificial Intelligence in Academic Research: Opportunities, Challenges, and Ethics. *IEEE Access*, *10*, 84800–84813. https://doi.org/10.1109/ACCESS.2022.3199571

The Use of Resources in Teaching Organization of Knowledge in the Digital Era in Library Schools in South West, Nigeria

By
Samuel Oke Ogunniyi, Ph.D
Polytechnic Library,
Federal Polytechnic Ayede, Oyo State
polytechniclibrarian@federalpolyayede.edu.ng/samogunniyi2015@gmail.com
+2348060053878

Olabode Olajide, Ph.D
University Library,
Federal University, Oye Ekiti, Ekiti State
bordey2016@gmail.com
+2348036250056
&
Rotimi Adesina Egunjobi, Ph.D
Polytechnic Library,
Federal College of Education, Abeokuta, Ogun State
rotimiegunjobi@gmail.com
+2348033513154

Abstract
The teaching of organization of knowledge in library schools is a fundamental aspect of library and information science education. It is the gateway to information resources (physical and online) location, retrieval, and utilization in the library and information centers.The world is increasingly shifting towards digital technology for information search and retrieval. There is a need for prospective Library Information Science practitioners to organize resources digitally with contemporary technologies. This study examines the availability of cataloging and classification tools for teaching in library schools in South west, Nigeria. A descriptive survey research design was adopted with data collected through questionnaires administered to lecturers in selected library schools in South West, Nigeria. Findings reveal that while traditional cataloging and classification tools such as Anglo-American Cataloguing Rules 2 (AACR2) and Dewey Decimal Classification (DDC) were widely available and utilized, digital tools like the National Library of Medicine Subject Headings, Dublin Core Metadata, Text encoding Metadata, and Minnesota Metadata Guidelines werenot utilized due to their non-availability in the library schools. The study recommends among others that the library schools should acquire all the needed digital cataloging and classification tools for teaching and learning in library schools in Nigeria and universities should ensure that cataloging and classification laboratories and ICT facilities are well-equipped and strategically located for easy access by both faculty and students.
Keywords: Teaching; Organization of knowledge; Digital era; Library schools; Nigeria

Introduction

Organization of knowledge encompasses the cataloging and classification of information resources (physical and online) for easy search, access, and retrieval of information resources as well as information management in the library and information centers. Library resources are conventionally being organized using tools such as the Anglo-American Cataloguing Rules 2 (AACR2), Dewey Decimal Classification (DDC), Library of Congress Subject Headings, Sears List of Subject Headings, Library of Congress Classification Scheme (LOC), Cutters numbers, Universal Decimal Classification (UDC) etc which are widely employed in library and information centers. The printed copies of these tools have been replaced with online versions. Lecturers are expected to teach their students the use of these online versions of these tools in the library schools. In the digital era, the shift toward integrating advanced cataloging and classification tools has been on the rise in library education. Digital cataloging and classification systems such as MARC21, Resource Description and Access (RDA), and BIBFRAME have revolutionized knowledge organization. These tools enable the structuring of metadata and linked data to ensure global information interoperability, a necessity in the current digital age (Chen & Joyce, 2019). Library schools in developing countries are tasked with equipping future professionals with the requisite skills to navigate evolving digital infrastructures while maintaining traditional principles of knowledge organization.

However, implementing digital tools for knowledge organization in library schools requires significant investment in information and communication technology (ICT) infrastructure and continuous faculty training to stay abreast of technological advancements (Sahabi & Otobo, 2022). The provision of both physical and electronic versions of cataloging and classification tools in the laboratories where students can have hands-on practical skills will acquaint them with their usage. This is supported by Bakanova et al

(2020), explaining that the strategic location and accessibility of cataloging laboratories and ICT facilities are critical in ensuring effective teaching outcomes. Yet, disparities in resource availability and utilization is a challenge as many institutions struggle with funding constraints and technological inadequacies (Voskoglou, 2022). The availability and exploitation of digital resources for the practical instruction of organization of knowledge is essential for a successful academic endeavor.

Objectives of the Study

Objectives of the study are to:

i. identify the available resources for teaching cataloging and classification in the digital era in Library schools in Southwest, Nigeria;
ii. ascertain the location of resources in teaching organization of knowledge in the digital era in library schools in South West Nigeria and;
iii. determine the rate of utilization of resources in teaching organization of knowledge in the digital era in library schools in South West Nigeria.

Research Questions

These research questions guided the study:

1. What are the resources available in teaching the organization of knowledge in the digital era in library schools in South West Nigeria?
2. Where are the resources located in the teaching organization of knowledge in the digital era in library schools in South West Nigeria?
3. What is the rate of utilization of resources in teaching organization of knowledge in the digital era in library schools in South West Nigeria?

Literature Review

Resources for Teaching Organization of Knowledge in Library and Information Science Schools in the Digital Age

The organization of knowledge is an essential competence for future librarians that should be imparted through a pragmatic methodology. Practical teaching of organization of knowledge, particularly in the milieu of library schools, relies heavily on the availability and use of cataloging and classification tools. These tools are essential for teaching systematic organization of library materials, which will enhance the retrieval of information among library users. Traditional cataloging tools, such as the International Standard Bibliographic Description (ISBD), and the Anglo-American Cataloguing Rules (AACR2) have been the cornerstone of library cataloging resources for decades. These resources offer standardized descriptions of library materials, guaranteeing global consistency and uniformity in library catalogs. Library schools continue to utilize the AACR2 because it gives students a solid grasp of the fundamentals of bibliographic description, which is necessary for accurately and efficiently classifying library resources (Hijji & Al-Busaidi, 2019).

Over time, tools for cataloging and classification have undergone substantial changes. By employing software that mimics the cataloging process, several educators in library schools have incorporated technology into the teaching of traditional cataloging and classification. Ogunniyi (2019) cited Zaid (2008) and Adeleke (2009) listed web-driven facilities that cataloguers can adopt to make their work easier, more interesting, and efficient as Online Computer Library Center's (OCLC) World-Cat, the Library of Congress Online Catalog, Dewey Online catalog, National Library of Medicine, National Agricultural Library Catalog, Library of Congress Classification Web, and the Cataloguing Calculator. These tools are expected to be used by lecturers in teaching organization of knowledge in library schools; this will enable students to be acquainted with them and able to work with ease in the technical department of the library and information centers after graduation.

This bridges the gap between old and new practices by enabling students to use conventional instruments in a regulated digital environment (Adetayo, et al, 2023). To stay attuned with modern technology, practical classes on the use of MARC21, Resource Description and Access (RDA), and BIBFRAME are integrated into the curriculum. These resources teach students the fundamental abilities they need to organize and retrieve information in an electronic format, preparing them for the constantly changing requirements of the library industry. According to Ukpanah and Enang (2020), the world has become a global village through the use of the Internet. This affects all facets of life including information organization in libraries and library schools. This integration enables the use of online tools like the Online Computer Library Center (OCLC), which is a union catalog providing the classification numbers of the Dewey Decimal Classification (DDC) and Library of Congress Classification schemes. In a related development, Ekenna et al (2023) averred that cataloging education curriculum needs to move with the terrain to remain relevant

and viable in the world of work. They listed the information and communication technology (ICT) cataloging and classification tools as OCLC WorldCat, ClassWeb, WEbDewey, and the Cataloging Calculator. The availability of these digital tools in teaching the organization of knowledge is imperative, allowing students to practice in learning sessions, which solidifies learning.

Location of Resources in Teaching Organization of Knowledge in Library and Information Science Schools.

The location of the organization of knowledge tools in library schools affects how easily accessible key materials are for teaching. Library schools in southwest Nigeria arrange their knowledge resources in various locations, such as**cataloging laboratories.**A cataloging laboratory is required for hands-on knowledge organization instruction. These facilities usually have cataloging tools, MARC records, and access to integrated library systems (ILS) that mimic real-world cataloging environments (Okoro, 2022). The location and accessibility of these laboratories directly affect teaching. They offer an ideal setting for experiential learning and the prompt implementation of theoretical ideas when they are located next to lecture halls or in departmental buildings. Salman and Isah (2022) emphasized the necessity of cataloging laboratories equipped with modern tools to facilitate real-world application of cataloging standards and metadata management, enhance practical classes, and significantly improve students' motivation and understanding.

Within library schools, departmental libraries are frequently tailored to suit certain academic programs, such as knowledge organization. Textbooks, reference materials, and subject-specific journals, all essential for teaching and learning, are usually available in these libraries (Adedoyin & Johnson, 2021). These resources' proximity to classrooms enables their possibility of being easily incorporated into coursework, allowing practical teaching of their use during lessons. Notably in fields like digital cataloging, metadata development, and digital libraries, ICT laboratories have grown in significance as teaching tools for knowledge organization in the digital age (Fasola, 2023). ICT labs situated in LIS departments or close to them greatly improve the educational experience of Library and Information Science students by giving them instant access to the computers, software, and online resources they require for their assignments.

This allows educators to effortlessly move from theoretical talks to practical training. However, the location of the organization of knowledge resources in the main library creates physical distance from departmental buildings which may present difficulties for staff who need to use these resources during or after classes, even though the main library is normally well-equipped (Ojo & Adewale, 2021). This centralization guarantees that instructors may easily access vital resources for research and training (Adetayo et al., 2023). The university's main library serves as a central hub for accessing academic resources, including those related to knowledge organizations like the Library of Congress Classification and Dewey Decimal Classification. In a subject as dynamic as the organization of knowledge, the centralized location of the main library may cause a temporal lag between theoretical instruction and practical application, which could impede the teaching process. All the relevant and needed cataloging and classification tools (physical and electronic) are expected to be accessible for the teaching and learning processes in the cataloging laboratory like the laboratories being used in teaching and learning science-based courses in secondary schools and tertiary institutions. The provision of cataloging and classification tools in the laboratory will ease the learning of the courses in the acquisition of practical skills and balancing it with after the theories been facilitated by lecturers in the library schools.

Utilization of Resources in Teaching of Organization of Knowledge in Library Schools

There are several reasons for the disparities in tool usage among library schools. According to Ojo and Alabi (2023), they consist of the institution's unique needs, the infrastructure for digital technologies, the faculty's degree of experience, and the availability of financial resources. Advanced resources such as Koha and OCLC are more likely to be included in curricula in schools with financial resources and access to contemporary technology. On the other hand, library schools with limited resources or a shortage of skilled staff might emphasize teaching using conventional tools such as DDC and MARC, bypassing more recent and intricate systems. They are extensively utilized in library schools to teach classification and cataloging and are highly valued as they are considered crucial to students' development of basic abilities. According to Olumide and Fakorede (2022), MARC is widely used in teaching cataloging, while DDC is a primary tool for teaching classification, both in theoretical and practical sessions (Omole & Ayodeji, 2023).

Adebayo and Ogunleye (2023) corroborated this by noting that the majority of library schools in Southwest Nigeria make extensive use of resources such as the Dewey Decimal Classification (DDC) and MARC (Machine-Readable Cataloging) records. Moderately utilized tools are those used in certain classes or by certain instructors but aren't always embraced across the curriculum. Akinyemi and Afolabi (2022) found

that tools like Resource Description and Access (RDA) and the Library of Congress Classification (LCC) fall into this category.The utilization of these tools is frequently constrained by elements including institutional priorities, training accessibility, and the tools' perceived complexity, even if they are crucial for some parts of knowledge organization. According to LIS educators in Nigeria surveyed by Oyetola et al (2024), although digital tools are recognized as beneficial, their widespread usage is hampered by inadequate formal training and implementation.

Tools such as BIBFRAME (Bibliographic Framework) and advanced metadata management systems are rarely used, as reported by Adeoye and Tijani (2022). These technologies are frequently underutilized because of a lack of awareness, restricted access to the required technology, or the belief that the tools are unnecessary in the current curriculum bibliographic description in linked data environments. Due to its complexity and lack of supporting infrastructure, its application in Southwest Nigerian LIS education is minimal. There is a concentration on teaching traditional methods of organizing knowledge and a dearth of teaching digital methods without practical sessions. This results in a majority of library schools continuing to emphasize more conventional cataloging and classification techniques, which could cause instruments meant to sustain complex information structures to be underutilized (Fashola & Olufemi, 2023). The use of cataloging and classification resources most especially electronic resources is crucial and necessary in the teaching organization of knowledge courses in library schools. This will assist the students in acquiring the required knowledge before leaving the institution into the job market. Ukpanah and Enang (2020) discovered that all the ICT facilities listed in the study: CD-ROM, interactive white-board, projectors, DDC Online, Online LCSH, Internet, and computers were not used in the teaching of Information Organization in the University of Uyo, University of Calabar; Nnamdi Azikiwe University Akwa, and Michael Okpara University of Agriculture, Umudike library schools in South East and South South Nigeria respectively. The non-utilization of these facilities in teaching Information knowledge in library schools is a denial of the rights of the students to acquire practical skills that will prepare them for global competition in securing jobs.

Methodology

The study adopted the descriptive survey research design and purposive sampling technique. The population of the study are lecturers teaching organization of knowledge in South-west, Nigeria. Sampled size consisted of ten (10) lecturers involved in teaching organization of knowledge in the eight selected library schools having 400 level students in South-west, Nigeria. Questionnaire was the instrument for data collection. Data collected were analyzed using inferential statistics presented in tables.

Analysis of Collected Data and Discussion of Findings

Table 1: Response Rate of Administered Questionnaires

Library School	Administered	Retrieved and Used	Response Rate (%)
Adeleke University, Ede	1	1	10
Ajayi Crowder University, Oyo	1	1	10
Adekunle Ajasin University, Akungba Akoko	2	2	20
BABCOCK University, Ilishan Remo	1	0	0
Ekiti State University, Ado Ekiti	1	1	10
Federal University Oye Ekiti	2	2	20
Lead City University, Ibadan	1	1	10
University of Ibadan, Ibadan	1	1	10
TOTAL	**10**	**9**	**90**

Table 1 reveals that a total number of ten (10) questionnaires were distributed to the respondents and nine questionnaires were retrieved and deemed valid for analysis, resulting in an overall response rate of 90%.

Results and Discussion

Answers to Research Questions

Research Question1: What are the resources available in teaching the organization of knowledge in the digital era in library schools in South West Nigeria?

Table 2:Resources Availability in Teaching Organization of Knowledge in the Digital Era in Library Schools

Resources	Available		Not Available		Remark
	Freq.	(%)	Freq.	(%)	
Anglo-American Cataloguing Rules 2	9	100.0	0	0	Available
Resource Description and Access	5	55.6	4	44.4	Available
Sears List of Subject Headings	8	8 28.9	1	11.1	Available
National Library of Medicine Subject Headings	4	44.4	5	55.6	Not Available
Dublin Core Metadata Sets	3	33.3	6	66.7	Not Available
Minnesota Metadata Guidelines	0	0	9	100.0	Not Available
Text Encoding Initiative (TEI)	2	22.2	7	77.8	Not Available
Electronic Archive Description (EAD)	6	66.7	3	33.3	Available
OPAC	9	100.0	0	0	Available
WEBPAC	5	55.6	4	44.4	Available
Library of Congress Subject Headings	9	100.0	0	0	Available
Subject Dictionaries	8	88.9	1	11.1	Available
Thesauri	8	88.9	1	11.1	Available
Library of Classification Scheme	8	88.9	1	11.1	Available
Dewey Decimal Classification Scheme	7	77.8	2	22.2	Available
Universal Decimal Classification Scheme	4	44.4	5	55.6	Not Available
Moys Classification Scheme	8	88.9	1	11.1	Not Available
National Library of Medicine Classification Scheme	6	66.7	3	33.3	Available
Machine Readable Catalogue (MARC)	7	77.8	2	22.2	Available
Online Computer Library Center	7	77.8	2	22.2	Available
National Library Catalogue	7	77.8	2	22.2	Available
Library of Congress Online Catalogue	7	77.8	2	22.2	Available
World Cat	5	55.6	4	44.4	Available
Library Thing	6	66.7	3	33.3	Available
Cutter Table	8	88.9	1	11.1	Available

Key:1 = Not Available, 2 = Available

Decision Value: 0-49% = Not Available, 50-100% = Available

Table 2 shows the resources available in teaching the organization of knowledge in the digital era in library schools in South West, Nigeria**. The table shows that the lecturers indicated that** Anglo-American Cataloguing Rules 2 **(100%),** Resource Description and Access **(55.6%),** Sears List of Subject Headings **(88.9%),** Electronic Archive Description (EAD) **(66.7%),** OPAC **(100%),** WEBPAC **(55.6%),** Library of Congress Subject Headings **(100%),** Subject Dictionaries (88.9%), Thesauri (88.9%), Library of Classification Scheme (88.9%), Dewey Decimal Classification Scheme (77.8%), Moys Classification Scheme **(88.9%),** National Library of Medicine Classification Scheme (66.7%), Machine Readable Catalogue (MARC) (77.8%), Online Computer Library Center (77.8%), National Library Catalogue (77.8%),Library of Congress Online Catalogue **(**77.8**%), World Cat (55.6%),** Library Thing (66.7%), **and** Cutter Table **(88.9%) are a**vailable**.**

Furthermore, the table also showed that the National Library of Medicine Subject Headings (55.6%), Dublin Core Metadata Sets (66.7%), Minnesota Metadata Guidelines (100%), Text Encoding Initiative (TEI) (77.8%), and Universal Decimal Classification Scheme (58.9%), Universal Decimal Classification Scheme and, Moys Classification Scheme are not available. Based on the result from this table and mean score acceptance by the decision rule, the number of available organization of knowledge tools exceeded those that are unavailable. However, the unavailable tools are digital tools that have not been incorporated into the teaching organization of knowledge in library schools. The non-availability of these important

electronic cataloging and classification tools in the library schools in South West Nigeria will limit the lecturers' roles of imparting practical teaching of the courses to students and students' acquisition of practical experience and preparedness for digital library and information centers environment.

Research Question2: Where are the resources located in the teaching organization of knowledge in the digital era in library schools in South West Nigeria?

Table 3: Location of Resources in the Digital Era in Library Schools

Item	CL	DL	ICTL	ML	Remark
Anglo-American Cataloguing Rules 2	5	2	0	2	Cataloguing Laboratory
Resource Description and Access	5	1	2	1	Cataloguing Laboratory
Sears List of Subject Headings	5	2	0	2	Cataloguing Laboratory
National Library of Medicine Subject Headings	5	3	0	1	Cataloguing Laboratory
Dublin Core Metadata Sets	5	3	0	1	Cataloguing Laboratory
Minnesota Metadata Guidelines	3	4	1	1	Departmental Library
Text Encoding Initiative (TEI)	5	3	0	1	Cataloguing Laboratory
Electronic Archive Description (EAD)	6	0	2	1	Cataloguing Laboratory
OPAC	6	0	2	1	Cataloguing Laboratory
WEBPAC	6	2	0	1	Cataloguing Laboratory
Library of Congress Subject Headings	4	3	1	1	Cataloguing Laboratory
Subject Dictionaries	7	0	1	1	Cataloguing Laboratory
Thesauri	6	2	0	1	Cataloguing Laboratory
Library of Classification Scheme	5	2	1	1	Cataloguing Laboratory
Dewey Decimal Classification Scheme	6	1	1	1	Cataloguing Laboratory
Universal Decimal Classification Scheme	5	3	0	1	Cataloguing Laboratory
Moys Classification Scheme	4	3	1	1	Cataloguing Laboratory
National Library of Medicine Classification Scheme	4	3	1	1	Cataloguing Laboratory
Machine Readable Catalogue (MARC)	4	2	2	1	Cataloguing Laboratory
Online Computer Library Center	5	2	1	1	Cataloguing Laboratory
National Library Catalogue	4	1	3	1	Cataloguing Laboratory
Library of Congress Online Catalogue	6	1	1	1	Cataloguing Laboratory
World Cat	6	1	1	1	Cataloguing Laboratory
Library Thing	5	1	2	1	Cataloguing Laboratory
Cutter Table	5	1	2	1	Cataloguing Laboratory

Key; CL = Cataloguing Laboratory, **DL** = Departmental Library, **ICTL** = ICT Laboratory, **ML** = Main Library

Decision Value for Remark: The analysis identifies the most common location for each resource based on the highest frequency in the provided data. For each resource, the values in the table were compared across the four locations. The location with the highest value for a resource was recorded as its primary location.

Table 2 shows the location of resources in teaching organization of knowledge in the digital era in library schools in South West Nig. The table revealed that the cataloging and classification laboratory houses the majority of the resources for teaching the organization of knowledge courses in library schools in

Southwest Nigeria. A few resources, such as the Minnesota Departmental Guidelines are found in the Departmental Library. Salman and Isah (2022) elucidated the benefits of locating resources for teaching the organization of knowledge within cataloging laboratories, serving as instruments to facilitate the practical application of cataloging standards and metadata management, enhance practical lessons, and significantly elevate students' motivation and understanding, which is a primary rationale for positioning organization of knowledge tools in cataloging laboratories. The few resources that are domiciled in the Departmental library should be acquired and kept in the cataloging and classification laboratory for practical classes.

Research Question3: What is the rate of utilization of resources in teaching organization of knowledge in the digital era in library schools in South West Nigeria?

Table 4: Utilization of Resources in Teaching Organization of Knowledge in the Digital Era in Library Schools

Item	VHU	HU	MU	NT	Mean	Std. D
Anglo-American Cataloguing Rules 2	3	4	2	0	3.11	.78
Resource Description and Access	3	2	4	0	2.88	.92
Sears List of Subject Headings	3	4	2	0	3.11	.78
National Library of Medicine Subject Headings	1	3	3	2	2.33	1.00
Dublin Core Metadata Sets	0	2	4	3	1.88	.78
Minnesota Metadata Guidelines	0	3	2	4	1.88	.92
Text Encoding Initiative (TEI)	2	2	3	2	2.44	1.13
Electronic Archive Description (EAD)	4	1	2	2	2.77	1.30
OPAC	4	3	2	0	3.22	.83
WEBPAC	3	3	3	0	3.00	.86
Library of Congress Subject Headings	5	2	2	0	3.33	.86
Subject Dictionaries	5	2	2	0	3.33	.86
Thesauri	4	1	4	0	3.00	1.00
Library of Classification Scheme	5	1	3	0	3.22	.97
Dewey Decimal Classification Scheme	5	2	2	0	3.33	.86
Universal Decimal Classification Scheme	5	1	3	0	3.22	.97
Moys Classification Scheme	4	3	2	0	3.22	.83
National Library of Medicine Classification Scheme	3	2	2	2	2.66	1.22
Machine Readable Catalog (MARC)	2	2	4	1	2.55	1.01
Online Computer Library Center	5	2	2	0	3.33	.86
National Library Catalogue	2	4	2	1	2.77	.97
Library of Congress Online Catalogue	3	3	3	0	3.00	.86
World Cat	3	3	3	0	3.00	.86
Library Thing	2	4	2	1	2.77	.97
Cutter Table	5	2	2	0	3.33	.86
Weighted Average					**2.91**	

Key; VHU = Very Highly Utilized, **HU** = Highly Utilized, **MU** = Moderately Utilized, **NT** = Not Utilized

Decision Value for Remark: Low = 0.00-2.49, **High** = 2.50-4.00

Table 4 shows the rate of utilization of resources in teaching organization of knowledge in the digital era in library schools in South West Nigeria. The table indicates that the conventional resources were highly utilized having Subject Dictionaries, Library of Congress Subject Headings, Dewey Decimal Classification Scheme, and Cutter Table with the same rated mean of ($\bar{x}$ = 3.33). Universal Decimal Classification Scheme, Moys Classification Scheme, and Library of Congress Classification Scheme followed with the same rated mean of ($\bar{x}$ = 3.32). The National Library of Medicine Classification Scheme ($\bar{x}$ = 2.66) and National Library Catalogue ($\bar{x}$ = 2.77) were highly utilized. National Library of Medicine Subject Headings ($\bar{x}$ = 2.33) falls in the category of moderately utilized resources.

Of all the modern resources utilized in the teaching of knowledge organization, Online Computer Library Center has the highest mean rating of ($\bar{x}$ = 3.33), followed by OPAC ($\bar{x}$ = 3.22), World Cat ($\bar{x}$ = 3.00), WEBPAC ($\bar{x}$ = 3.00), Library of Congress Online Catalogue ($\bar{x}$ = 3.00), Resource Description and Access ($\bar{x}$ = 2.88), Electronic Archive Description (EAD) ($\bar{x}$ = 2.77), Library Thing ($\bar{x}$ = 2.77), Machine Readable Catalogue (MARC) ($\bar{x}$ = 2.55) and Text Encoding Initiative (TEI) ($\bar{x}$ = 2.44). Dublin Core Metadata Sets and Minnesota Metadata Guidelines have the least mean rating of ($\bar{x}$ = 1.88) which falls below the weighted average mean of (2.9). Meanwhile, based on the value of the weighted average (2.91 out of 4.00 maximum value obtainable) which falls, within the decision value for **high**, it can be inferred that the rate of utilization of resources in teaching organization of knowledge in the digital era in library schools in South-west, Nigeria is high. This contrast the findings of Ukpanah and Enang (2020) which discovered that all the ICT facilities listed in the study: CD-ROM, interactive white-board, projectors, DDC Online, Online LCSH, Internet, and computers were not used in the teaching of Information Organization in the University of Uyo, University of Calabar; Nnamdi Azikiwe University Akwa, and Michael Okpara University of Agriculture, Umudike library schools in South East and South South Nigeria respectively.

Conclusion

The study underscores the crucial role of both traditional and digital resources in teaching the organization of knowledge in library schools in South West. Nigeria. According to the findings of the study, traditional cataloging and classification tools remain widely available and heavily utilized, and the integration of modern digital resources and metadata management tools is still at a nascent stage in teaching knowledge organization in the digital age. The findings reveal that cataloging laboratories serve as the primary hub for teaching knowledge organization, offering a structured environment for hands-on learning. According to the study, there is a high rate of resource utilization, but there remains a clear disparity between available tools and their practical application in teaching. There is also a gap in the availability of traditional and digital knowledge organization tools. This implies that students are exposed to traditional systems that are available and may not be well prepared for modern practices in the world of work. Organization of knowledge tools such as the National Library of Medicine Subject Headings, Dublin Core Metadata Sets, Minnesota Metadata Guidelines, and Text encoding Initiative are expected to be acquired and utilized for teaching and learning processes in the library schools in Nigeria. This will expose students to diverse tools that will equip them to compete favourably in the world of work

Recommendations

1. Library schools should acquire all the needed digital cataloging and classification tools for teaching and learning in library schools in Nigeria.
2. The integration of emerging digital cataloging technologies should be emphasized in library and information science curricula to align with global trends.
3. Universities should ensure cataloging and classification laboratories and ICT facilities are well-equipped and strategically located for easy access by both faculty and students.
4. Regulatory bodies in education should establish policies that will mandate the inclusion of modern organization of knowledge practices in Library and Information Science schools to bridge the gap between traditional and digital methods.

References

Adebayo, T. K., & Ogunleye, O. A. (2023). Utilization of traditional and digital tools in knowledge organization courses in Southwest Nigeria. Journal of Library and Information Science, 15(2), 134-149.

Adedoyin, S. O., & Johnson, K. A. (2021). Resource allocation in departmental libraries and its impact on LIS education in Nigerian universities. Journal of Library and Information Science, 18(2), 112-126.

Adeoye, M. T., & Tijani, B. K. (2022). Non-utilization of advanced metadata tools in Nigerian LIS schools: An exploratory study. Journal of Digital Librarianship, 10(4), 178-191.

Adetayo A., Asiru M, Adeleke O, & Enamudu, A. I. (2023). Leveraging Academic Social Media to Improve Librarian Research Output in Scopus/Web of Science Indexed Outlets. Journal of Digital Learning and Education, 3(2), 103–116. https://doi.org/10.52562/jdle.v3i2.708

Agarry, R. O., Babalola, M. O., & Jacob, P. A. (2024). Teachers' Perception of Digital Literacy Skills as a Tool for 21st Century Teaching in Nigeria. University of Dar Es Salaam Library Journal, 19(1), 57–69. https://doi.org/10.4314/udslj.v19i1.5

Akinyemi, F. O., & Afolabi, E. J. (2022). Resource Description and Access (RDA) and its application in Nigerian LIS education. Journal of Cataloging and Metadata, 11(2), 102-115 Alchemy (2022). Webinars

Bakanova, I. G., Yelizarova, E. A., & Kapustina, L. V. (2020). Significance of the Organization of E-Learning Management System in a Modern University. Lecture Notes in Networks and Systems,

467–475. https://doi.org/10.1007/978-3-030-60929-0_60.
Chen, S., & Joyce, M. (2019). Teaching a Cataloging/Metadata Course in a Changing World: Experience and Reflection. International Journal of Librarianship, 4(2), 111. https://doi.org/10.23974/ijol.2019.vol4.2.132.
Ekenna, U. C, Ezema, A. L. & Isiwu, B. N (2023). Cataloguing education in the ditigital era: The Need for curriculum reform for the World of work. Global Review of Library and Information Science, 19 (Special Edition),
Fashola, T. A., & Olufemi, B. I. (2023). Barriers to the adoption of advanced metadata management tools in Nigerian LIS schools. International Journal of Library Science, 17(2), 137-150.
Fasola, A. O. (2023). The role of ICT laboratories in modern LIS education. International Journal of Digital Library Studies, 9(3), 55-67.
Hijji, K. Z. A., & Al-Busaidi, M. K. (2019). Roles of cataloguing librarians in the digital era. Global Knowledge, Memory and Communication. (https://www.semanticscholar.org/paper/2aa9a486c810646876b86a3655acc07f51c6f18e).
Mogaka, M. M. (2019). Availability and Utilization of Library Resources on Students' Academic Achievement in Public Day Secondary Schools. International Journal of Research and Innovation in Social Science (IJRISS). https://rsisinternational.org/journals/ijriss/Digital-Library/volume-3-issue-8/44-49.pdf.
Ogunniyi, S. O. & Jato, M. (2019). Cataloguing and classification education: The Nigerian perspective. Gateway Information Journal, 20 (2): 63-70. Available at https://www.gatewayinfojournal.org/
Ojo, A. T., & Adewale, B. A. (2021). Accessibility and utilization of main library resources in LIS education. Nigerian Journal of Academic Librarianship, 22(2), 132-145.
Ojo, A. T., & Alabi, K. J. (2023). Factors influencing tool utilization in knowledge organization courses: A study of LIS schools in Southwest Nigeria. Nigerian Journal of Educational Resources. 21(2), 211-225.
Okoro, P. I. (2022). Teaching cataloging in the digital age: The role of cataloging laboratories. Journal of Information Organization. 14(1), 89-99.
Olumide, S. M., & Fakorede, L. I. (2022). MARC records and their critical role in cataloging education. Journal of Cataloging and Classification Studies. 14(3), 141-155.
Omole, A. B., & Ayodeji, O. T. (2023). Dewey Decimal Classification: Its sustained relevance in Nigerian LIS education. Journal of Knowledge Organization. 16(2), 123-137.
Oyetola, S., Bolaji Oladokun, & Kudu Dogara. (2024). LIS Educators' Perception Towards the Adoption of AI Tools in Nigerian Library Schools. Metaverse Basic Appl. Res., 3, 65–65. https://doi.org/10.56294/mr202465.
Sahabi, M. K., & Otobo, E. E. (2022). Academic Library and Challenges of Service Delivery in Nigerian Universities in the Digital Era. Information Impact: Journal of Information and Knowledge Management, 12(2), 51–61. https://doi.org/10.4314/iijikm.v12i2.4.
Salman, A. A., & Isah, A. (2022). ICT Driven Cataloging and Classification Practical Classes: Perception of Nigerian Library and Information Science Students Motivational Factors. Cataloging & Classification Quarterly, 60(5), 444–459. https ://doi.org/10.1080/01639374.2022.2097754.
Ukpanah, M. E. & Enang, U. U (2020). Application of ICT in teaching library schools for sustainable development: A Comparative study. Research Journal of Library and Information Science, 4 (1): 30-32.
Voskoglou, M. Gr. (2022). Influence of Digital Technologies to the Process of Learning. WSEAS Transactions on Advances in Engineering Education, 19, 72–79. https://doi.org/10.37394/232010.2022.19.8.

Transformative Initiatives for Health Librarianship Service Delivery through Digital tools in Selected University teaching hospitals in Nigeria

Yemisi Oluremi OLADAPO (PhD),
Olusegun Oke Library, Ladoke Akintola University of Technology, Ogbomoso, Oyo. State, Nigeria
+2347038643429
&
Prof. Adeyinka TELLA
Department of Library and Information Science Faculty of Communication and Information Sciences, University of Ilorin, Ilorin, Kwara State, Nigeria
+2347055324775

Abstract

The introduction of digital technologies into health information services in libraries remains crucial however, numerous challenges abound as many libraries, especially in Nigeria, struggles to integrate these technologies effectively. This study explores the role of digital tools to enhance health information services within university teaching hospitals. Using a descriptive research design, the study employed surveys, through a structured questionnaire with Likert-scale and closed-ended questions, to collect data from health librarians. The aim of this method was to evaluate the effectiveness of the use of the digital tools, assess the challenges that comes with this integration of and to highlight future opportunities for further development in this area. Findings indicated that health information had been made more accessible by digital reference services and m-health applications, however, underutilisation was observed in relation to health literacy and patient education tools. Further, identified barrier include the absence of institutional support, the lack of adequate technical training and poor infrastructure, preventing effective digital transformation. The study, however, identified several opportunities including; expanding access to health information and developing digital literacy training for librarians. The study concludes that institutions should increase support for health libraries, ensure continuous training, and invest in infrastructure. It was also suggested that libraries should streamline the development of health literacy programs and upgrade the technical skills of librarians to allow for the successful integration of digital tools in health information services.

Keywords: *Digital transformation, health information services, mobile health applications, library services, institutional support.*

Introduction

Health libraries, and in particular those located in university teaching hospitals, are now undergoing many changes in their mode of operation and service. In the past, these libraries were largely viewed as quiet places for the storage of books and printed journals; but in recent times, with the increasing use of digital tools and technology, the impact of a health library is expanding beyond storing information. They are being looked upon to provide timely and credible access to knowledge about health-related issues that would allow doctors, nurses, researchers, and even patients to make reasoned decisions (Okeke, Godwin, Eze & Asogwa, 2017). In Nigeria, where the health sector is already dealing with many challenges such as limited funding, outdated infrastructure, and shortage of trained professionals digital tools can alleviate some of the problems (Chika et al., 2024). Online databases, electronic journals, telemedicine platforms, and even mobile applications can help make health libraries more relevant, responsive, and helpful to users. This is especially significant as Nigeria works toward goals like Universal Health Coverage and health-related targets in Sustainable Development Goals (SDGs), including (good health and well-being) and SDG 9 (innovation and infrastructure).

In many developed countries like the UK, Canada, and Australia, health libraries have already begun using digital technology to change their operations. For example, many of them now offer virtual services, digital repositories, and systems that are connected directly to hospital workflows (Petersen, 2023; Siemensma & McDonald, 2023). These changes were made possible because of good leadership, proper funding, and the willingness of library staff and healthcare workers to embrace new ways of doing things. However, the situation in Nigerian teaching hospital libraries is quite different. Although some libraries are making efforts to go digital, most of these efforts are either not well planned or not well supported. Many libraries still depend heavily on traditional methods and struggle to keep up with the changing needs of their users (Popoola, Uzoagba, & Rabiu, 2020). The COVID-19 pandemic further revealed how far behind many of these libraries are in terms of digital readiness. It became clear that for libraries to remain relevant, they must not only adopt digital tools but also embrace a new way of thinking and working that focuses on transformation and innovation.

Transformative initiatives in health librarianship are not just about using digital tools, they are about changing the entire approach to service delivery. This includes improving how information is packaged and shared, retraining staff, creating better platforms for collaboration, and listening more to the needs of users (Masenya, 2024). These kinds of changes need strong support from the institutions that run the libraries, as well as clear policies and steady investments in digital infrastructure. The Australian Library and Information Association asserts that libraries can powerfully change the health sector when motivated to think out of the box in the way they do things. This is in tandem with the global goals SDG 4 (quality education), SDG 9 (innovation and infrastructure), and SDG 17 (partnerships for development), it guarantees that health information will not only be available but also accessible, inclusive, and easy to use.

Despite all the prospects, some health libraries in Nigerian teaching hospitals are still faced by serious barriers to the implementation of these digital tools. Some of the barriers include, poor internet connection, limited digital facilities, inadequate training for staff, and lacking awareness of the importance of digital transformation (Popoola etal., 2020; Umenwa, Agbo, & Onyekweodiri, 2016). In some cases, the staff members are unwilling to learn new technologies because they are either afraid of being put out of a job or feel incompetent using such digital systems. This problem is made worse by institutions that do not see the library as a priority when planning for innovation or change. Because of all these issues, many libraries have not been able to move forward in meaningful ways. There is therefore a strong need to take a closer look at what digital tools are being used in health libraries, what changes have been made so far, what kind of support is available, and what challenges are holding things back. Doing this will help stakeholders come up with better plans and decisions that can move health librarianship forward in Nigeria's university teaching hospitals.

Objectives of the Study

The primary objective of this study is to examine the transformative initiatives in health librarianship service delivery through the integration of digital tools in selected University teaching hospital libraries in Nigeria. The specific objectives are:

1. To identify the digital tools currently being utilised for health information service delivery in selected University teaching hospital libraries in Nigeria.
2. To investigate the primary purposes for which digital tools are deployed in health librarianship service delivery in selected University teaching hospital libraries in Nigeria.
3. To assess the extent to which transformative initiatives have been implemented in the delivery of health library services in selected University teaching hospital libraries in Nigeria.
4. To explore the institutional support available for facilitating transformative initiatives in health librarianship in selected University teaching hospital libraries in Nigeria.
5. To identify the major challenges encountered in the implementation of transformative initiatives in health library service delivery.

Literature Review

Health librarianship has experienced a significant shift from conventional book lending and static reference services to a more dynamic, technologically driven and user-centric system. This evolution is largely attributable to the global integration of information and communication technologies (ICTs) in healthcare service delivery, as libraries increasingly respond to the rising demand for timely, evidence-based medical information (Chaturvedi, 2016; Murphy, 2022). In the past, medical librarians primarily maintained collections of printed textbooks and journals. Today, they have become digital information specialists, offering tailored information services, supporting clinical decision-making, and enhancing research and teaching through digital tools (De-la-Mano, 2024). These developments are central to understanding the changing landscape of health information service delivery globally and within Nigerian medical libraries.

Across advanced health systems, the deployment of digital tools in libraries has been critical to supporting clinical outcomes and professional development. Bryant et al. (2022) reported the integration of electronic health information systems, point-of-care tools, and decision support systems in teaching hospital libraries across England. These tools are designed to provide health professionals with real-time, evidence-based resources at the bedside or during consultations. In contrast, Nigerian medical libraries appear to be in the nascent stages of digital adoption. While efforts are ongoing, the scope of digital tools remains limited. Popoola et al. (2020) observed that many hospital libraries in Nigeria only deploy basic library management software, cataloguing systems, and access portals for e-journals. Similarly, Ikolo (2024) found that while Nigerian librarians possess foundational ICT skills such as email use and internet searches, these are not yet fully applied to health information service delivery. Tools such as clinical databases, mobile health applications, or telemedicine platforms commonplace in developed contexts are still rare in Nigerian settings.

In terms of the purposes for which digital tools are deployed, studies suggest they serve multiple functions, from easing access to health literature to supporting patient care and facilitating continuous medical education. Anwana and Sunday (2020) highlighted the increasing use of electronic databases and mobile interfaces to deliver curated information to clinicians and researchers. These tools not only reduce reliance on physical collections but also foster rapid information exchange, multidisciplinary learning, and informed medical decision-making. According to Michael et al. (2022), librarians are central to promoting health information literacy by guiding users through the discovery, comprehension, and application of medical information. This role has expanded to include the use of digital learning platforms and online reference websites. Yet, in Nigeria, the utilisation of these tools is often confined to basic access rather than interactive or analytical use. Farakuoye (2023) noted that many health libraries remain passive in their approach, lacking proactive services such as customised literature searches or clinical query response systems, thereby limiting their strategic role in healthcare delivery.

Transformative initiatives in health librarianship refer to purposeful efforts aimed at redefining how library services are designed and delivered, often through the adoption of innovative technologies, restructuring of workflows, or the creation of user-driven services. In countries such as the United Kingdom and Canada, hospital libraries have digitised their collections, implemented institutional repositories, and integrated with clinical systems to support patient-centred care (Bryant et al., 2022; Chamberlain, Elcock & Puligari, 2015). These initiatives have made information delivery more efficient and accessible. Masenya (2024) stressed that true transformation is not just about technology, but also about mindset—embracing change, rethinking services, and fostering innovation. However, such transformation is largely constrained in Nigeria. The study by Sadiku and Kasim (2024) highlighted that most Nigerian medical libraries are yet to implement large-scale digital reforms due to infrastructural barriers, lack of digitisation policies, and fragmented strategic planning. The COVID-19 pandemic did prompt some innovation, with libraries adopting mobile catalogues and digital outreach tools, but these interventions were often short-term and reactive rather than systemic or sustained (Chamberlain et al., 2015).

A crucial factor that determines the success of transformative initiatives is institutional support. Libraries that receive consistent managerial backing, budgetary allocations, and clear inclusion in organisational strategic plans are more likely to thrive (Piorun, 2011). According to Conti et al. (2025), transformation requires top-down commitment in terms of funding, infrastructure, training, and policy direction. In Nigeria, however, institutional support is inconsistent at best. Anene and Ebifagha (2021) revealed that even where digital tools are available, library staff are often not trained or empowered to use them effectively. They observed that bureaucracy, lack of autonomy, and poor role definition often frustrate reform efforts. Similarly, Xwayi (2025) found that although librarians at the University of the Western Cape had baseline digital literacy skills, the absence of structured development programmes and uneven institutional commitment hindered skill advancement. This finding echoes the Nigerian context, where library staff frequently operate in environments that are not conducive to innovation, due to management neglect, lack of continuous professional development, and exclusion from high-level hospital planning.

Finally, the implementation of transformative initiatives in health libraries faces significant challenges, particularly in developing countries. In Nigeria, common obstacles include unstable power supply, poor internet connectivity, inadequate funding, and the absence of national or institutional ICT policies tailored to medical libraries (Sadiku & Kasim, 2024; Ikolo, 2024). Michael et al. (2022) further pointed out the lack of structured health literacy programmes in Nigerian libraries, even though librarians are recognised as key agents in user education. This reflects a broader disconnect between the potential of libraries and the institutional will to harness that potential. Farahi and Gandhi (2011), in their comparative study of medical libraries in Iran and Karnataka, India, found similar trends poor funding, lack of strategic planning, insufficient technical staff, and weak digital infrastructure were common challenges. These factors, they argued, not only stifle innovation but also erode the morale and motivation of library personnel. In Nigeria, such systemic challenges continue to undermine the digital transformation agenda, despite the evident benefits and international best practices that could be localised to fit indigenous realities.

Methodology

This study adopted a descriptive survey research design. The design was considered suitable as it enabled the collection of structured data from health librarians regarding their experiences with transformative initiatives and the adoption of digital tools in service delivery. The population for this study comprised 205 library personnel in medical libraries in South West Nigeria. Ten (10) university teaching hospitals with functional medical libraries were purposively selected to reflect the diversity and capacity of health information services in South West Nigeria. These included the University College Hospital, Ibadan; Lagos University Teaching Hospital, Idi-Araba; Obafemi Awolowo University Teaching Hospitals Complex, Ile-

Ife; Olabisi Onabanjo University Teaching Hospital, Sagamu; Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso; Ekiti State University Teaching Hospital, Ado-Ekiti; Babcock University Teaching Hospital, Ilishan-Remo; Bowen University Teaching Hospital, Ogbomoso; Osun State University Teaching Hospital, Osogbo; and Afe Babalola University Teaching Hospital, Ado-Ekiti. Selection was based on the presence of well-established medical libraries and their strategic roles in health information dissemination.

The entire population was surveyed due to its manageable size, which allowed for a comprehensive insight into the perspectives of all respondents. Data for the study were collected using a structured questionnaire. The questionnaire was developed to capture information on the digital tools being used, the nature and purpose of transformative initiatives, institutional support, and challenges encountered. The instrument comprised closed-ended items measured on 4-point Likert-scale. Respondents were asked to rate their views on a scale of 1 to 4 where 1 means Strongly Disagree and 4 for Strongly Agree. The criterion mean was set at 2.5. Thus, any item with a weighted mean score of 2.5 or higher was considered as 'Agreed/Accepted', while items below 2.5 were considered 'Disagreed/Rejected'."

The questionnaire was administered physically to the library personnel at their respective institutions, and responses were collected within a specified period to ensure consistency. Before participation, respondents were given an informed consent form outlining the purpose of the study, voluntary participation, confidentiality, and their rights as participants. A census method was employed, targeting all personnel to ensure comprehensive coverage and eliminate sampling bias. Out of the 205 administered questionnaires, 185 were duly completed and returned, and were found usable for the study. Data obtained were analysed using descriptive statistics such as frequency counts and percentages. This helped to summarise the demographic characteristics and core findings regarding transformative service delivery initiatives. The study adhered to ethical research standards, including voluntary participation and strict confidentiality of all responses. While the study provides useful insights, it is limited to selected university teaching hospitals and may not reflect the experiences of health librarians in other settings.

Findings

Demographic Characteristics of the Respondent

Table 1: Gender of the respondents (185)

SN	Gender	Frequency	Percentage
1.	Male	85	45.9%
2.	Female	100	54.1%
	Total	**185**	**100**

The gender distribution of respondents shows a slightly higher number of females (54.1%) compared to males (45.9%). This suggests that more women participated in the study than men.

Table 2: Years of experience of the respondents (185)

SN	Year of experience	Frequency	Percentage
1.	Less than 1 year	45	24.3%
2.	1-5 years	65	35.1%
3.	6-10 years	35	18.9%
4.	Over 10 years	40	21.6%
	Total	**185**	**100**

Most respondents (35.1%) have between 1 and 5 years of work experience, while 24.3% have less than a year. Those with 6–10 years make up 18.9%, and 21.6% have been in the field for over 10 years. This indicates a fairly balanced mix of new and experienced professionals.

Table 3: Affiliated Institutions of the respondents (185)

SN	Affiliated Institution	Frequency	Percentage
1.	Teaching Hospital	42	22.7%
2.	Research Institute	48	25.9%
3.	University Medical Library	49	26.4%
4	Others	46	24.8%
	Total	**185**	**100**

Respondents are spread across various institutions, with the majority working in university medical libraries (26.4%), followed closely by research institutes (25.9%). Others include teaching hospitals (22.7%) and other categories of medical information settings (24.8%).

Table 4: Educational Qualifications the respondents (185)

SN	Qualification	Frequency	Percentage
1.	ND/HND	71	38.3%
2.	BSC/B.TECH	69	37.2%
3.	MASTER	27	14.5%
4.	PHD	18	7.5%
	Total	**185**	**100**

A large proportion of respondents hold either ND/HND (38.3%) or BSc/B.Tech degrees (37.2%). A smaller number have a Master's degree (14.5%), while only 7.5% possess a PhD. This shows that most of the workforce is at the diploma or first-degree level.

Table 5: Designation of the respondents (185)

SN	Level	Frequency	Percentage
1.	Principal Librarian	15	8.1%
2.	Senior Librarian	30	16.2%
3.	Librarian 1 and 2	57	30.8%
4.	Library Officer	83	44.8%
	Total	**185**	**100**

Most respondents are Library Officers (44.8%), followed by Librarian I and II (30.8%). Senior Librarians make up 16.2%, while only 8.1% are Principal Librarians. This shows a workforce dominated by lower to mid-level professionals.

Table 6: Demographic details of the respondents (185)

SN	Age	Frequency	Percentage
1.	23-35	20	10.8%
2.	36-45	28	15.1%
3.	46-55	68	36.7%
4.	56 and above	69	37.2%
	Total	**185**	**100**

The age range is skewed towards older professionals, with 37.2% aged 56 and above, and 36.7% between 46 and 55. Younger respondents are fewer: 15.1% fall between 36 and 45, while only 10.8% are aged 23 to 35. This points to an ageing workforce in the medical librarianship sector.

Table 7: Identify the digital tools that are currently being used for health information services delivery

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	I use online public access catalogue (OPAC) to enhance health information delivery	185	3.05	0.95	5th	Accepted
2.	I employed utilizing electronic database to transfer health Information for services deliveries	185	3.02	0.96	7th	Accepted
3.	Institution repository plays a crucial role for transforming health information deliveries	185	3.09	0.99	3rd	Accepted
4.	Tele-health information support systems assist me in transforming health information deliveries	185	3.06	1.01	4th	Accepted
5.	Digital reference services are essential for health services deliveries	185	3.24	0.86	1st	Accepted
6	Library management systems play crucial roles in health services deliveries	185	3.03	0.98	6th	Accepted
7	Mobile library application helps in health information services deliveries	185	3.10	0.94	2nd	Accepted
8	Artificial intelligence tools for information retrieval help in health information services deliveries	185	3.00	1.06	8th	Accepted
Weighted Mean= 3.07						

Table 7 shows the digital tools currently used for health information delivery. The most frequently used tools, Digital reference services (3.24) and Mobile library application (3.10), were accepted as crucial. Institution repository (3.09) was also accepted, ranking 3rd. However, tools like Tele-health information support systems (3.06), Library management systems (3.03), and Electronic databases (3.02) were less favored and rejected. The lowest-ranked tool, Artificial intelligence tools for information retrieval (3.00), was also rejected. The weighted mean of 3.07 suggests that while these tools are somewhat useful, they are not universally relied upon for health information delivery.

Table 8: What is the primary purpose of using digital tools in your library

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	It provides clinical support to health care staffs	185	3.11	0.92	3rd	Accepted
2.	It improves access to scholarly resources	185	3.18	0.86	2nd	Accepted
3.	It supports research and publication	185	3.08	0.94	4rd	Accepted
4.	It delivers patient education and health literacy	185	3.01	0.98	5th	Accepted
5.	It enhances internal library operation	185	3.29	0.81	1st	Accepted
Weighted Mean= 3.13						

Table 8 reveals the main purposes why the library implements digital tools. The results showed that library personnel rate internal operational enhancement (3.29) as their most important purpose followed by resource accessibility improvement (3.18). Both purposes received positive acceptance. Higher priority was given to improve internal library operations (3.29) than to support health care professionals (3.11) or help research publication activities (3.08) and patient education delivery (3.01). These results suggest that the library's focus is more on operational improvements and enhancing access to resources rather than clinical support or patient education.

Table 9: Implementation of transformative initiative in your library

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	I engage digital platform	185	2.96	0.98	6th	Accepted
2.	I embrace new (innovation) services	185	3.10	0.86	4th	Accepted
3.	I enjoy outreach programme	185	3.15	0.91	3rd	Accepted
4.	Strategic role as one of transformative initiative	185	3.04	0.98	5th	Accepted
5.	Systemic role is part of TI	185	3.21	0.85	1st	Accepted
6	Sustainable role also a TI	185	3.29	1.04	7th	Accepted
7	Inclusive role is part of TI	185	3.17	0.98	2nd	Accepted
Weighted Mean= 3.08						

Table 9 highlights the implementation of transformative initiatives in the library. The highest-rated items include systemic role (3.21) and inclusive role (3.17), both of which were accepted. Other accepted items include embracing new (innovative) services (3.10) and enjoying outreach programmes (3.15). Survey participants demonstrated lower priority toward engaging digital platforms (2.96), strategic (3.04) and sustainable roles (3.29). The library directs most of its transformational efforts toward systemic approaches and inclusive initiatives and innovative roles rather than digital platforms, strategic planning and sustainability.

Table 10: Initiative in your library

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	Digital library system e.g (Koha, D S S)	185	3.11	0.89	3rd	Accepted
2.	Mobile health information services	185	3.16	0.88	2nd	Accepted
3.	Health literacy programme	185	2.99	0.93	5th	Accepted
4.	Enables librarianship in health teams	185	3.09	0.97	4th	Accepted
5.	Artificial intelligence based information tools	185	3.27	0.83	1st	Accepted
Weighted Mean= 3.12						

Table 10 presents various initiatives within the library. The highest-rated items are Artificial Intelligence-based information tools (3.27) and Mobile health information services (3.16), both of which were accepted, indicating that these initiatives are viewed as important in enhancing library services. On the other hand, items such as digital library systems (3.11), health literacy programmes (2.99), and enabling librarianship in health teams (3.09) were less favored and rejected, with lower mean scores. Overall, the library appears to prioritize AI-based tools and mobile health information services as key initiatives while placing less emphasis on traditional systems and health literacy efforts.

Table 11: Opportunity for transformative initiative in the Library

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	Improve users engagement	185	3.14	0.93	3rd	Accepted
2.	Professional growth and trainee for librarian	185	3.18	0.83	2nd	Accepted
3.	Expanded access to health information	185	3.33	0.74	1st	Accepted
4.	Greater collaboration with health care professionals	185	3.18	0.88	2nd	Accepted
5.	Increase feasibility of library services	185	3.10	0.92	4th	Accepted
Weighted Mean= 3.18						

Table 11 highlights various opportunities for transformative initiatives in the library. Research participants endorsed the Supreme Opportunity of expanded Healthcare Information Access (3.33) indicating a strong belief in its potential impact. Followed by professional growth and training for librarians (3.18) and Greater collaboration with healthcare professionals (3.18). Users were less interested in Improved user engagement (3.14) and Increased feasibility of library services (3.10). Thus, the findings shows a distinct tendency to improve access to health information together with professional growth and medical professional collaboration while the feasibility of library services and user engagement were less emphasized.

Table 12: Institution support in enabling transformative changes

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	Providing adequate facility and resources for librarians	185	3.28	0.83	3rd	Accepted
2.	Training and capacity building	185	3.13	0.88	5th	Accepted
3.	Interdepartmental collaboration	185	3.11	0.90	6th	Accepted
4.	Recognition and inclusion i.e including librarians in policy making and health teams formations	185	3.08	0.93	7th	Accepted
5.	Monitoring and evaluation (institution support routine assessment of library services	185	3.32	0.78	2nd	Accepted
6	Policy and strategic directions institution that develop clear policies and strategic plan for digital transformation	185	3.38	0.74	1st	Accepted
7	Funding and resources allocation adequate financial support is essential for acquiring and maintaining digital tools	185	3.16	0.87	4th	Accepted
Weighted Mean= 3.20						

Table 12 indicates Policy and strategic directions (3.38), Monitoring and evaluation (3.32) and Providing adequate facilities and resources for librarians (3.28) as highest support for transformative changes in health libraries. These factors highlight the importance of clear policies, routine assessments, and resource provision. On the other hand, Training and capacity building (3.13), Interdepartmental collaboration (3.11), Recognition and inclusion (3.08), and Funding and resource allocation (3.16) were ranked lower and rejected, suggesting these areas receive less institutional support for transformation.

Table 13: Challenges encounter while implementing transformative initiative

S/N	Items	Total	Mean	Std.Dev	Rank	Decision
1.	Adequate funding by the university management	185	3.30	0.82	3rd	Accepted
2.	Lack of digital skill around librarian	185	3.31	0.79	2nd	Accepted
3.	Resistance to change by staff or users	185	3.22	0.83	5th	Accepted
4.	Poor infrastructure e.g electricity, internet	185	3.31	0.77	2nd	Accepted
5.	Limited institutional support	185	3.40	0.72	1st	Accepted
6	Unclear Policy or strategic decision	185	3.24	0.81	4th	Accepted
Weighted Mean= 3.29						

Table 13 reveals that Limited institutional support (3.40) ranks the highest, followed by Lack of digital skills among librarians (3.31), Resistance to change (3.22) Unclear policy or strategic decision (3.24) and Poor infrastructure (3.31), all of which were accepted as significant challenges. These factors suggest that insufficient support, lack of skills, and inadequate infrastructure are major obstacles in implementing transformative initiatives.

Discussion of Findings

This study examined the role of digital transformation in enhancing health information services in libraries. Findings indicate that digital tools, particularly digital reference services and mobile health applications, are pivotal in improving access to health information. These tools enhance user engagement by offering immediate, accurate responses, aligning with the broader trend towards mobile-responsive platforms over traditional methods like OPACs and electronic databases, which are less interactive and real-time. This observation aligns with existing literature (Thangiah, Leo, Suraj and Ramar, 2024) which emphasizes that libraries are increasingly moving towards digital tools that promote interaction and engagement, rather than static repositories of information. The study also found that while digital tools improve internal operations and access to scholarly resources, tools aimed specifically at patient education and health literacy are underutilized. As libraries continue to evolve, there is a need for more targeted initiatives that leverage digital tools for improving health information literacy as recommended by Michael, Ikegwuiro, Nyatse and Odoh (2024).

Moreover, the study identified AI-based tools and mobile health services as key drivers of transformation. These initiatives allow for more personalized and accessible health information delivery, echoing findings from Chamberlain et al. (2015), who stressed the growing importance of mobile technologies in library services. However, initiatives like digital library systems and health literacy programs are still in their early stages, indicating that libraries must focus more on these areas for a more comprehensive transformation of health information services.

The research investigated available opportunities to deploy transformative initiatives inside modern libraries. The study identified expanded access to health information alongside career development opportunities as the two main transformative opportunities. Digital tools enhance accessibility as described in Al-Shorbaji (2021) when he emphasized how digital libraries effectively connect users to relevant health information. Additionally, Xwayi (2025) suggested that librarians should receive adequate training on both digital literacy and AI skills as it enables them to manage new technology to meet users' need more effectively.

Furthermore, institutional support guarantees digital transformation success because libraries need specific guidelines for digital tool implementation to have a well-defined framework that guides the integration of digital tools into their operations and ensures that these tools are effectively utilized The research exemplifies weak links between departments as well as shortages in ongoing training programs that may suppress the successful integration of these digital tools. The lack of available training programs along with insufficient resources indicates an institutional weakness as libraries struggle to leverage digital tool effectively.

Finally, the research includes three main obstacles including inadequate institutional support, deficicncy in Librarians digital skills and poor infrastructure. These challenges aligns with Sadiku and Kasim (2024) who identified infrastructure and training gaps as barriers faced by libraries in Nigeria when it comes to digital transformation. These obstacles need specific action from both institutional leaders and policymakers to provide libraries with necessary resources that will enable them to permanently implement digital health information services.

Conclusion and Recommendations

This research explored digital transformation in libraries and health information services: integrating digital tools, identifying opportunities and challenges, and institutional support. Findings revealed that libraries utilize many digital tools, like institutional repositories, mobile health services, and digital reference services, but the integration of these tools is faced with several challenges such as limited institutional support, inadequate digital skills, and poor infrastructure. Although the tools have been significantly used in enhancing access to health information, some sections such as digital library systems and programs in health literacy are still underutilized and need further development. Other challenges identified in the study hindering full digital transformation include resistance to change, inadequate infrastructure, and lack of strategic planning. To solve these problems, it is crucial for libraries to train, develop infrastructure, and initiate strategic vision. Progress has been made, but to make a real and lasting impact, libraries must invest in both technology and human capital, not only in health information but also

in service that users will benefit from. It is through such investments in technology and human capacity by libraries that initiatives to transform will have a lasting impact.

Based on the findings and conclusion of this study, the following recommendations are proffered:

1. Investment reliable digital infrastructure and consistent adequate funding by library management will allow for sustainable acquisition and maintenance of advanced health information tools which result in seamless information service delivery.
2. Continuous training education focused on digital and emerging tools especially AI and mobile applications must be part of librarians' training program to increase their ability to handle and improve health information services.
3. Policymakers need to establish clear guidelines and adequate funding support for library digital reformation and ensure access to modern technologies needed for delivering effective health information services.
4. Health institutions should partner with libraries to implement digital health technologies through their services thus providing better access to trustworthy health information for medical staff and the public.
5. Users should actively engage with digital health information tools and provide feedback to libraries to ensure that the services meet their needs and remain accessible and relevant.

Implications for health information service delivery

Health information delivery can be greatly improved by leveraging on essential digital tools such as mobile health applications, digital reference services and AI-based tools. Through their implementation libraries can provide faster and reliable health information which improves people's understanding of healthcare and outcomes. The implementation of digital health services requires resolving challenges involving insufficient funding, lack of digital skills and resistance to change among library staff. Also, to support the longevity of these initiatives, institutional support including adequate resources and clear policies are sacrosanct. The solution demands that libraries must embrace digital transformation to meet the growing need of health information users.

References

Al-Shorbaji, N. (2021). *Improving healthcare access through digital health: The use of information and communication technologies.* In IntechOpen. https://www.intechopen.com/chapters/78328

Anene, I., & Ebifagha, T. (2021). Digital Literacy Training Needs for Enhancing Job Performance of Library Staff in Federal Universities in Nigeria. *Niger Delta Journal of Library and Information Science.* 2(1). 90-103

Australian Library and Information Association (n.d). 10 WAYS THAT LIBRARY AND INFORMATION SERVICES POWER THE HEALTH SECTOR PATIENT CARE. Retrieved April 21, 2025, from https://hla.alia.org.au/wp-content/uploads/2022/01/10_ways_that_library_and_information_services_power_the_health_sector.pdf

Bryant, L. S., Bridgen, R., Hopkins, E., McLaren, C., & Stewart, D. (2022). NHS knowledge and library services in England in the digital age. *Health Information & Libraries Journal*. https://doi.org/10.1111/hir.12457

Chamberlain, D., Elcock, M., & Puligari, P. (2015). The use of mobile technology in health libraries: A summary of a UK-based survey. *Health Information & Libraries Journal,* 32(4), 265–275. https://doi.org/10.1111/hir.12116

Chaturvedi, K. C. (2016). Evidence-Based Library and Information Practice & Educational Needs of Health Librarians: National and International Trends. *DESIDOC Journal of Library & Information Technology*, *37*(1), 24–29. https://doi.org/10.14429/djlit.37.1.10653

Chika, E. U., Dike, U. P., Ahuchaogu, K., Ezenri, G., Okechukwu, N. T., Chidozie, C., & Madubugwu, R. (2024). Digital Healthcare Tools in Nigeria: Strengthening Public Health and Pandemic Preparedness - Insights from the COVID-19 Crisis. *Telehealth and Medicine Today*, *9*(1). https://doi.org/10.30953/thmt.v9.445

De-la-Mano, M. (2024). The historical development and current landscape of health library standards: A critical review. *Health Information & Libraries Journal*. https://doi.org/10.1111/hir.12530

Farahi, M. T., & Gandhi, R. T. (2011). Adoption of information technologies in medical

libraries in Karnataka, India and Iran: A comparative study. *International Journal of Library and Information Science.* 3(2). 38-45

Farakuoye, M. A. (2023). The role of librarians in healthcare interprofessional collaboration: a literature review. *Journal of Health Information and Librarianship*, 6(1). 51-58

Ikolo, V. (2024). Availability of Information and Communication Technology (ICT) Tools and Skills for their Use in Operation in Medical Libraries in Nigeria. *Nigerian Libraries*. https://doi.org/10.61955/eioxbk

Le, B. P. (2015). Academic library leadership in the digital age. *Library Management*, *36*(4/5), 300–314. https://doi.org/10.1108/lm-07-2014-0083

Masenya, T. M. (2024). Digital transformation of Medical Libraries. *International Journal of E-Health and Medical Communications.* 15(1). 1-13. DOI:10.4018/IJEHMC.345402

Michael, G. A., Ikegwuiro, P. U., Nyatse, R. D., & Odoh, N. J. (2022). Librarians' and information scientists' roles in health information literacy: A review of literature. *International Journal of Applied Technologies in Library and Information Management,* 8(3), 28–34. https://www.ajol.info/index.php/jatlimi/article/view/269960

Murphy, J. (2022). Transforming health science libraries around the globe: The impact of technology. *Health Information & Libraries Journal*, *39*(3), 203–206. https://doi.org/10.1111/hir.12451

Okeke, O. C., Godwin, S., Eze, J. U., & Asogwa, G. E. (2017). Status of Medical Library Resources and Services in Teaching Hospitals in Enugu State, Nigeria: implications for quality health care services. *DOAJ (DOAJ: Directory of Open Access Journals)*. https://doi.org/10.5865/ijkct.2017.7.2.021

Osaro, E. N., & Garrick, M. J. (2024). Repositioning Nigerian Education and Heathcare System Using Quality Library and Information Services. *Journal of Health, Applied Sciences and Management.* 8(1). 74-80.

Petersen, D. (2023). Virtual Services in the Health Sciences Library: A Handbook. *Medical Reference Services Quarterly*, *42*(1), 69–70. https://doi.org/10.1080/02763869.2023.2160138

Piorun, M. (2011). Evaluation of strategic plans in academic medical libraries. *Library & Information Science Research*, *33*(1), 54–62. https://doi.org/10.1016/j.lisr.2010.05.002

Popoola, B. O., Uzoagba, N. C., & Rabiu, N. (2020). "What's happening over there?": a study of the current state of services, challenges, and prospects in Nigerian medical libraries. *Journal of the Medical Library Association JMLA*, *108*(3). https://doi.org/10.5195/jmla.2020.607

Sadiku, S. A., & Kasim, A. (2024). Digital library development and the challenges in Nigeria. *Journal of Library and Information Architecture,* 1(1/2), 83–92. https://doi.org/10.47524/jlia.v1i1.84

Siemensma, G., & McDonald, D. (2023). Technology and informatics in Australian health libraries. *Health Information and Libraries Journal*, *40*(2), 218–222. https://doi.org/10.1111/hir.12496

Thangiah, R., Leo, M. J., Suraj, M., & Ramar, R. (2024). Digital transformation of academic libraries. *In Advances in Library and Information Science (ALIS)IGI Global.* https://doi.org/10.4018/979-8-3693-2782-1.ch017

Umenwa, E., Agbo, A. D., & Onyekweodiri, N. E. (2016). Issues Militating against Effective Provision of Medical Library Services in Federal University Teaching Hospitals in South-East Geo-Political Zone of Nigeria. *Journal of Applied Information Science and Technology,* 9(6). 137-143

Xwayi, N. (2025). *Digital literacy skills of librarians in the 21st century: A case study of the University of the Western Cape* [Master's mini-thesis, University of the Western Cape]

Transforming Librarianship and Information Service Delivery in the 5th Industrial Revolution through Innovative Technology: A Case Study of Donald Ekong Library, University of Port Harcourt

By

VICTOR WAGWU PhD (CLN)
Dame Patience Goodluck Jonathan Automated Library, Ignatius Ajuru University of Education Rumuorlumeni, Port-Harcourt, Rivers State, Nigeria.
Victor.wagwu@iaue.edu.ng

CAROLINE A. OKORO PhD (CLN)
Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.
carolokoroamara@gmail.com
ANGELA EBELE OKPALA PhD (CLN)
University librarian, National Open University of Nigeria (NOUN), Jabi, Abuja
aokpala@noun.edu.ng

Abstract

The advent of the 5th Industrial Revolution (IR) marks a paradigm shift in the integration of human-centric and advanced technological innovations across various domains, including librarianship and information service delivery. This study investigated how innovative technologies such as artificial intelligence (AI) and other modern technologies is reshaping libraries and information services. The descriptive survey design was used for the study. The population of the study consists of 22 librarians and 18 library officers in the Donald Ekong Library University of Port Harcourt. The sample size of the study was 40. Census sampling technique was used for the study. Instrument for data collection was a four Likert scale of self-structured questionnaire while data collected was analysed *using mean and standard deviation to answer the research questions. The findings of the study revealed among others a high extent of availability and application of innovative technologies, which is a positive indicator for the development of library services in the country. It also showed that innovative technologies are applied to a high extent in library service delivery in Nigerian university libraries. The study recommended among others that Donald Ekong Library should seek more substantial funding and investment to acquire, maintain, and upgrade technological tools. Donald Ekong Library should implement regular and comprehensive training programs for library staff to ensure they have the technical skills to operate and manage new technologies effectively.*

Keywords: *Industrial Revolution, innovative technology, librarianship transformation, information service delivery, artificial intelligence.*

Introduction

The field of librarianship and information service delivery has witnessed significant transformations over the years, from traditional manual operations to digital and automated services. The advent of the Fifth Industrial Revolution (5IR), characterized by the fusion of human intelligence and cutting-edge technologies such as artificial intelligence (AI), robotics, blockchain, and the Internet of Things (IoT), presents new opportunities and challenges for libraries and information centers (Okechukwu, 2021). According to Opara (2022), "libraries must evolve from being mere repositories of knowledge to interactive, technology-driven knowledge hubs that support real-time user engagement."

The 5IR builds upon the Fourth Industrial Revolution (4IR) by emphasizing not only automation and smart technologies but also human-machine collaboration. This revolution introduces personalized and intelligent services that can transform the way library users' access, retrieve, and interact with information. Smart technologies such as AI-powered recommendation systems, robotic assistance in libraries, and blockchain for secure and transparent record-keeping offer immense potential to enhance service efficiency and user satisfaction (Eze, 2022).

Despite these advancements, many Nigerian libraries face challenges in adopting these innovative technologies. Infrastructural limitations, inadequate funding, lack of skilled personnel, and resistance to change hinder the seamless integration of 5IR tools into library operations. There is a growing need for libraries to embrace digital transformation by investing in technological infrastructure, training library personnel, and fostering collaborations with tech industries to enhance information service delivery (Makori & Bitso, 2021). This study aims to explore how Nigerian libraries using Donald Ekong Library, Port Harcourt can leverage 5IR innovations to improve service accessibility, operational efficiency, and overall user experience in the digital era.

Statement of the Problem

Despite the numerous benefits that innovative technologies offer in library and information services, many libraries, especially in Nigeria, have not fully embraced the 5IR paradigm. Issues such as inadequate funding, lack of technical expertise, resistance to change, and poor digital infrastructure hinder the seamless integration of advanced technologies. The reluctance to transition from traditional methods to smart, technology-driven systems further exacerbate the challenges faced by libraries in meeting the information needs of users effectively.

There is a growing demand for real-time information access and personalized library services, yet the implementation of AI-driven tools, cloud-based repositories, and blockchain-enabled security measures remains minimal. This raises concerns about the relevance and sustainability of Nigerian libraries in an era where digital transformation is rapidly redefining global information service delivery. Hence, there is a need to examine how emerging technologies can be effectively deployed to enhance library services and user experiences, while addressing the underlying challenges that hinder their adoption.

Objectives of the Study

The aim of the study is to examine thetransforming librarianship and information services delivery in the 5th industrial revolution through innovative technology. Specifically, the objectives are;

1. to determine the extent of availability of innovative technologies in university libraries in Nigeria.
2. to ascertain the extent to which innovative technologies are applied in library service delivery.
3. to identify the challenges faced by university libraries in the application of innovative technologies.
4. to explore strategies for overcoming the challenges associated with the application of innovative technologies in university libraries.

Research Questions

The study will be guided by the following research question

1. What is the extent of availability of innovative technologies in university libraries in Nigeria?
2. What extent are innovative technologies applied in library service delivery in Nigerian universities?
3. What challenges do university libraries in Nigeria face in applying innovative technologies?
4. What strategies can be employed to overcome the challenges associated with the application of innovative technologies in university libraries in Nigeria?

Literature Review

Fifth Industrial Revolution (5IR)

The Fifth Industrial Revolution (5IR) builds on the advancements of the Fourth Industrial Revolution (4IR) but differentiates itself by emphasizing the symbiotic relationship between human intelligence and cutting-edge technologies. While 4IR was marked by automation, robotics, artificial intelligence (AI), and big data, 5IR goes a step further by integrating these technologies in ways that prioritize human well-being, creativity, and ethical considerations (Nwosu, 2023).

In the context of librarianship, 5IR transforms libraries from being traditional repositories of information into highly interactive, intelligent knowledge hubs that foster deeper engagement between humans and machines. AI-driven cataloging systems enhance the efficiency of library operations by automating indexing and classification, reducing manual labor, and improving retrieval accuracy. Blockchain technology plays a crucial role in information security by ensuring the authenticity and permanence of digital records, preventing unauthorized access and data manipulation. Additionally, smart digital assistants, powered by machine learning and natural language processing, provide personalized user experiences by assisting with book recommendations, answering research queries, and even automating administrative tasks. The 5IR revolution presents both opportunities and challenges for libraries, particularly in developing countries such as Nigeria (Adebayo & Yusuf, 2019). While its technologies promise enhanced efficiency, accessibility, and inclusivity, their successful adoption depends on factors such as digital literacy, infrastructural readiness, and policy frameworks that encourage technological innovation in library services.

Librarianship in the 5IR

The role of librarians in the 5IR is undergoing a significant transformation, moving beyond traditional responsibilities such as cataloging and book lending to more dynamic functions that require proficiency in digital tools, data analytics, and artificial intelligence (Eze, 2022). In this era, librarians are expected to act as information architects, data curators, and digital literacy facilitators who guide users in navigating vast digital landscapes. One of the major shifts in librarianship within 5IR is the adoption of smart libraries, which incorporate Internet of Things (IoT) sensors, automated book retrieval systems, and AI-powered recommendation engines to improve user experiences. For instance, IoT devices can track book

movements within a library, monitor space usage, and automate inventory management, reducing the workload of library staff. Similarly, AI-driven research assistance tools enable librarians to provide more personalized research guidance, making information retrieval more efficient and user-centered.

Digital content curation has become an essential skill for librarians in the 5IR. Unlike the past, where print resources were the primary focus, today's librarians must manage and curate digital collections, ensuring access to high-quality online databases, open-access resources, and multimedia learning materials. Furthermore, data-driven decision-making allows libraries to analyze user preferences, predict future information needs, and optimize service delivery accordingly (Afolabi, 2021).

The evolution of librarianship in the 5IR also necessitates continuous professional development. Librarians must undergo training in digital technologies, cybersecurity, and AI-based research tools to remain relevant in this rapidly changing environment. Institutions must also invest in upskilling their library staff to bridge the digital divide and ensure equitable access to knowledge resources.

Innovative Technology in Library Services

The integration of innovative technology in library services is reshaping how information is accessed, managed, and delivered in academic and public libraries. Emerging technologies such as artificial intelligence (AI) powered Chatbots and Virtual Assistants, Blockchain-Based Authentication and Digital Record Management, virtual reality (VR) and Augmented Reality (AR) and Cloud Computing and Digital Repositories are enhancing efficiency, security, and user engagement in unprecedented ways (Obi, 2022).

Empirical Review

Johnson and Adegbite (2021) examined the integration of artificial intelligence (AI) in Nigerian university libraries and its impact on service efficiency. The study was conducted across five federal university libraries in Nigeria, with a population of 300 library staff. Using a descriptive survey research design, a sample of 150 respondents was selected through purposive sampling. The study employed Structural Equation Modeling (SEM) to analyze the relationship between AI adoption and library service delivery. The results revealed that AI-powered cataloging, chatbots, and predictive analytics significantly enhanced user satisfaction and service responsiveness. However, challenges such as limited funding, inadequate digital literacy, and resistance to change hindered full-scale adoption. The study recommended increased investment in AI infrastructure, librarian training programs, and policy development to facilitate seamless AI integration in Nigerian libraries.

Eze and Okoro (2020) investigated the application of blockchain technology for securing digital resources in academic libraries in Nigeria. The study focused on 10 university libraries, covering a population of 250 librarians and IT staff. A mixed-method research design was used, with a sample size of 120 participants selected through stratified random sampling. The researchers utilized a combination of interviews and questionnaire surveys, with data analyzed using thematic analysis and regression modeling. Findings showed that blockchain technology enhances data integrity, prevents unauthorized access, and improves authentication of digital collections. However, technical complexities, lack of awareness, and high implementation costs posed significant barriers. The study is similar in the objectives used and differ in the populations and area of the study.

Musa et al. (2022) examined the impact of the Internet of Things (IoT) on the development of smart libraries in Nigeria. The study was conducted in 12 university libraries across three geopolitical zones, with a population of 600 students and library professionals. A total of 250 respondents were selected through cluster sampling. A quasi-experimental research design was employed, and data was analyzed using a multivariate regression approach. The results indicated that IoT-enabled book tracking systems, automated self-checkout kiosks, and smart shelves significantly improved library efficiency and user experience. However, major challenges included unreliable power supply, lack of skilled personnel, and high maintenance costs. The reviewed study is similar in the design used while differ in population and area studied.

Nwachukwu and Bello (2021) explored the effectiveness of virtual reality (VR) technology in enhancing learning experiences within university libraries. The study was conducted in three Nigerian universities that had recently introduced VR-based learning labs. The population consisted of 1,000 students, with a sample size of 300 selected through a simple random sampling technique. A pre-test and post-test experimental research design was used to measure students' engagement and knowledge retention before and after using VR tools. The study employed a t-test analysis to determine the effectiveness of VR in library learning environments. The findings revealed that VR significantly improved student engagement, knowledge retention, and interactive learning. However, technical challenges, such as high equipment costs and inadequate technical support, limited VR's widespread adoption. The reviewed study is similar in the topic and differs in research design and area studied.

Obi and Nwankwo (2023) examined the role of cloud computing in enhancing digital library services in Nigerian universities. The study targeted 15 university libraries with established digital repositories, covering a population of 800 librarians and students. A total of 350 respondents were selected using a stratified sampling technique. The research employed a survey design, and data was analyzed using Structural Equation Modeling (SEM). Findings indicated that cloud computing significantly improved remote access to digital resources, facilitated knowledge sharing, and reduced storage costs. However, concerns related to cybersecurity threats, data privacy, and unreliable internet connectivity hindered full adoption.The objective the reviewed area is similar and differs in area and population of the study.

Methodology

The area of the study was Donald Ekong Library, University of Port Harcourt. The descriptive survey design was used in conducting the study. The population of the study consisted of 22 librarians and 18 library officers in the University of Port Harcourt Library. These categories of staff in the library were chosen to serve as respondents for this study because they can provide accurate data needed for the purpose of this study. The sample size of the study was 40. Census sampling technique was used for the study. This technique was considered appropriate for this study because of the limited size of the population. Instrument for data collection was a self-structured questionnaire while data collected was analyzed using mean and standard deviation to answer the research questions.

Research Question 1: What is the extent of availability of innovative technologies in university libraries in Nigeria?

Table 1: Respondents mean rating and standard deviation on extent of availability of innovative technologies in university libraries in Nigeria.

S/N	ITEMS	VHE	HE	LE	VLE	MEAN	S/D	DECISION
1	AI-driven cataloging and classification systems are readily available in my university library.	12	15	8	5	2.85	0.98	High Extent
2	The library provides access to cloud -based digital repositories for academic resources.	14	13	7	6	2.88	1.02	High Extent
3	Smartphones for service delivery.	10	14	9	7	2.68	1.05	High Extent
4	The library has sustainable electricity	11	16	8	5	2.83	0.97	High Extent
5	The university library is well -equipped with virtual and augmented reality tools for research and learning.	13	12	9	6	2.80	1.04	High Extent
	Grand Mean					**2.81**	**1.01**	**High Extent**

Very High Extent…..1, High Extent…….2, Low Extent…….3, Very Low Extent……4

The results from Table 1 show the summary of mean ratings and standard deviation on the extent of availability and application of innovative technologies in university libraries in Nigeria. With a grand mean of 2.81 and SD=1.01, the respondents indicated a high extent of availability and application of innovative technologies. Specifically, as shown in the above table which findings revealed that university libraries in Nigeria have a high extent of availability and application of innovative technologies, which is a positive indicator for the development of library services in the country.

Research question 2: To what extent are innovative technologies applied in library service delivery in Nigerian universities?

Table 2: Respondents mean rating and standard deviation on the extent if innovative technologies applied in library service delivery in Nigerian universities

S/N	ITEMS	VHE	HE	LE	VLE	MEAN	S/D	DECISION
1	Chatbots are actively used for responding to library users' inquiries.	13	14	9	4	2.90	1.01	High Extent
2	The library integrates blockchain technology for authentication and data security purposes.	12	13	10	5	2.80	1.02	High Extent
3	Cloud computing is effectively utilized to provide remote access to library resources.	14	12	8	6	2.85	1.03	High Extent
4	Emails are used for library service delivery	11	15	9	5	2.80	1.00	High Extent
5	Virtual reality (VR) tools are incorporated into the library's instructional and research support services.	10	16	8	6	2.75	1.4	High Extent
	Grand Mean					**2.82**	**1.02**	**High Extent**

Very High Extent…..1, High Extent…….2, Low Extent…….3, Very Low Extent……4

The results from the table present the summary of mean ratings and standard deviation on the extent to which innovative technologies are applied in library service delivery in Nigerian universities. With a grand mean of 2.82 and SD=1.02, the respondents indicated a high extent of application of these technologies. Specifically, as shown in the table above which findings indicate that innovative technologies are applied to a high extent in library service delivery in Nigerian university libraries.

Research question 3: What challenges do university libraries in Nigeria face in applying innovative technologies?

Table 3: Respondents mean rating and standard deviation on the challenges university libraries in Nigeria face in applying innovative technologies

S/N	ITEMS	VHE	HE	LE	VLE	MEAN	S/D	DECISION
1	High costs of acquiring and maintaining innovative technologies.	14	13	8	5	2.90	1.01	High Extent
2	Lack of adequate training and technical expertise among library staff.	12	14	9	5	2.83	1.02	High Extent
3	Poor internet connectivity.	13	12	10	5	2.83	1.03	High Extent
4	Resistance to change among library users and staff.	11	15	9	5	2.80	1.00	High Extent
5	Inadequate government and institutional support.	10	16	8	6	2.75	1.04	High Extent
	Grand Mean					**2.82**	**1.02**	**High Extent**

Very High Extent…..1, High Extent…….2, Low Extent…….3, Very Low Extent……4

The results from the table present the summary of mean ratings and standard deviation on the extent of challenges affecting the adoption of innovative technologies in university libraries in Nigeria. With a grand mean of 2.82 and SD=1.02, the respondents indicated that these challenges exist to a high extent. Specifically, as shown in the above table which findings suggest that while innovative technologies have the potential to enhance library services in Nigerian universities, their adoption is hindered by financial constraints, inadequate training, poor internet access, resistance to change, and insufficient institutional support.

Research Question 4: What strategies can be employed to overcome the challenges associated with the application of innovative technologies in university libraries in Nigeria?

Table 4: Respondents mean rating and standard deviation on strategies that can be employed to overcome the challenges associated with the application of innovative technologies in university libraries in Nigeria

S/N	ITEMS	VHE	HE	LE	VLE	MEAN	S/D	DECISION
1	Increased funding and investment in technological infrastructure.	15	12	9	4	2.95	1.00	High Extent
2	Continuous training and capacity -building programs for librarians.	13	15	7	5	2.88	1.03	High Extent
3	Strengthening internet and power supply infrastructure.	14	11	11	4	2.85	1.04	High Extent
4	Creating awareness campaigns on the benefits of innovative technologies.	12	14	10	4	2.83	1.01	High Extent
5	Government and institutional policies should prioritize and support the integration of emerging technologies in university libraries.	11	16	9	4	2.80	1.05	High Extent
	Grand Mean					**2.86**	**1.03**	**High Extent**

Very High Extent…..1, High Extent…….2, Low Extent…….3, Very Low Extent……4

The results from the table summarize the mean ratings and standard deviation on the extent of strategies for enhancing the adoption of innovative technologies in university libraries in Nigeria. With a grand mean of 2.86 and SD=1.03, the respondents indicated that these strategies are needed to a high extent. Specifically, as shown in the above table which findings revealed that improving financial investment, training

opportunities, infrastructure, awareness, and policy support is crucial for fostering the adoption of innovative technologies in university libraries.

Summary of findings

1. The findings in table 1 revealed that Donald Ekong Library have a high extent of availability and application of innovative technologies, which is a positive indicator for the development of library services in the country.
2. The findings in table 2 indicated that innovative technologies are applied to a high extent in library service delivery in Donald Ekong Library.
3. The findings in table 3 revealed that challenges such as high acquisition and maintenance costs, inadequate training, poor internet connectivity, resistance to change, and lack of institutional support hinder the adoption of innovative technologies in university libraries to a high extent.
4. The findings in table 4 showed that strategies such as increased funding, continuous training, improved infrastructure, awareness campaigns, and supportive policies are essential for enhancing the adoption of innovativetechnologies in university libraries to a high extent.

Discussion of Findings

Availability of Innovative Technologies in University Libraries in Nigeria

Table 1 above presents the respondents' mean rating and standard deviation on the extent of availability of innovative technologies in university libraries in Nigeria. The overall grand mean score of 2.81 and a standard deviation of 1.01 indicate that innovative technologies are available in Nigerian university libraries to a high extent. Item 1 shows that AI-driven cataloging and classification systems have a mean score of 2.85, suggesting a high availability. In item 2, cloud-based digital repositories are also rated highly available with a mean of 2.88, while the use of smartphones for library service delivery received a mean rating of 2.68, still within the range of high extent. Similarly, sustainable electricity (item 4) and the availability of virtual and augmented reality tools (item 5) were rated 2.83 and 2.80 respectively, both indicating a high extent of availability. This finding implies that university libraries in Nigeria are embracing modern and innovative technologies, although not at the maximum level. It aligns with the findings of Nnadozie, Osuigwe, and Udem (2015) who reported that many Nigerian university libraries have made considerable progress in integrating digital technologies, particularly AI tools and digital repositories. However, they also cautioned that the level of integration varies depending on institutional funding and management priorities.

Innovative Technologies Applied in Library Service Delivery in Nigerian Universities

Table 2 shows the respondents' mean ratings and standard deviations on the extent to which innovative technologies are applied in library service delivery in Nigerian universities. With a grand mean of 2.82 and standard deviation of 1.02, the result indicates that innovative technologies are applied to a high extent. Specifically, the use of chatbots for responding to user inquiries (mean = 2.90), the application of blockchain for authentication (mean = 2.80), and the utilization of cloud computing for remote access (mean = 2.85) all received high ratings. Other items such as the use of emails (2.80) and virtual reality tools (2.75) also reflect high application levels. These findings suggest that Nigerian university libraries are not only acquiring innovative technologies but are also integrating them into their service delivery systems. This is consistent with the work of Adeleke and Olorunsola (2020), who observed that innovative technologies such as chatbots and cloud services are increasingly used in Nigerian libraries for real-time service delivery, enhancing user satisfaction and expanding service reach beyond physical library spaces.

Challenges University Libraries in Nigeria Face in Applying Innovative Technologies

Table 3 illustrates the challenges faced by university libraries in Nigeria in applying innovative technologies, with a grand mean of 2.82 and standard deviation of 1.02, indicating that these challenges exist to a high extent. Among the challenges, the high cost of acquisition and maintenance received the highest mean score (2.90), followed by inadequate staff training (2.83) and poor internet connectivity (2.83). Other challenges include resistance to change (2.80) and insufficient government and institutional support (2.75). These findings highlight the persistent infrastructural and human capital limitations affecting technology adoption in Nigerian university libraries. They support the conclusions of Ezeani and Igwesi (2012), who found that financial constraints, inadequate ICT skills among library staff, and infrastructural deficits were major barriers to the adoption of digital innovations in Nigerian university libraries. These challenges need to be systematically addressed to ensure full realization of the benefits of innovative technologies.

Strategies Employed to Overcome the Challenges Associated with the Application of Innovative Technologies in University Libraries in Nigeria

Table 4 shows the respondents' mean ratings and standard deviations on strategies to overcome challenges associated with innovative technologies in Nigerian university libraries. With a grand mean of 2.86 and standard deviation of 1.03, the responses indicate a high extent of support for the proposed strategies. Increased funding for infrastructure development received the highest mean rating (2.95), followed by continuous training programs (2.88) and strengthening internet and power infrastructure (2.85). Other recommended strategies include awareness campaigns (2.83) and stronger government and institutional policies (2.80). This suggests that stakeholders recognize the need for a multi-pronged approach involving financial investment, staff development, infrastructure upgrades, and policy reforms. These findings align with Adebayo and Omotayo (2017), who emphasized the need for comprehensive strategies including policy backing, human capacity building, and consistent funding to overcome the systemic challenges facing libraries in the digital age.

Conclusion

The findings of this study revealed a strong positive outlook regarding the availability and application of innovative technologies in Donald Ekong Library. A significant proportion of respondents acknowledged the presence of various technological tools such as AI-powered cataloging systems, cloud-based repositories, virtual and augmented reality, and blockchain technology. Despite these advancements, several challenges, including high costs, inadequate training, poor internet connectivity, and resistance to change, hinder the full potential of these technologies in enhancing library services. Nevertheless, the majority of respondents suggested practical strategies, such as increased funding, continuous training, improved infrastructure, and stronger policy frameworks, to overcome these challenges. The study emphasizes the importance of proactive measures to foster the effective integration of innovative technologies into university libraries, which will ultimately contribute to improved service delivery and user satisfaction.

Recommendations

1. Donald Ekong Library should seek more substantial funding and investment to acquire, maintain, and upgrade technological tools.
2. Donald Ekong Library should implement regular and comprehensive training programs for library staff to ensure they have the technical skills to operate and manage new technologies effectively.
3. There is an urgent need for improved internet connectivity and reliable power supply in university libraries.
4. Donald Ekong Library should administration and government bodies should launch awareness campaigns to highlight the advantages of adopting innovative technologies in libraries.

References

Adebayo, S. O., & Yusuf, M. M. (2019). The impact of efficient tax administration on income distribution in Nigeria. *African Journal of Public Policy*, 8(2), 111-125.

Adeyemi, O. (2023). Challenges of digital transformation in Nigerian libraries. *Journal of Library and Information Science, 15*(2), 45-59.

Adigun, G. O., Adio, G., & Durodolu, O. O. (2025). Innovation and Skills Needed for Sustainable Knowledge Systems in the Fifth (5th) Industrial Revolution: Implications for Libraries and the Users. In *Navigating AI in Academic Libraries: Implications for Academic Research* (pp. 211-230). IGI Global.

Afolabi, M. (2021). AI in academic libraries: Impacts and challenges. *African Journal of Library and Information Science, 10*(3), 112-127.

Ajani, Y. A., Adefila, E. K., Olarongbe, S. A., Enakrire, R. T., & Rabiu, N. (2024). Big data and the management of libraries in the era of the Fourth Industrial Revolution: implications for policymakers. *Digital Library Perspectives*, *40*(2), 311-329.

Eze, C. (2022). The evolving role of librarians in the digital age. *Nigerian Library Journal, 9*(1), 78-91.

Ibinaiye, I. D., Jiyane, G. V., & Africa, S. (2021). The prospect of 5th industrial revolution and academic library services: Exploring the role of data science in the post pandemic period. In *4th international conference on information technology in education and development* (pp. 87-99).

Lee, M., Yun, J. J., Pyka, A., Won, D., Kodama, F., Schiuma, G., ... & Zhao, X. (2018). How to respond to the fourth industrial revolution, or the second information technology revolution? Dynamic new combinations between technology, market, and society through open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *4*(3), 21.

Makori, E. O., & Bitso, C. (2021). Information profession in digital transformation and development: future directions. In *Handbook of Research on Knowledge and Organization Systems in Library and Information Science* (1-24). IGI Global.
Moonasar, A. (2024). Assessing the alignment of a University of Technology Library infrastructure with the Fourth Industrial Revolution: implications for librarian roles. *Library Management*.
Nwachukwu, K. (2022). Blockchain for digital preservation: A new paradigm for library security. *International Journal of Information Management, 17*(4), 205-219.
Nwosu, P. (2023). The fifth industrial revolution: Implications for African economies. *Technology and Society Review, 14*(2), 33-49.
Obi, T. (2022). Emerging technologies in library service delivery. *Library Innovations, 7*(1), 50-67.
Okafor, M. O., & Oladimeji, A. A. (2021). The role of tax policy changes in economic growth in Nigeria. *Journal of Taxation and Economic Development*, *15*(3), 45-60.
Okechukwu, J. (2021). The changing landscape of information services in Nigeria. *African Journal of Information Science, 5*(4), 98-113.
Opara, E. (2022). Rethinking library services in the digital era. *Journal of African Library Science, 11*(2), 20-37.

Transforming Librarianship and Information Service Delivery through Innovative Technologies

[1]KAJANG, Victor S. (CLN), [2] OBUEZIE, Adaora C. (PhD), [3]ABDULAZIZ, Hadiza A. (CLN)
[1]Department of Library and Information Sciences,
National Research Institute for Chemical Technology, Basawa – Zaria.
Email: kajhvictor73@gmail.com/ 08167248379
[2]Department of Library and Information Science,
Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
Email: adaoraobuezie@yahoo.com / 08038854403
[3]Department of Planning and Information Technology.
Nigerian Building and Road Research Institute, Abuja-Nigeria.
Email: haa4sure@yahoo.com / 08036262618

Abstract
Librarianship is a profession that involves managing, organizing and providing access to information, knowledge, and cultural heritage, with a focus on promoting equitable access to information for all. In the last few decades, technology has revolutionised many professions, as librarianship is not exceptional. Emerging technologies such as Artificial Intelligence, Blockchain, Machine Learning, Cloud Computing, automation and Internet of Things (IoT) are changing information management and services delivery in libraries worldwide. This paper explored Transforming Librarianship and Information Services Delivery through Innovative Technology. It highlights the impact of innovative technologies on librarianship, identify current trends, challenges and future possibilities. It offers a comprehensive review of how libraries are integrating these technologies to enhance information access, improve users experience, and structured administrative tasks. The paper concludes by presenting a future-oriented vision for libraries, stressing the importance of adoptability and continuous innovation in maintaining their relevance in an increasing digital world to enhance broader goals of knowledge dissemination and accessibility.
Keywords: Information Services, Librarianship, Innovative Technology, Transforming,

Introduction

In the digital age, librarianship and information services delivery has undergone significant transformation, largely driven by the advancement and integration of innovative technologies. This shift reflects broader transformational changes in information consumption, digital library and the growing demand for more accessible, diverse and real-time information which has reshaped how libraries operate, how information is accessed and how services are delivered to users. Libraries basically serve as physically repositories for books, journals, and other media, however, the rise of digital technologies has expanded their role, making the libraries central hubs for knowledge management and dissemination in diverse formats, including digital databases, e-books, and multi-media resources (Mellon, 2018). The advancement of information and communication technologies, such as Artificial Intelligence (AI), Machine Learning, Cloud Computing, Big Data, Analytic, Internet of Things (IoT) has created new opportunities and challenges for libraries and library professionals. These technologies enable the creation of more users-centred services, including personalised content recommendations, efficient information retrieval systems, and improved accessibility for diverse population (Jaeger et al., 2019). Moreover, the integration of these technologies in library systems has facilitated more seamless management of information resources, streamlined workflows, and enhanced best practices and collaboration across institutions.

As libraries increasingly adopt these technologies, the role of librarians has expanded from traditional custodian of physical materials to a more dynamic facilitator of digital information. Librarians are now tasked with not only managing and curating digital content but also ensuring that users possess the digital literacy necessary to navigate and utilize the resources effectively (Bertot et al., 2016). This transformation has led to a rethinking of the traditional skill set required for librarianship, with a growing emphasis on technological fluency and data management capabilities. Additionally, the integration of open-source software and the growth of digital repositories has enhanced access to a vast array of information resources, making libraries more inclusive and accessible to a global audience (Liu & Hu, 2017). In light of these developments, the rise of digital literacy has prompted libraries to extend their roles beyond traditional information providers, positioning themselves as key players in fostering information literacy and critical thinking skills (Zhang & Goh, 2020).

The shift towards technology-driven library services is driven by the evolving information needs of users, who demand instant, remote, and user-friendly access to resources. These technologies include but are not limited to radio-frequency identification (RFID), artificial intelligence (AI), virtual and augmented reality (VR/AR), cloud computing, and digital library platforms (Liu & Zhang, 2020). For example, AI-powered chatbots are being deployed for virtual reference services, improving response time and user satisfaction (Jain & Goria, 2022). Likewise, RFID systems have revolutionized inventory management and self-checkout processes, reducing human error and enhancing operational efficiency (Singh & Mahajan, 2019).

Moreover, the transformation of librarianship is deeply tied to the professional competencies and adaptability of librarians. As stewards of information, librarians must possess digital fluency and the

capacity to integrate new tools into their service frameworks (Saunders, 2015). The role of librarians has expanded from custodians of books to facilitators of digital knowledge, requiring continuous upskilling and engagement with emerging technologies. However, this transition is not without challenges. Issues such as limited funding, resistance to change, and infrastructural constraints often hinder the seamless integration of innovative technologies in many library systems, particularly in developing countries (Baro, Idiodi, & Eze, 2019). Understanding the enablers and barriers to technology-driven transformation in librarianship is thus critical for creating sustainable, inclusive, and future-ready information services. This paper explores the role of innovative technologies in transforming librarianship, examining their practical applications, implications for library services, and the strategies needed to overcome challenges in their implementation.

Emerging Innovative Technologies for Enhancing Librarianship and Information Services Delivery

Several emerging technologies are transforming librarianship and information services delivery. These technologies facilitate both the backed operations of libraries and the front-end users experiences. Some of the current key innovations include:

i. Artificial Intelligence (AI) and Machine Learning;

AI is reshaping how libraries interact with users and how information is managed. AI-driven chatbots and virtual assistants, for instance, provide users with immediate, automated responses to inquiries, enhancing customer service (Zhang & Lyu, 2021). Machine learning algorithms are used to analyze user behavior, helping libraries personalize information services, recommend resources, and even predict future research needs (Agarwal & Dey, 2020). AI-driven tools like chatbots provide round-the-clock reference services and personalized recommendations. They can interpret user queries and direct them to appropriate resources, improving user support and service quality (Patel & Desai, 2022).

ii. Blockchain Technology for Digital Preservation:

As libraries take on greater responsibility for digital archives, blockchain technology is emerging as a tool for ensuring the integrity, provenance, and security of digital records. Blockchain offers decentralized, immutable storage solutions that ensure digital assets remain trustworthy and tamper-proof, a critical need in information management (Liu & Wang, 2022).

iii. Virtual Reality and Augmented Reality (VR & AR):

Virtual Reality (VR) and Augmented Reality (AR) technologies are providing new dimensions in the way libraries deliver information and educational services. For instance, VR can create immersive environments for learning, enabling users to experience historical events or explore scientific concepts interactively. AR, on the other hand, enhances physical spaces by overlaying digital information onto the real world, improving the library's usability and experience for users (Conlon & Lee, 2020). VR and AR technologies are used in libraries for immersive learning experiences. They support interactive educational programs and virtual tours of historical collections, fostering deeper engagement (Brown et al., 2021).

iv. Makerspaces and 3D Printing:

Many modern libraries have introduced maker spaces equipped with 3D printers, allowing patrons to create physical prototypes, models, and educational tools. This innovation facilitates creativity and learning, enabling users to turn ideas into tangible outcomes (Nesbit & Tractenberg, 2021). These spaces, along with other technological equipment such as robotics kits, foster a hands-on, practical approach to learning and innovation. Makerspaces equipped with 3D printers, laser cutters, and other tools offer patrons opportunities for creativity, prototyping, and STEM learning. These spaces position libraries as centers for innovation and skill development (Slatter & Howard, 2019).

v. Big Data and Analytics:

Big data analytics are used in libraries to track usage patterns, predict trends, and optimize library services. Libraries leverage data collected from users' interactions with digital systems to inform decision-making processes, improving resource allocation and enhancing user engagement (Case, 2021). Moreover, big data supports evidence-based management, helping libraries prove their value and impact to stakeholders. Libraries leverage data analytics to understand user needs, personalize services, and make informed decisions about resource allocation (Jones & Sheridan, 2021).

Impact of Innovative Technologies on Transforming Librarianship and Information Services Delivery

i. Digital Cataloguing and Access

One of the most significant contributions of technology to librarianship is the digitization of library catalogs. Traditional card catalogs, once the backbone of library information systems, have been replaced by more efficient and accessible digital cataloging systems. Technologies like Integrated Library Systems (ILS) enable libraries to manage books, journals, and other materials more effectively, allowing users to access information remotely via Online Public Access Catalogs (OPACs) (Miller, 2019).

ii. Cloud Computing and Data Management:
Cloud technologies have become essential tools for managing vast amounts of data. Libraries increasingly use cloud-based solutions to store, manage, and share resources. Cloud computing not only facilitates the storage of digital content but also supports collaborative efforts across institutions, helping libraries to share resources, collaborate on research projects, and even provide virtual services (Armstrong & Mcknight, 2020).

iii. Remote Access and Digital Libraries:
Through digital libraries and online databases, libraries can provide remote access to their collections, allowing users to access materials from anywhere in the world (Schmidt & Ecker, 2020). This is particularly important as more education and research move online. Digital libraries provide 24/7 access to e-books, journals, and multimedia resources, eliminating physical constraints. Cloud-based systems facilitate seamless access to data, remote collaboration, and digital resource management (Zhou & Li, 2020). These systems also support scalable storage and enhanced security.

iv. Enhanced User Experience:
Technology provides new opportunities to improve user experience. Through mobile apps, online interfaces, and digital platforms, libraries can offer convenient access to information resources, improving user satisfaction and engagement. Personalized search recommendations powered by Artificial Intelligence (AI) enhance the ease with which users discover relevant materials (Martin & Mehta, 2019).

v. Job Transformation and Skill Development:
Librarians themselves are undergoing a transformation in terms of skill sets. Modern librarians are not only information curators but also tech-savvy professionals skilled in managing and implementing emerging technologies. They need to be proficient in data analytics, AI management, and digital curation to maintain relevance in this evolving landscape (Davenport, 2021). Ongoing professional development in these areas is necessary to ensure librarians can adapt to the fast-paced technological environment.

vi. Data Privacy and Ethics
The advanced reliance on innovative technologies also brings concerns related to privacy and ethics. Librarians have a responsibility to ensure that users data is protected and that technology is used ethically in information retrieval process. With Artificial Intelligence (AI) and data analytics often relying on users data, librarians must balance the need for personalised services with safeguarding privacy rights (Nobel & Tufekci, 2021).
Artificial Intelligence (AI) is increasingly transforming library services worldwide, yet its implementation and impact differ significantly between developed and developing countries due to variations in infrastructure, resources, and expertise. While AI holds transformative potential for libraries globally, its successful implementation hinges on addressing contextual challenges. Developed countries have made significant strides in integrating AI, thanks to favorable conditions. In contrast, developing countries must overcome infrastructural, financial, and educational barriers to harness AI's benefits effectively. By adopting targeted strategies and fostering collaborations, libraries in developing nations can gradually integrate AI to enhance their services and meet the evolving needs of their communities (Akinola, 2024.

Challenges
I. Digital Divide and Inequitable Access: Many libraries, especially in developing regions, face limited access to ICT infrastructure, leading to a disparity in the availability and quality of digital services (Ojedokun & Moahi, 2020). This digital divide restricts both users and staff from benefiting fully from innovative technologies.
ii. Lack of Technical Skills: A significant challenge is the insufficient ICT competence among library staff. Many librarians require training to handle digital cataloging, metadata management, digital preservation, and the use of emerging tools such as AI and data analytics (Wang & Dawes, 2021).
iii. Financial Constraints: Implementing and maintaining new technologies involves high costs related to hardware, software, and staff training. Many institutions struggle with budget constraints, which hinder sustainable technology integration (Tammaro, 2019).
iv. Resistance to Change: Some librarians and users are resistant to adopting new technologies due to fear of job loss, unfamiliarity, or comfort with traditional methods. This cultural resistance slows down the pace of innovation (Mabweazara, 2014).
v. Cybersecurity and Data Privacy: As libraries move services online, protecting user data becomes a major concern. Inadequate cybersecurity measures can expose sensitive information to risks (Sturges et al., 2019).

Conclusion
The field of librarianship and information services is undergoing a profound transformation, driven by the rapid integration of innovative technologies. From artificial Intelligence and Machine Learning to digital

repositories and virtual reality, these advancements are redefining how information is curated, organised, accessed, and delivered. Many libraries globally still heavily rely on physical spaces, but with the proliferation in emerging technologies, some have evolved into dynamic, hybrid environments that support diverse community users' needs through personalised and interactive experiences. Ultimately, the transformation of librarianship through these innovative technologies is not merely about modernisation. It is a strategic imperative to ensure that information services remain relevant, inclusive ad impactful in a digital connected world. Therefore, this shift requires librarians to adopt new skills for competencies, and embrace data-driven decision-making, and reimagine their roles and facilitators of digital literacy and information equity for professionalism, expertise and best practices.

Way Forward

The rapid advancement of information and communication technology (ICT) has significantly reshaped the landscape of libraries and information services. Traditional libraries are evolving into digital and hybrid models, offering users access to digital repositories, e-books, virtual reference services, and online learning platforms. Librarians are no longer just custodians of physical books but are becoming digital information facilitators, knowledge managers, and technology instructors (Shafack & Mokwede, 2022). Below are recommendations as way forward which include:

i. **Capacity Building and Training:** Continuous professional development programs should be provided to librarians to equip them with necessary digital skills. This includes workshops, online courses, and certification programs on data science, digital curation, and information literacy. Implement training programs to enhance the AI skills of library staff, enabling them to manage and utilize AI tools effectively.

ii. **Collaborative Partnerships:** Libraries can partner with technology providers, academic institutions, and government agencies to share resources, reduce costs, and enhance innovation. Engage in partnerships with technology firms and academic institutions to gain access to AI resources and expertise.

iii. **User-Centered Service Design**: Incorporating user feedback in the design and implementation of digital services ensures the relevance and usability of the tools provided. Personalized information services can also be developed using AI and big data analytics

iv. **Infrastructure Investment:** Stakeholders must prioritize funding for robust digital infrastructure, including high-speed internet, cloud storage, and digital management systems to support new technologies. Invest in upgrading digital infrastructures, including reliable internet access and modern hardware, to support AI applications.

v. **Promoting Digital Literacy:** Libraries should offer training to users, helping them become competent in using digital tools, evaluating information sources, and navigating the digital environment safely and effectively.

vi. **Policy Formulation**: Develop and enforce data privacy regulations and ethical guidelines to ensure responsible AI usage and protect user rights.

References

Agarwal, P., & Dey, D. (2020). "Artificial Intelligence in Libraries: Trends and Future Directions."*International Journal of Information Management*, 50, 172-180.

Akinola, S. A. (2024). Overcoming Barriers to AI Implementation in University Libraries: A Developing Country Perspective. Edulib. Retrieved from https://ejournal.upi.edu/index.php/edulib/article/view/66752 Feb. 2025

Armstrong, C., & McKnight, S. (2020). "Cloud computing in Libraries: New Opportunities for Resource Management."*Journal of Library Administration*, 60(4), 310-327.

Baker, L. & Williams, H. (2021). "Innovative Technologies in Libraries: Enhancing Access and Engagement."*Library and Information Science Research*, 43(2), 78-92

Baro, E. E., Idiodi, E. O., & Eze, M. E. (2019). "Challenges and Prospects of Integrating ICT in Nigerian Academic Libraries."*The Electronic Library*, 37(3), 456-474. https://doi.org/10.1108/EL-03-2018-0065

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2021). "The Digital Divide and Public Libraries: Challenges and Opportunities."*Journal of Librarianship and Information Science*, 53(2), 154-167.

Bertot, J.C. & Jaeger, P.T. & McClure, C.R. (2016). "Public Libraries and the Internet: Roles, Perspectives, and Implications."*Library Quality*, 86(1), 24-41.

Brown, L., Smith, K., & Thomas, A. (2021). "Enhancing Library Services through Virtual Reality."*Journal of Academic Librarianship*, 47(4), 102365.

Case, D. O. (2021). "Big Data Analytics in Library Services: Improving Decision-making and User Engagement."*Library Management*, 42(7), 424-438.

Conlon, T., & Lee, L. (2020). "Using Augmented Reality in Libraries: Engaging Users in Innovative Ways."*Library Journal*, 145(8), 42-45.

Davenport, T. H. (2021). "The Changing Role of the Librarian in the Age of Technology."*Library & Information Science Research*, 43(3), 101-113.
Hayward, J., Smith, A., Liu, M. & Patel, R. (2023). "Trends and Challenges in Cloud Computing: A Comprehensive Review". *Journal of Cloud Technology and Innovation*, 12(3), 145-167.
Hernandez, M. (2020). "Data Privacy and Security in Libraries: A Guide to Legal Compliance."*International Journal of Information Management*, 50, 213-222.
Jain, P., & Goria, S. (2022). "Artificial Intelligence Applications in Libraries: A Review of Recent Trends."*Library Hi Tech News*, 39(1), 12–17. https://doi.org/10.1108/LHTN-01-2022-0002
Jones, M., & Sheridan, E. (2021). "Data-Driven Libraries: Using Analytics for Better Decision Making."*Information Technology and Libraries*, 40(1), 1–10.
Liu, X., & Wang, M. (2022). "Blockchain Technology for Digital Archives: Preservation and Security."*Journal of Digital Preservation*, 9(1), 39-56.
Liu, Y., & Zhang, Y. (2020). "Emerging Technologies in Libraries: A Review."*Journal of Library Innovation*, 11(1), 34–45.
Liu, Z. & Hu, Q. (2017). *Digital Libraries and their Development*, 33(3), 291-300.
Mabweazara, H. M. (2014). Digital Technologies and the Evolving African Newsroom Culture: The Convergence of Old and New Media Practices. Routledge.
Martin, M., & Mehta, S. (2019). "Personalization in Library Services: How AI is Transforming User Experience."*Journal of Information Science*, 45(2), 210-220.
Mellon, C.A. (2018). "The Digital Library: A Premier for Librarians."*College & Research Libraries*, 79(5), 589-606.
Miller, P. (2019). "Library Catalog Systems and Digital Transformation."*International Journal of Library Science*, 24(3), 123-135.
Nesbit, T., & Tractenberg, P. (2021). "Makerspaces in Libraries: The Evolution of Creative Learning Environments."*Journal of Library Innovation*, 12(1), 78-92.
Ojedokun, A. A., & Moahi, K. H. (2020). "Digital Transformation in African Libraries: Prospects and Challenges."*Library Management,* 41(3/4), 107-119.
Patel, R., & Desai, S. (2022). "AI Chatbots in Academic Libraries: A Study on User Perceptions."*Library Management*, 43(2/3), 123–134.
Raju, J. (2017). "Information Professional or IT Professional? The Knowledge and Skills Required by Academic Librarians in the Digital Library Environment."*Library Hi Tech*, 35(2), 263-281. https://doi.org/10.1108/LHT-06-2016-0068
Schmidt, K., & Ecker, M. (2020). "The Digital Library: A Critical Review of Virtual Collections and their Future."*Journal of Digital Libraries*, 15(4), 50-68.
Shafack, R., & Mokwede, V. (2022). "Transforming Librarianship through Innovative Technologies in Sub-Saharan Africa."*Information Development,* 38(4), 593–604.
Singh, N., & Mahajan, P. (2019). "Adoption of RFID Technology in Libraries: Benefits and Barriers."*DESIDOC Journal of Library & Information Technology,* 39(4), 180–186. https://doi.org/10.14429/djlit.39.4.14551
Slatter, D., & Howard, Z. (2019). "Makerspaces and User Innovation in Libraries."*Journal of Librarianship and Information Science*, 51(2), 256–267.
Sturges, P., Davies, E., Dearnley, J., Iliffe, U., Oppenheim, C., & Stephens, D. (2019). Information and the Law. Facet Publishing.
Tammaro, A. M. (2019). "Innovation and Digital Transformation in Academic Libraries: Meeting the Evolving Needs of Users."*International Journal of Librarianship*, 4(2), 1–11.
Wang, Y., & Dawes, S. S. (2021). "The Role of Librarians in Data Literacy: Building Capacity for Data-Driven Decision Making."*Journal of Information Science*, 47(5), 621–632.
Zhang, Q., & Lyu, H. (2021). "AI-Powered Information Services: The Future of Libraries in the Digital Age."*Library Management*, 43(1), 15-29.
Zhang, Y. & Goh, D. H. (2020). "Libraries in the Digital Age: The Role of Information Literacy in the Digital Economy."*Journal of Information Science*, 46(4), 487-498.

Transforming Librarianship and Information Services Delivery in the era of 5th Industrial Revolution: Prospects and Implications for the Future

By
Dr. Mulikat Yetunde Abdulkareem
Faculty of CIS
Department of library and information science
University of Ilorin
Ilorin, Kwara state
mulikatadisa@yahoo.com

&
Dr. Abdulmumin Isah
College Librarian, FCE Ilawe-Ekiti &
Associate Professor of Library and Information Science,
University of Ilorin
abdulmumin.isah@yahoo.com
+2348132471622

Abstract
A significant period of technological advancement and social transformation is being ushered in by the Fifth Industrial Revolution (5IR), demanding a critical analysis of how libraries are evolving in response. Traditionally known as repositories of knowledge, libraries are now challenged to realign their functions within an interconnected world while preserving their foundational values of equity, privacy, and access. This paper explores the integration of 5IR technologies such as artificial intelligence (AI), Internet of Things (IoT), cloud computing, blockchain, augmented and virtual reality (AR/VR), and robotics into library and information service delivery, with focus on Nigeria. Emphasizing AI's potential, the study highlights innovations in services personalization, data analytics, and knowledge dissemination, while acknowledging ethical concerns related to data privacy, algorithmic bias, and digital inclusivity. Through a document analysis approach, the study reviews global and local practices, examines the implications of intelligent libraries, and identifies challenges such as digital divide, skill gap, and financial constraints. The paper underscores the need for staff upskilling, robust cybersecurity, user-centered service, and sustainable digital infrastructures. Despite these obstacles, libraries remain vital to knowledge preservation, research, civic engagement, and sustainable development. To remain relevant and impactful in this era of technological-human synergy, libraries must deliberately adopt 5IR technologies, reimagine their roles, and reinforce their position as knowledge institutions committed to inclusive and ethical information access.
Keywords: Fifth Industrial Revolution, Intelligent Libraries, Artificial Intelligence, Digital Transformation, Information Service Delivery.

Introduction

Librarianship and information service delivery is undergoing serious transformation, which is driven by the technological and human-centric shifts to the Fifth Industrial Revolution (5IR). Unlike previous revolutions that emphasized mechanization, electrification, or digitization, the 5IR combines advanced technologies such as artificial intelligence (AI), robotics, the Internet of Things (IoT), virtual/augmented reality (VR/AR), blockchain, and the metaverse with a focus on human agency, ethics, and inclusiveness (Adigun et al., 2024; Hirsh, 2024). This era introduces interaction between machines and humans, pushing libraries to rethink their roles and embrace new approach.

Globally, libraries are adopting strategies and technologies to customize services in ways that meet the complex demands of users (Hirsh, 2024; Singh et al., 2024). Concepts such as “Intelligent Libraries” have emerged as labels denoting next-generation library innovations that integrate automation, personalization, and predictive analytics (Adigun et al., 2024; Shahzad et al., 2024). These developments are not only altering service delivery methods but also redefining the very identity of libraries as knowledge institutions capable of adapting to a digital society.

However, the concept of IL remains contested. Some scholars argue that it offers a vision for librarianship in the 5IR, while others caution against its possibility to dilute core professional values and create unrealistic expectations (Okunlaya et al., 2022; Adigun et al., 2024). The implementation of technologies, though promising, raises concerns regarding privacy, equity, and intellectual freedom, which is a foundational pillar of librarianship that must be upheld (Adigun et al., 2025; Han et al., 2024).

Moreover, as users become active in the creation and dissemination of information, librarians are required to develop new skills, including digital literacy, data ethics, and human-machine collaboration. This shift is

prompting a fundamental reassessment of library missions, structures, and services in the face of automation and digital disruption (Singh et al., 2024; Mason, 2024). AI-powered tools, for instance, can enhance search precision, automate administrative tasks, and personalize user experiences thereby expanding the reach and impact of library services (Okunlaya et al., 2022; Hirsh, 2024).

Literature Review

Libraries and Transformative Changes in the Era of the 5th Industrial Revolution

The Fifth Industrial Revolution (5IR) is a pivotal moment in global technological advancement, characterized by the fusion of cutting-edge tools such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, robotics, virtual and augmented reality (VR/AR), biotechnology, and quantum computing. This is redefining industries and societies by enabling groundbreaking innovation and hyper-personalized experiences (Merino et al., 2024; Craver, 2019). Central to this transformation is the role of data generation, processing, and ethical use. As AI systems become adept at analysing data, they are used to support innovation and informed decision-making across sectors, including libraries (Adigun et al., 2025; Ziatdinov et al., 2024).

Despite these benefits, concerns around data security, privacy, and employment disruption remain prominent. As Boisrond et al. (2024) and Adigun et al. (2025) emphasize, the automation of decision-making processes brings about the risk of job displacement, demanding upskilling of workers. Technologies like blockchain, known for decentralization and immutability, are aiding trust and transparency, especially in sectors such as finance and supply chain management (Islam & Rihan, 2023).

Libraries are not isolated from these dynamics. Instead, they are central to realities of the 5IR by redefining how information is accessed, stored, shared, and preserved (Schellnack-Kelly & Modiba, 2024). Unlike the past, where libraries were seen primarily as static depositories. The integration of digital platforms and AI has transformed the library into a hub of innovation and connectivity, capable of supporting the flow of information that characterizes the modern world (Deja et al., 2021; Schiller, 2024).

Furthermore, intelligent systems personalize user interaction. Libraries notify users of new arrivals, events, and due dates through AI-powered messaging tools (Gul & Ba, 2019). Robotic assistants and location-based technologies help users find materials quickly and keep library spaces secure and efficient (Baviskar, 2024; Cheung et al., 2023). Technologies like 3D printing, mobile apps, wearable devices, and VR/AR are also enhancing both the academic and social services within libraries (Syed et al., 2022; Bermejo et al., 2023). These support user needs and expand the purpose of libraries beyond traditional services.

A key feature of this is the intelligent library. Through AI-driven virtual assistants and chatbots, users now receive personalized recommendations, enhancing the efficiency and relevance of information retrieval (Sampath et al., 2024; Meesad & Mingkhwan, 2024). Advanced algorithms tailor user experiences by analysing preferences and usage patterns, thus ensuring more meaningful engagement (Asim & Arif, 2023).

Moreover, data analytics play a vital role in aligning library services with user expectations. Libraries now rely on usage of data to improve resource allocation and design user-centric programs (Khan et al., 2024; Hamad et al., 2022). Alongside this, community engagement initiatives such as workshops and cultural events are reinforcing libraries as civil institutions that promote lifelong learning and social connection (Okechukwu et al., 2024).

The Role of Libraries in Sustaining Knowledge Systems in the Era of the 5th Industrial Revolution (5IR)

Introduction of technology has made information more accessible than ever, with cloud storage, online repositories, and mobile platforms redefining traditional library functions. Despite these advancements, integrating technologies such as artificial intelligence (AI), wearables, and smart automation remains a challenge for many libraries, particularly in developing regions (Bots, 2023; Adigun et al., 2024; Farkhari et al., 2024). Research suggests that the continued relevance of libraries hinges on their ability to remain open to technological growth, upskilling staff, and expanding their digital capabilities (Adigun et al., 2025). Librarians, therefore, must embrace emerging tools and realign services to meet evolving user expectations (Ajani et al., 2024; Ayinde et al., 2024).

Fundamentally, libraries serve as custodians of knowledge systems and cultural heritage. They preserve centuries of human thought through collections, ranging from ancient manuscripts to digital archives, thereby ensuring that the history of past civilizations is available to future generations (Onunka et al., 2023). This archival function is complemented by their role in supporting lifelong learning across all age groups through access to print and electronic resources, skill development programmes, and inclusive community services (Chigwada & Ngulube, 2024; Chandrakar, 2024). These functions affirm the role of libraries in response to changing social and informational needs (Onunka et al., 2024).

The contribution of libraries to research, education, and innovation is profound. By granting access to specialized databases, journals, and academic literature, libraries facilitate knowledge discovery, support evidence-based inquiry, and accelerate scholarly breakthroughs (Adigun et al., 2024). Furthermore, they play a crucial role in promoting equity by providing free access to digital infrastructure and internet-enabled resources, thereby narrowing the digital divide (Adigun et al., 2024; Adigun et al., 2025). Public libraries, in particular, function as community information centres that preaches civic engagement through educational workshops, cultural programmes, and social initiatives (Chigwada & Ngulube, 2024).

Librarians, as information professionals, curate and manage vast collections using cataloguing, classification, and indexing systems that simplify access and enhance user experience (Adamawa, 2022; Hendrawan et al., 2024). As part of their evolving digital role, libraries have also embraced digital preservation practices such as archiving websites, electronic journals, and multimedia records to safeguard information against obsolescence and data loss (Verma & Sharma, 2023; Wong & Chiu, 2024; Adigun et al., 2025).

In our society today, libraries continue to champion intellectual freedom and unrestricted access to information by offering and upholding democratic values. By integrating digital catalogues and e-book platforms, they remain relevant in both physical and virtual spaces (Wong & Chiu, 2024). More importantly, they foster information literacy by equipping users with critical skills to assess sources, verify facts, and navigate the complex terrain of digital content (Onunka et al., 2023; Chandrakar, 2024).

Implementing AI in Nigerian Libraries: Present Difficulties

The integration of Artificial Intelligence (AI) into Nigerian libraries, particularly under the Intelligent Library (IL) framework, is marked by multifaceted challenges that hinder full-scale adoption and functionality. These challenges span ethical, infrastructural, technical, financial, and sociocultural dimensions.

One of the barriers to AI implementation in Nigerian libraries is the digital divide, which exacerbates issues of access and inclusivity. Many library users still face limitations related to internet connectivity, device availability, and digital literacy. Without deliberate interventions, AI-enabled services risk marginalizing those who are already digitally disadvantaged, thereby contradicting the democratic ethos of libraries as inclusive knowledge center (Onunka et al., 2023; Ogunmodede & CLN, 2023; Yelwa, 2024).

AI and Machine Learning (ML) applications raises ethical concerns, particularly regarding data privacy, algorithmic bias, and transparency. Libraries collect and process user data to personalize services, but this also makes them susceptible to data breaches and misuse (Shahzad et al., 2024). Establishing ethical frameworks is essential to ensure fairness, accountability, and user consent in AI system design, deployment, and governance.

The librarians transition from traditional roles to more specialized, tech-savvy, and user-focused positions. This transformation demands extensive training in areas such as data science, AI system management, and digital service design skills that many library professionals in Nigeria currently lack (Okunlaya et al., 2022).

AI technologies often rely on various platforms, data formats, and communication protocols. This heterogeneity brings challenges when integrating the systems with existing library infrastructures. Achieving seamless system integration requires substantial investment in adaptable platforms and skilled technical personnel capable of navigating these complexities (Shahzad et al., 2024).

The cost of implementing AI systems remains a significant to the growth. Expenses related to procuring AI tools, upgrading infrastructure, and training staff can be hard for many libraries, particularly in underfunded institutions. Budgetary limitations require resource management and prioritization to support long-term AI integration (Okunlaya et al., 2022; Hamad et al., 2023).

Conclusion

The Fifth Industrial Revolution (5IR) is transforming libraries from traditional knowledge repositories into digital technology-driven institutions that balance innovation with human-centered values. Libraries are adopting tools like artificial intelligence, blockchain, augmented reality, and virtual reality to improve access, personalize services, and support lifelong learning. In doing so, they continue to protect cultural heritage and improve knowledge systems.

However, this transition also brings challenges. Issues such as digital inequality, ethical concerns over data use, skill shortages among library staff, and the need for financial investment must be addressed. Despite these hurdles, libraries, particularly in Nigeria are aiming and a ready to evolve. They are rebranding their services, adopting sustainable practices, and reaffirming their relevance in both physical and digital spaces.

As vital institutions in the knowledge economy, libraries must not only embrace change but also guide it as the future of librarianship lies in this balance: leveraging innovation while preserving trust, inclusion, and democratic access to information is important and sacrosanct.

Recommendations

The following recommendations are important to achieve the desired goal:

1. Nigerian libraries must prioritize funding for modern technologies by advocating that governments and stakeholders should allocate specific budgets to support digital transformation projects.
2. Continuous training programs should be provided for librarians to develop new digital skills in data management, AI applications and digital ethics.
3. Libraries must develop clear ethical guidelines for the use of AI and user data. Transparency, informed consent, and accountability must be integrated into information delivery services.
4. Public policies and partnerships should focus on improving internet access, digital literacy, and device availability to ensure all user groups can benefit from new library services.
5. National library policies should be updated to reflect the demands of the 5IR, ensuring legal support for intellectual property, digital archiving, and equitable access.

References

Adigun, G. O., Ajani, Y. A., & Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) Industrial Revolution. Libri, 74(3), 211- 223.

Ajani, Y. A., Danmaigoro, F., Ilori, O. O., Onanuga, A. O., Amaechi, N. M., Ishola, S. O., & Onyebinama, C. O. (2024). Flying books: a new frontier of mobile libraries in the era of Fifth Industrial Revolution (5IR). Library Hi Tech News.

Ajani, Y. A., Enakrire, R. T., Oladokun, B. D., & Bashorun, M. T. (2023). Reincarnation of libraries via metaverse: A pathway for a sustainable knowledge system in the digital age. Business Information Review, 40(4), 191-197.

Asim, M., & Arif, M. (2023). Internet of things adoption and use in academic libraries: A review and directions for future research. Journal of Information Science, 01655515231188338.

Ayinde, L., Ajayi, A. O., & Adedeji, A. (2024). Reimagining the roles and skills of information professionals in the 5IR. Business Information Review, 02663821241310380.

Baviskar, Y. N. (2024). Artificial Intelligence in Lighting for Educational Institutions (Master's thesis, Pratt Institute).

Bermejo, B., Juiz, C., Cortes, D., Oskam, J., Moilanen, T., Loijas, J., ... & Dunlea, D. (2023, May). AR/VR teaching-learning experiences in higher education institutions (HEI): A systematic literature review. Informatics 10 (2) 45

Boisrond, K., Tardif, P. M., & Jaafar, F. (2024). Ensuring the integrity, confidentiality, and availability of IoT data in Industry 5.0: A Systematic Mapping Study. IEEE Access.

Bots, F. L. C. (2023). A Review on Intelligent Library Services and Systems: Utilizing Recommender Systems. Emerging Technology-Based Services and Systems in Libraries, Educational Institutions, and Non-Profit Organizations, 78.

Chandrakar, K. (2024). Introductory Library Science and Technology. Academic Guru Publishing House.

Cheung, H. C., Lo, Y. Y. M., Chiu, D. K., & Kong, E. W. (2023). Development of smart academic library services with internet of things technology: a qualitative study in Hong Kong. Library Hi Tech. doi: 10.1108/LHT-06-2023-0219

Chigwada, J., & Ngulube, P. (2024). Librarians' role in the preservation and dissemination of indigenous knowledge. IFLA Journal, 50(2), 242-256.

Craver, K. W. (2019). School Libraries in a Time of Change: How to Survive and Thrive. Bloomsbury Publishing USA.

Deja, M., Rak, D., & Bell, B. (2021). Digital transformation readiness: perspectives on academia and library outcomes in information literacy. The Journal of Academic Librarianship, 47(5), 102403.

Enakrire, R. T., Oladokun, B. D., Nsirim, O., & Gaitanou, P. (2024). Paperless libraries: The trending way to go in the fifth industrial revolution. Business Information Review, 41(4), 164-173.

Farkhari, F., CheshmehSohrabi, M., & Karshenas, H. (2024). Smart library: Reflections on concepts, aspects and technologies. Journal of Information Science, 01655515241260715.

Gul, S., & Bano, S. (2019). Smart libraries: an emerging and innovative technological habitat of 21st century. The Electronic Library, 37(5), 764-783.

Hamad, F., Al-Fadel, M., & Fakhouri, H. (2023). The provision of smart service at academic libraries and associated challenges. Journal of Librarianship and Information Science, 55(4), 960-971.

Hamad, F., Fakhuri, H., & Abdel Jabbar, S. (2022). Big data opportunities and challenges for analytics strategies in Jordanian academic libraries. New Review of Academic Librarianship, 28(1), 37-60.

Han, C., Yuan, Z., & Wang, X. (2024). Enhancing Library Learning Environments: Leveraging 5G and Smart Mobile Technologies. International Journal of Interdisciplinary Telecommunications

and Networking (IJITN), 16(1), 1-14.
Hendrawan, M. R., Ariyani, L. P. S., & Bafadhal, A. S. (2024). The Library and Information Science Perspective on Knowledge Management. In Creating and Sustaining an Information Governance Program (pp. 308-324). IGI Global.
Hirsh, S. (Ed.). (2024). Library 2035: Imagining the Next Generation of Libraries. Rowman & Littlefield.
Islam, M. A., & Rihan, N. M. (2023). AI and Blockchain as Sustainable Teaching and Learning Tools to Cope with the 4IR. In Blockchain and AI (pp. 123-153). CRC Press.
Khan, R., Gupta, N., Sinhababu, A., & Chakravarty, R. (2024). Impact of conversational and generative AI systems on libraries: A use case large language model (LLM). Science & technology libraries, 43(4), 319-333.
Marques, G., & Pitarma, R. (2019). An internet of things-based environmental quality management system to supervise the indoor laboratory conditions. Applied Sciences, 9(3), 438.
Mason, C. (2024). The World Digital Library and the Politics and Promises of Knowledge Societies (Doctoral dissertation, Rensselaer Polytechnic Institute).
Meesad, P., & Mingkhwan, A. (2024). Algorithmic Innovations: Pioneering the Future of Library Services. In Libraries in Transformation: Navigating to AI-Powered Libraries (pp. 57-97). Cham: Springer Nature Switzerland.
Merino, A., Maroun, W., & Callaghan, C. (2024). Framework for academic success: Roles and responsibilities of both students and lecturers.
Ogunmodede, T. A., & CLN, M. (2023). Librarianship in The Era of Digital Divide: Review of Literature. International Journal of Library and Information Science Studies, 9(5), 53-66.
Okechukwu, N. N., Charity, O. K., & Jacinta, C. C. (2024). Integrating Cultural Diversity and Inclusion in the Acquisition of Library Resources and Services for Sustainable Development of Public Libraries. The Progress: A Journal of Multidisciplinary Studies, 5(2), 34-47.
Okunlaya, R. O., Syed Abdullah, N., & Alias, R. A. (2022). Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. Library Hi Tech, 40(6), 1869-1892.
Onunka, O., Onunka, T., Fawole, A. A., Adeleke, I. J., & Daraojimba, C. (2023). Library and information services in the digital age: Opportunities and challenges. Acta Informatica Malaysia, 7(1), 113-121.
Sampath Kini, K., Ranjan, K., Avula, V. A., Ratkanthiwar, M. S., Kondagurle, M. R., Agashe, P. A. T., & Zende, S. S. (2024). The Role of Artificial Intelligence in Enhancing Information Retrieval Systems in Academic Libraries. Library Progress International, 44(3), 22526-22541.
Schellnack-Kelly, I., & Modiba, M. (2024). Developing smart archives in society 5.0: Leveraging artificial intelligence for managing audiovisual archives in Africa. Information Development, DOI: 10.1177/02666669241286224
Schiller, D. (2024). How to think about information. University of Illinois Press.
Shahzad, K., Khan, S. A., & Iqbal, A. (2024). Identifying librarians' readiness to leverage artificial intelligence for sustainable competence development and smart library services: an empirical investigation from universities' librarians. Global Knowledge, Memory and Communication.
Singh, H., Rana, P., Thakur, S., Singh, H. K., & Tiwari, S. (2024). Revolutionizing Libraries: A Review of Advanced Library Management Systems.
Syed, T. A., Siddiqui, M. S., Abdullah, H. B., Jan, S., Namoun, A., Alzahrani, A., ... & Alkhodre, A. B. (2022). In-depth review of augmented reality: Tracking technologies, development tools, AR displays, collaborative AR, and security concerns. Sensors, 23(1), 146.
Verma, R., & Sharma, A. K. (2023). Digital Preservation and Conservation of Library Collections in the Digital Age: Issues and Challenges. Library of Progress-Library Science, Information Technology & Computer, 43(2).
Wong, A. K. K., & Chiu, D. K. (2024). Digital curation practices on web and social media archiving in libraries and archives. Journal of Librarianship and Information Science, DOI: 10.1177/09610006241252666
Yelwa, A. S. (2024). The role of libraries in harnessing technology for promoting digital inclusion in Nigeria. Rima, 3(2).
Ziatdinov, R., Atteraya, M. S., & Nabiyev, R. (2024). The fifth industrial revolution as a transformative step towards society 5.0. Societies, 14(2), 19.

Transforming Library and Information Services Delivery Through Innovative Technology: Trends and Opportunities

By
Abubakar Muhammad Sadauki
Federal University of Education, Kano.
abubakarsadauki220@gmail.com
07062767518
&
Yusuf Bako
Federal University of Education, Kano.
yusufbako35@gmail.com
0806 494 2194

Abstract
The rapid evolution of innovative technologies has significantly transformed librarianship and the delivery of information services, enabling libraries to evolve from traditional knowledge repositories into dynamic, user-centered, and technology-driven service hubs. This paper explores the critical role of technologies such as artificial intelligence (AI), digital libraries, mobile applications, and blockchain in redefining how libraries acquire, organize, preserve, and disseminate information. These technologies present transformative opportunities, their adoption is not without challenges. Financial constraints, particularly in developing regions, limit access to advanced technologies. The digital divide continues to exclude marginalized populations, and ethical concerns related to data privacy and algorithmic bias require careful consideration. Despite these barriers, libraries worldwide are finding innovative ways to overcome limitations and embrace these technological advancements to enhance service delivery, support lifelong learning, and remain relevant in the digital age. This paper synthesizes current literature, providing review of emerging trends, real-world applications, and opportunities for innovation. It also highlights practical examples and proposes actionable recommendations for integrating technology into library practices. By addressing the challenges and using the opportunities presented by technology, libraries can continue to serve as vital pillars of knowledge dissemination and inclusivity in a rapidly changing world.
Keywords: *Transforming Library, Information Service Delivery, Innovative Technology, Trends, Opportunities*

Introduction

Libraries and information have long served as the backbone of knowledge dissemination, supporting academic institutions, research communities, and the general public. However, rapid technological advancements have significantly transformed the way information is created, accessed, and utilized. The emergence of digital technologies, artificial intelligence (AI), cloud computing, and big data analytics has reshaped the landscape of library and information services, necessitating a shift from traditional service delivery models to more innovative and technology-driven approaches (Hahn & Wyatt, 2014; Okite-Amughoro, Ukpebor, & Uwaifo, 2020).

In the 21st century, libraries are no longer just repositories of printed materials; they have evolved into dynamic knowledge hubs that provide seamless access to vast digital resources, electronic databases, and online learning platforms. The increasing demand for remote access to information, coupled with the growing preference for digital content, has compelled libraries to adopt innovative technologies such as AI-powered search tools, machine learning-based recommendation systems, virtual and augmented reality (VR/AR) applications, and blockchain for secure information management (Bates, 2019; Joo & Cahill, 2022). These advancements have not only improved the efficiency of information retrieval but have also enhanced user experience and engagement.

Moreover, the shift towards technology-enabled service delivery has created new opportunities for libraries to expand their reach beyond physical boundaries. Cloud-based library management systems, digital repositories, and mobile applications have facilitated the seamless sharing of resources, enabling institutions to collaborate and offer more personalized services to users (Koohang, 2021). Additionally, data analytics has empowered librarians to better understand user preferences and tailor services accordingly, thus improving decision-making and resource allocation (Cox, Pinfield, & Rutter, 2019).

Despite these opportunities, libraries also face significant challenges in adopting innovative technologies. Issues such as inadequate funding, lack of technical expertise, digital literacy gaps, and infrastructural constraints hinder the full implementation of modern technological solutions in many libraries, particularly in developing regions (Issa, Igwe, & Oyewole, 2020). Moreover, concerns related to data privacy, cybersecurity, and the ethical use of emerging technologies pose additional challenges to library and information service providers (Gonzalez, 2023).

Given these developments, this study seeks to explore the trends and opportunities associated with transforming library and information service delivery through innovative technology. It aims to examine how emerging technologies are shaping the future of libraries, identify best practices for technology integration, and assess the challenges that must be addressed to maximize the benefits of digital transformation in the library sector. Understanding these aspects will contribute to the formulation of strategic policies and frameworks that can guide libraries in leveraging technology for improved service delivery and knowledge dissemination.

Emerging Technologies in Library Services

The integration of advanced technologies has revolutionized various aspects of librarianship. Key technological innovations include (Smith, 2020; Jones & Lee, 2021):

1. **Artificial Intelligence (AI)** AI-powered tools, such as chatbots, machine learning algorithms, and predictive analytics, are enhancing library services. AI applications facilitate efficient, personalized recommendations, and automated reference services, thereby improving user experience. AI also helps in digitizing rare manuscripts and improving search algorithms for better resource discovery (Johnson, 2018).
2. **Digital Libraries** Digital repositories have expanded access to vast collections of books, journals, and multimedia resources. Open-access initiatives and institutional repositories enable seamless knowledge sharing across institutions and geographical boundaries. They also enhance the long-term preservation of valuable materials through digitization efforts (Doe, 2019).
3. **Mobile Applications** Mobile applications provide users with on-the-go access to library resources, allowing them to search, borrow digital materials, and interact with librarians remotely. These apps improve user engagement and accessibility, especially for students and researchers who require flexible access to resources (Smith, 2020).
4. **Blockchain Technology** Blockchain has emerged as a tool for ensuring secure digital archiving, copyright protection, and authentication of academic records. By maintaining decentralized and tamper-proof records, blockchain enhances data security in libraries. This technology also prevents unauthorized alterations of archived documents, ensuring data integrity (Jones & Lee, 2021).

Challenges in Adopting Technology in Libraries

Despite the potential benefits, libraries face several obstacles in implementing these technologies (Doe, 2019; Patel, 2022):

1. **Financial Constraints:** Many libraries, particularly in developing regions, struggle with limited funding, making it difficult to acquire and maintain advanced technological infrastructure. Financial challenges also hinder staff training and limit the availability of digital resources. Country like Nigeria, financial constraints remains a significant barrier to the adoption of innovative technology in libraries. Many academic and public libraries operate with inadequate funding, making it difficult to acquire modern digital infrastructure, such as high-speed Internet, cloud storage, and AI-driven information systems (Issa, Igwe, & Oyewole, 2020). The cost of maintaining and upgrading existing technologies further strains limited budgets. Additionally, insufficient funding affects staff training, leaving many librarians without the necessary skills to effectively manage digital resources (Okite-Amughoro, Ukpebor, & Uwaifo, 2020). As a result, Nigerian libraries often rely on outdated systems, limiting access to global knowledge networks and reducing the efficiency of information service delivery. Without sustainable financial support from the government, private sector, and international donors, the digital transformation of Nigerian libraries will remain slow, widening the information gap between Nigeria and technologically advanced countries (Edewor, Okite-Amughoro, Osuchukwu, & Egreajena, 2021).
2. **Digital Divide:** Socioeconomic disparities limit access to digital resources, preventing marginalized populations from benefiting from technological advancements in libraries. The lack of Internet access and digital literacy among certain demographics exacerbates this issue (Patel, 2022). In Nigeria, the digital divide remains a critical challenge in the adoption of innovative technology in libraries. Socioeconomic disparities significantly limit access to digital resources, particularly in rural and underserved communities, where many individuals lack the financial means to afford internet access or digital devices (Issa, Igwe, & Oyewole, 2020). While urban areas may have better technological infrastructure, a large portion of the population still struggles with digital literacy, preventing them from fully utilizing e-resources and online library services (Edewor, Osuchukwu, & Egreajena, 2021). This divide is further exacerbated by inconsistent electricity supply and high data costs, making digital access even more challenging (Adeleke & Olorunsola, 2020). As a result, many Nigerian libraries face difficulties in ensuring inclusive access

to knowledge, widening the information gap between privileged and disadvantaged groups. Addressing this issue requires comprehensive digital literacy programs, affordable internet access initiatives, and government policies that prioritize equitable technology integration in library services (Patel, 2022).

3. **Data Privacy and Ethical Concerns:** The use of AI and digital platforms raises concerns about user data privacy, algorithmic biases, and the ethical use of information. Libraries must ensure data protection policies align with global privacy regulations (Smith, 2020). Data privacy and ethical concerns pose challenges in library technology adoption in Nigeria. Issues such as weak data protection laws, algorithmic biases, and cybersecurity threats hinder trust in digital platforms. Libraries must implement strict data policies that align with global standards to protect user information (Smith, 2020; Edewor & Osuchukwu, 2021).
4. **Technological Adaptation and Training:** Librarians and users require continuous training to keep up with evolving technologies. Resistance to change and lack of digital literacy can hinder the effective utilization of these innovations. In Nigeria, inadequate training and resistance to change among librarians and users hinder technological adaptation. Limited digital literacy and insufficient professional development programs further restrict effective technology adoption. Continuous training and capacity-building initiatives are essential for maximizing the benefits of digital innovations (Adeleke & Olorunsola, 2020; Smith, 2021).

Strategies for Overcoming Challenges

To bridge the gap and enhance technological adoption, libraries can implement the following strategies:

1. **Securing Funding and Partnerships** Libraries can seek grants, collaborate with technology firms, and engage in public-private partnerships to secure necessary funding and resources. Successful models include library consortia that share resources to minimize costs (Johnson, 2018).
2. **Bridging the Digital Divide** Libraries can provide free digital literacy programs, expand Internet access, and develop community outreach initiatives to include underserved populations.
3. **Enhancing Data Security and Ethics Policies** Implementing stringent data privacy policies, ensuring transparent AI algorithms, and adopting ethical information management practices can mitigate risks associated with technology.
4. **Continuous Training and Capacity Building** Regular training programs for library staff and users can enhance digital competency and facilitate smoother adaptation to new technologies.

Case Studies and Real-World Applications

Several libraries worldwide have successfully integrated technology to enhance their services (Johnson, 2018; Wang & Kim, 2020):

1. The British Library leverages AI-driven systems to enhance resource classification, metadata accuracy, and accessibility. By automating indexing and classification, AI improves search efficiency, enabling users to retrieve relevant information faster. This innovation also supports multilingual access and optimizes digital archiving, ensuring seamless integration of vast collections into online databases (Smith, 2021; Brown, 2022).
2. The New York Public Library (NYPL) offers a mobile app that enables users to borrow digital books, access audiobooks, and explore interactive learning experiences. This app enhances accessibility by providing seamless remote access to library resources, personalized recommendations, and multilingual support, making information more inclusive and engaging (Johnson, 2021; Williams, 2022).
3. The Kenya National Library Service (KNLS) implements digital literacy programs to bridge the digital divide in rural communities. These initiatives provide training on internet use, e-resources, and ICT skills, empowering users with essential digital competencies. KNLS also facilitates access to computers and mobile technologies, enhancing information accessibility (Mwangi, 2021; Otieno, 2022).

Future Directions and Recommendations

Future research should focus on assessing the long-term impact of emerging technologies in libraries and developing frameworks for their sustainable implementation across diverse library settings. As digital transformation continues to evolve, it is crucial to evaluate how technologies such as artificial intelligence (AI), blockchain, and cloud computing influence library services, user engagement, and information accessibility. Understanding these long-term effects can guide policymakers and library administrators in making data-driven decisions for sustainable adoption.

Moreover, libraries should explore advanced technologies like virtual and augmented reality (VR/AR) to

create immersive learning experiences. VR/AR can enhance digital storytelling, interactive archives, and simulated learning environments, making information more engaging for users. This approach is particularly beneficial in educational libraries, where experiential learning can improve knowledge retention and research exploration.

Collaborations with academic institutions, technology firms, and government agencies can further enhance research opportunities and technology adoption. Universities and research institutions can support libraries through joint projects, funding initiatives, and knowledge-sharing programs. Such partnerships can also foster capacity-building initiatives for library professionals, ensuring they acquire the necessary skills to integrate and manage emerging technologies effectively.

By prioritizing innovation and collaboration, libraries can remain relevant in the digital age, bridging the gap between traditional and technology-driven knowledge dissemination.

Conclusion

Technology offers immense opportunities to transform libraries into more efficient, accessible, and user-friendly knowledge hubs. By integrating artificial intelligence (AI), libraries can automate improve search precision, and provide personalized recommendations, enhancing the overall user experience. Digital libraries enable remote access to vast information resources, ensuring inclusivity for users in underserved regions. Mobile applications further extend library services beyond physical boundaries, allowing users to borrow e-books, access research materials, and participate in virtual discussions. Additionally, blockchain technology can enhance data security, ensuring the integrity and authenticity of digital records, which is crucial in protecting intellectual property and user privacy. These advancements collectively modernize library operations, fostering greater engagement and convenience for users.

Despite these advancements, financial, ethical, and digital literacy challenges hinder the seamless adoption of innovative technologies in libraries. Limited funding often restricts the acquisition of essential digital infrastructure, training programs, and maintenance of technological tools. Ethical concerns, including data privacy risks and algorithmic biases, raise critical issues regarding user trust and information security. Moreover, the digital divide remains a pressing issue, as many individuals, especially in developing countries, lack the necessary digital literacy skills to utilize advanced library technologies effectively. Addressing these challenges requires proactive strategies such as government funding, corporate sponsorships, and robust digital literacy initiatives to ensure equitable access to information and technology-driven library services.

To overcome these barriers, libraries must adopt strategic measures that prioritize emerging technologies and foster collaboration with relevant stakeholders. By investing in staff training programs, libraries can equip professionals with the skills needed to integrate and manage modern technologies efficiently. Additionally, forming partnerships with academic institutions, technology firms, and government agencies can facilitate knowledge sharing, funding opportunities, and research collaborations. Libraries should also explore the use of virtual and augmented reality (VR/AR) to create immersive learning experiences, enhancing user engagement and knowledge retention. With continuous innovation and adaptive strategies, libraries can remain at the forefront of knowledge dissemination, bridging the gap between traditional and digital information access while ensuring long-term sustainability in the digital age.

References

Adeleke, A. A. & Olorunsola, R. (2020). *Digital exclusion in Nigerian libraries: Challenges and solutions.* Information Development, 36(2), 243-255.

Brown, L. (2022). *AI applications in library cataloging: Case studies from the British Library.* Journal of Library Technology, 15(3), 112-126.

Doe, J. (2019). *Challenges in Library Technology Adoption*. Library Journal, 45(3), 112-130.

Edewor, N. & Osuchukwu, N. P. (2021). *Ethical challenges in digital library services: A Nigerian perspective.* Library Philosophy and Practice, 2021(1), 1-9.

Edewor, N., Okite-Amughoro, F., Osuchukwu, N. P., & Egreajena, D. E. (2021). *Challenges of digital libraries in Nigeria: A review of funding, infrastructure, and human resources.* Library Philosophy and Practice, 2021(1), 1-12.

Issa, A. O., Igwe, K. N., & Oyewole, O. O. (2020). *The digital divide and library services in Africa: Challenges and prospects.* Library Philosophy and Practice, 2020(1), 1-15.

Johnson, R. (2018). *AI and Digital Libraries: A New Era of Information Management*. Information Science Review, 12(4), 55-72.

Johnson, R. (2021). *Mobile applications in public libraries: Enhancing digital access and user*

engagement. Library Technology Reports, 57(2), 45-58.
Jones, M., & Lee, K. (2021). *Blockchain Applications in Academic Libraries*. Journal of Digital Innovation, 8(2), 23-41.
Mwangi, P. (2021). *Digital literacy initiatives in Kenyan libraries: Bridging the knowledge gap.* African Journal of Library & Information Science, 31(2), 112-126.

Okite-Amughoro, F., Ukpebor, C. O., & Uwaifo, S. (2020). *Digital transformation in African libraries: A case study of e-resources adoption.* African Journal of Library, Archives & Information Science, 30(2), 177-191.

Otieno, J. (2022). *ICT integration in public libraries: The Kenya National Library Service experience.* Library Trends, 70(3), 321-338.
Patel, R. (2022). *Socioeconomic barriers to digital access: Examining the global digital divide.* Journal of Information Science, 48(3), 367-380.
Patel, S. (2022). *Bridging the Digital Divide: Strategies for Inclusive Librarianship*. Global Library Studies, 15(1), 78-96.
Smith, A. (2020). *The Role of Mobile Applications in Enhancing Library Services*. Technology and Libraries, 19(5), 89-105.
Smith, J. (2020). *Data privacy in digital libraries: Challenges and best practices.* Journal of Information Ethics, 29(2), 45-60.

Smith, J. (2021). *Artificial intelligence and metadata management in digital libraries.* Library Trends, 69(4), 543-558.

Smith, J. (2021). *Enhancing digital literacy among librarians: Strategies for professional development.* Journal of Library Innovation, 12(1), 78-92.

Wang, T., & Kim, H. (2020). *Real-World Applications of Emerging Library Technologies*. Library Technology Trends, 10(3), 134-150.
Williams, T. (2022). *The role of mobile apps in modern library services: A case study of NYPL.* Public Library Quarterly, 41(1), 33-47

Up-Skilling Libraries and Information Science Professionals for the 5th Industrial Revolution

CAROLINE A. OKORO PhD (CLN)
Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.
carolokoroamara@gmail.com
08069389723

NGOZI PERPETUA OSUCHUKWU PhD(CLN)
Department of library and Information Science,
Nnamdi Azikiwe University Awka,AnambrState Nigeria
np.osuchukwu@unizik.edu.ng

IHUOMA SANDRA BABATOPE PhD(* (CLN)*)
Senior Librarian/Delta State College of Education Mosogar
ihuoma.babatope@descoem.edu.ng

Abstract

The 5th Industrial Revolution (IR) emphasizes the synergy between advanced technologies and human-centered approaches, creating new opportunities and challenges for libraries and information science (LIS) professionals. This study examined the skills, knowledge, and competencies required to equip LIS professionals for effective service delivery in the 5th Industrial Revolution (IR) era. This study employed a descriptive survey design. The population consists of 10 professional librarians from Dame Patience Goodluck Automated Library, IAUE. The sample size of the study was 10 librarians. The study adopted a census sampling technique. The entire population of the study was adopted since is manageable size. Data analysed using mean rating to answer the research questions. The findings of the study revealed among others that emerging technologies are beneficial in reshaping LIS service delivery. It also revealed that there are essential skills and competencies required by LIS professionals in the 5IR era such as, strong digital literacy skills, knowledge of data management, communication and collaboration skills etc. The study concluded that LIS professionals need to stay current with emerging technologies and continuously develop their skills to meet the demands of the evolving field. It recommended that libraries should prioritize training on emerging technologies, particularly AI, virtual reality, and digital platforms. In addition, libraries should foster a culture of lifelong learning among LIS professionals.

Keywords*: Industrial Revolution, libraries and information science, professional development, emerging technologies, artificial intelligence, digital skills.*

Introduction

The 5th Industrial Revolution (5IR) presents a paradigm shift where human intelligence and advanced technologies collaborate to create ethical, sustainable, and inclusive digital environments. Unlike the 4th Industrial Revolution, which focused primarily on automation, robotics, and artificial intelligence, the 5IR emphasizes the integration of these technologies with human creativity, ethics, and sustainability. According to Nnadozie and Nkamnebe (2020), the future of information services will rely heavily on the synergy between human expertise and intelligent systems, ensuring that technology remains an enabler rather than a replacement for human roles in libraries.

Libraries, as knowledge centers, play a crucial role in fostering digital transformation and ensuring equitable access to information. Okoro and Chukwuemeka (2021) argue that libraries must move beyond their traditional roles of archiving and lending books to becoming proactive centers for digital literacy, innovation, and knowledge-sharing. In Nigeria, university libraries have begun integrating emerging technologies such as artificial intelligence (AI), big data analytics, and machine learning to enhance information retrieval and accessibility (Eze & Ugwu, 2022). However, the adoption rate remains slow due to a lack of digital skills and inadequate infrastructure.

LIS professionals must develop competencies in digital literacy, data management, and artificial intelligence applications to remain relevant in the rapidly evolving digital landscape. As Ugwu and Nnaji (2023) emphasize, continuous professional development programs are essential to equip librarians with the necessary technological skills. This study explores the evolving role of LIS professionals in the 5IR era, examining necessary competencies, technological trends, and strategies for effective service delivery. It aims to highlight the skills that LIS professionals must acquire and the strategies needed to integrate emerging technologies while maintaining human-centered information services

Statement of the Problem

As technology advances, LIS professionals face increasing pressure to adapt to new digital tools and AI-driven innovations. However, many professionals lack the requisite skills to fully leverage these technologies, resulting in a gap between traditional library services and modern digital expectations. In Nigeria, studies such as Nwosu and Eze (2022) have shown that many LIS professionals struggle with digital transformation due to inadequate training and infrastructure. Similarly, Okafor (2021) highlights that while librarians recognize the need for AI and data analytics, limited access to professional development programs hinders adoption. The rapid emergence of AI-driven cataloging, virtual reference services, and big data management further underscores the urgency of up-skilling LIS professionals. This study seeks to identify the key challenges and propose strategic solutions for up-skilling LIS professionals in preparation for the 5IR.

Objectives of the Study

The aim of the study was to investigate up-skilling libraries and information science professionals for the 5th industrial revolution. Specifically the objectives are;

1. To examine the role of emerging technologies in reshaping LIS service delivery.
2. To identify essential skills and competencies required by LIS professionals in the 5IR era.
3. To propose strategies for effective up-skilling and professional development.

Research Questions

1. What role do emerging technologies play in reshaping LIS service delivery?
2. What essential skills and competencies are required by LIS professionals in the 5IR era?
3. What strategies can be proposed for effective up-skilling and professional development of LIS professionals?

Literature Review

Industrial Revolution

The Industrial Revolution refers to a series of transformative changes in production, industry, and economic structures brought about by technological advancements. Historically, the world has witnessed multiple industrial revolutions, each marked by significant breakthroughs in technology and their impact on human life. According to Adeyemi and Nwosu (2020), the Industrial Revolution represents "a shift in human economic activities from manual labor to mechanized and automated processes, leading to increased productivity and efficiency. The First Industrial Revolution (18th-19th century) introduced mechanized production power by steam and water. The Second Industrial Revolution (late 19th-early 20th century) brought electricity and mass production techniques. The Third Industrial Revolution (mid-20th century) was characterized by the rise of computers and automation, while the Fourth Industrial Revolution (21st century) introduced cyber-physical systems, artificial intelligence, and the Internet of Things (IoT).

The 5th Industrial Revolution (5IR), which is currently unfolding, emphasizes the integration of advanced technologies with human-centered approaches. According to Ojo and Adekunle (2023), "unlike previous revolutions that focused purely on technological advancements, 5IR seeks to harmonize artificial intelligence with human intelligence to create ethical, sustainable, and inclusive systems." In the context of libraries and information science, the 5IR demands a shift from traditional service delivery to AI-enhanced, digitally-driven, and user-centered approaches.

Libraries and Information Science Professionals

LIS professionals are responsible for managing, organizing, and disseminating information resources to support academic, research, and public knowledge needs. Traditionally, these professionals performed roles such as cataloging, classification, and reference services. However, as the digital landscape evolves, their responsibilities have expanded to include digital content management, data curation, digital literacy training, and AI integration (Afolabi, 2022).

In the context of the 5th Industrial Revolution (5IR), LIS professionals must develop competencies in emerging technologies to enhance information access and service delivery. According to Okafor and Umeh (2021), Nigerian university librarians are increasingly required to navigate digital repositories, manage institutional repositories, and engage in digital preservation efforts to remain relevant in the modern knowledge ecosystem. Furthermore, Nwankwo and Eze (2022) emphasize that LIS professionals must acquire advanced technological skills to facilitate efficient knowledge dissemination, particularly in an era where AI-driven systems are reshaping library operations.

To remain effective, LIS professionals must undergo continuous professional development in digital skills, data analytics, and emerging technologies. Institutions should provide opportunities for training and collaboration to ensure that librarians keep pace with rapid technological advancements while maintaining their core responsibilities in information organization and dissemination.

Emerging Technologies in Libraries

Technologies such as artificial intelligence (AI), machine learning, big data analytics, blockchain, and virtual reality are transforming information management in libraries. These innovations enhance the efficiency, accuracy, and accessibility of library services while enabling personalized and data-driven decision-making.

AI-powered chatbots are increasingly used in libraries to provide instant responses to user queries, thereby improving reference services. Automated cataloging systems leverage AI and machine learning algorithms to classify materials more efficiently, reducing the time and effort required for manual cataloging. Additionally, predictive analytics tools help libraries assess user behavior and anticipate information needs, enabling proactive and tailored service delivery.

Big data analytics is another transformative technology that allows LIS professionals to analyze large volumes of user data to optimize collection management and improve user experiences. According to Ojo and Adekunle (2023), Nigerian academic libraries that leverage big data analytics can enhance research support services, resource allocation, and digital content recommendations based on user engagement trends.

Virtual reality (VR) and augmented reality (AR) are also emerging as innovative tools in libraries, offering immersive learning experiences and interactive engagement with digital collections. For example, VR-based archival tours provide users with an interactive way to explore historical documents and cultural artifacts without physical constraints.

Blockchain technology is being explored in some libraries to enhance security, authentication, and data integrity in digital repositories. This technology ensures transparent and tamper-proof record-keeping, particularly in managing digital rights and preserving intellectual property. As these technologies continue to evolve, LIS professionals must embrace digital transformation through strategic training and policy adaptation. Integrating emerging technologies into library operations requires a forward-thinking approach that aligns with the principles of 5IR—harmonizing human expertise with advanced technological solutions to create more efficient, ethical, and inclusive knowledge environments.

Empirical Review

Several studies have examined the impact of technological advancements on library services.

A study conducted by Adeyemi and Nwosu (2020) in Nigeria examined digital competencies among librarians in academic institutions. The study adopted a descriptive survey design with a population of 250 librarians from federal and state universities. Using a stratified random sampling technique, 150 respondents were selected. Data were analyzed using descriptive statistics, including frequency, percentage, and mean. Findings revealed that while many librarians acknowledged the significance of digital skills, only 40% had formal training in artificial intelligence, data analytics, and cloud computing. The study identified a significant gap between technological advancements and librarians' ability to integrate them effectively into service delivery. It was recommended that universities should organize continuous professional development programs, workshops, and collaborations with technology companies to enhance the digital competencies of librarians. The study concluded that professional up-skilling is critical for ensuring the relevance of LIS professionals in the 5IR era, particularly as AI-driven innovations reshape service delivery.

Similarly, Okafor and Umeh (2021) explored AI adoption in university libraries across Southeast Nigeria. The study employed a mixed-methods approach, drawing data from a population of 100 librarians across five universities. A purposive sampling technique was used to select 80 respondents, with qualitative data analyzed thematically and quantitative data processed using SPSS. Results indicated that while 65% of librarians were aware of AI applications in library services, many lacked the expertise to utilize them effectively. Key challenges included inadequate training, limited funding, and resistance to technological change. The study recommended the integration of AI literacy into LIS curricula and the provision of hands-on training through collaborations with technology firms. It was concluded that without structured training and institutional policy support, LIS professionals would face challenges in adapting to the technological demands of the 5IR era.

Another study by Ojo and Adekunle (2023) assessed the readiness of LIS professionals for the 5th Industrial Revolution in selected university and public libraries in Lagos and Ogun States. Using a cross-sectional survey design, the study targeted 200 LIS professionals, with 120 respondents selected through simple random sampling. Data were analyzed using inferential statistics, including chi-square and regression analysis. Findings revealed that most librarians lacked confidence in utilizing AI and big data analytics for library services. However, younger professionals, particularly those under 40 years, demonstrated a greater willingness to embrace digital innovations compared to their older counterparts. The study highlighted the

absence of institutional policies supporting digital up-skilling initiatives. It was recommended that library associations should take an active role in advocating for digital training programs, while institutions should offer incentives for librarians to acquire AI-related certifications. The study concluded that a proactive learning culture is essential for LIS professionals to remain relevant in a rapidly evolving technological landscape.

In a related study, Nwankwo and Eze (2022) investigated digital transformation and LIS professional development in federal university libraries in South-South Nigeria. The study utilized an exploratory survey research design, focusing on a population of 300 librarians and library assistants. A cluster sampling technique was employed to select 180 respondents, with data analyzed using descriptive statistics, including mean and standard deviation, as well as ANOVA. Findings indicated that while digital transformation was underway in university libraries, the pace of adoption varied. Institutions with strong administrative and financial support reported higher success rates in implementing AI tools and digital repositories. The major barriers identified were inadequate funding and technical expertise. The study recommended fostering collaborations between government agencies and the private sector to secure funding for digital infrastructure and staff training. It concluded that strategic investment in professional development is crucial to equipping LIS professionals with the necessary competencies for the 5IR era.

Methodology

This study employed a descriptive survey design. The population consists of 10 librarians from Dame Patience Goodluck Automated Library, IAUE. **The study was conducted in Dame Patience Goodluck Automated Library, Ignatius Ajuru University of Education**, (IAUE). The population of the study consisted of 10 librarians working with **Dame Patience Goodluck Automated Library, Ignatius Ajuru University of Education**, (IAUE). The sample size of the study was 10 librarians. The study adopted a census sampling technique. The entire population of the study was adopted since is manageable size. Data analysis was done usingmean rating to answer the research questions.

Data Presentation

Research Question 1: What role do emerging technologies play in reshaping LIS service delivery?

Table 1: Respondents mean rating on the role emerging technologies play in reshaping LIS service delivery

S/N	ITEMS	SD	D	N	A	SA	Mean	Remark
1	Emerging technologies have significantly improved access to library resources.	2	1	0	0	7	3.90	**Agreed**
2	The integration of AI tools has enhanced the efficiency of library service delivery.	1	1	1	1	6	4.00	**Agreed**
3	Virtual reality and augmented reality have added value to library services.	6	1	1	1	1	2.00	**Disagreed**
4	The use of digital platforms has increased user engagement with library services.	7	0	0	2	1	2.00	**Disagreed**
5	Emerging technologies have helped in the provision of personalized library services.	6	1	2	0	1	1.90	**Disagreed**
	Grand mean						**2.76**	**Agreed**

on the role emerging technologies play in reshaping LIS service delivery, with a grand mean of 2.76 which indicated that emerging technologies are beneficial in reshaping LIS service delivery.

Research question 2: What essential skills and competencies are required by LIS professionals in the 5IR era?

Table 2: Respondents mean rating on essential skills and competencies are required by LIS professionals in the 5IR era

S/N	ITEMS	SD	D	N	A	SA	Mean	Remark
1	LIS professionals need strong digital literacy skills to navigate emerging technologies.	1	1	0	7	1	3.60	Agreed
2	Knowledge of data management and analytics is essential for modern LIS professionals.	1	1	1	6	0	3.50	Agreed
3	The ability to understand and implement AI tools is crucial for LIS professionals in the 5IR era.	0	1	1	1	7	4.40	Agreed
4	Communication and collaboration skills are important for working with cross-disciplinary teams.	2	2	0	5	1	3.10	Agreed
5	Adaptability and lifelong learning are key competencies for LIS professionals in the 5IR era.	1	1	1	0	7	4.10	Agreed
	Grand mean						3.74	Agreed

The result from Table 2 shows the summary of mean ratings on the essential skills and competencies required by LIS professionals in the 5IR era, with a grand mean of 3.74 which revealed thatthere essential skills and competencies required by LIS professionals in the 5IR era such as, strong digital literacy skills, knowledge of data management, communication and collaboration skills etc.

Research Question 3: What strategies can be proposed for effective up-skilling and professional development of LIS professionals?

Table3: Respondents mean rating on the strategies for effective up-skilling and professional development of LIS professionals.

S/N	ITEMS	SD	D	N	A	SA	Mean	Remark
1	Continuous professional development programs focusing on emerging technologies.	1	0	1	1	7	4.30	Agreed
2	Collaboration with tech companies and universities.	1	1	1	6	1	3.50	Agreed
3	Mentorship programs.	1	1	1	0	7	4.10	Agreed
4	Online courses and certifications.	1	1	1	6	1	3.50	Agreed
5	In-house workshops and seminars.	0	1	1	7	1	3.80	Agreed
	Grand mean						3.84	Agreed

shows the summary of mean ratings on strategies for effective up-skilling and professional development of LIS professionals, with a grand mean of 3.84 which revealed strategies for effective up-skilling and professional development of LIS professionals such as continuous professional development programs, collaboration with tech companies etc.

Summary of the Findings

1. The grand mean of 2.76 in table 1 indicated that emerging technologies are beneficial in reshaping LIS service delivery.
2. The grand mean of 3.74 in table 2 revealed that there essential skills and competencies required by LIS professionals in the 5IR era such as, strong digital literacy skills, knowledge of data management, communication and collaboration skills etc.
3. The grand mean of 3.84 in table 3 revealed strategies for effective up-skilling and professional development of LIS professionals such as continuous professional development programs, collaboration with tech companies etc.

Discussions of Findings

The result from Table 1 shows the summary of mean ratings on the role of emerging technologies in reshaping LIS service delivery, with a grand mean of 2.76. The respondents agreed that technologies such as AI have improved access to library resources and enhanced the efficiency of service delivery. However, there was disagreement regarding the impact of virtual reality, digital platforms, and personalized services, suggesting that these technologies are not yet fully integrated or effective in reshaping LIS services. The grand mean indicates an overall positive view of the role of emerging technologies, particularly AI, but a need for further development and integration of other technologies like virtual reality and digital platforms. This is consistent with the findings of studies such as that of Kaur and Kaur (2021), who emphasized the positive impact of AI on library services, while also noting the slow adoption of newer technologies like virtual reality in library settings. The disagreement on the impact of certain technologies may suggest that while there is an acknowledgment of their potential, there are barriers to their implementation and effective use.

The result from Table 2 indicates that respondents strongly agree on the essential skills and competencies required by LIS professionals in the 5IR era, with a grand mean of 3.74. The ability to understand and implement AI tools and adaptability to continuous learning were highlighted as crucial competencies. Respondents also agreed on the importance of digital literacy, data management, and communication skills, which are essential for navigating the rapidly evolving technological landscape. These findings align with the work of Afolabi (2022), who argued that LIS professionals must develop competencies in emerging technologies to stay relevant. The strong agreement on the need for adaptability and lifelong learning is particularly relevant, as the rapid pace of technological advancements requires professionals to continuously update their skills.

The result from Table 3 shows the summary of mean ratings on strategies for effective up-skilling and professional development of LIS professionals, with a grand mean of 3.84. Respondents strongly supported continuous professional development programs, mentorship programs, and collaboration with tech companies and universities as key strategies for enhancing LIS professionals' skills. The emphasis on continuous learning and mentorship aligns with research by Ajayi and Oladipo (2021), who found that ongoing professional development is critical for keeping LIS professionals up to date with new technologies. While all strategies were rated positively, the strong endorsement of continuous professional development programs focused on emerging technologies highlights a clear need for structured learning environments to ensure that LIS professionals remain equipped with the necessary skills to succeed in the 5IR era.

Conclusion

The findings from the study reveal that emerging technologies play an essential role in reshaping LIS service delivery, with AI tools being recognized for improving access and efficiency. However, the impact of virtual reality, digital platforms, and personalized services is less clear, suggesting that these technologies are still in the early stages of adoption. The study also highlights the essential skills and competencies required by LIS professionals in the 5IR era, such as digital literacy, data management, AI implementation, and adaptability to lifelong learning. Additionally, the results show strong support for strategies to up-skill LIS professionals, particularly through continuous professional development programs, mentorship, and collaboration with tech companies. Overall, the findings emphasize the need for LIS professionals to stay current with emerging technologies and continuously develop their skills to meet the demands of the evolving field.

Recommendations

1. Libraries should prioritize training on emerging technologies, particularly AI, virtual reality, and digital platforms.
2. Libraries should establish mentorship programs and collaborate with tech companies and universities. These partnerships can provide valuable insights and resources, helping LIS professionals stay up-to-date with technological advancements and industry best practices.
3. Libraries should foster a culture of lifelong learning among LIS professionals.

References

Abe, E. N., Abe, I. I., & Adisa, O. (2021). Future of work: Skill obsolescence, acquisition of new skills, and upskilling in the 4IR. In *Future of work, work-family satisfaction, and employee well-being in the fourth industrial revolution* (217-231). IGI Global.

Adeyemi, T., & Nwosu, C. (2020). Digital competencies among librarians in Nigerian academic institutions: Challenges and prospects. *Nigerian Journal of Library and Information Science, 15*(2), 45-62.

Afolabi, M. (2022). Developing competencies in emerging technologies for librarians in the 5IR era: A case for up-skilling and professional development. *Journal of Information Technology, 28*(1), 55-67.

Ajayi, A. O., & Oladipo, S. E. (2021). Ongoing professional development for library and information professionals in the digital age: A necessity for relevance. *Nigerian Journal of Library and Information Science, 14*(2), 22-31.

Ayinde, L., & Kirkwood, H. (2020). Rethinking the roles and skills of information professionals in the 4th Industrial Revolution. *Business Information Review*, *37*(4), 142-153.

Chigwada, J. P., & Nwaohiri, N. M. (Eds.). (2021). *Examining the impact of industry 4.0 on academic libraries*. Emerald Publishing Limited.

El-Kalash, K. I., Saka, K. A., Mohammed, S. B., & Ncube, H. (2023). Upskilling the Library and Information Science Professionals for Effective Information Service Delivery in the 21st Century Global Economy. *International Journal of Knowledge dissemination (IJKD)*, *4*(2), 67-77.

Kaur, G., & Kaur, M. (2021). Impact of artificial intelligence in reshaping library services: A global perspective. *Library Management Review, 46*(4), 330-342.

Kumar, R., & Kukreja, R. (2024). Ready-made solution to face 5th Industrial Revolution-acquiring 4Cs skills. In *2024 4th International Conference on Innovative Practices in Technology and Management (ICIPTM)* 1-6).

Nwankwo, B., & Eze, I. (2022). Digital transformation and LIS professional development in federal university libraries in South-South Nigeria. *Journal of Library and Digital Innovations, 10*(1), 33-50.

Nwaohiri, N. M., & Nwosu, M. C. (2021). Reskilling the library workforce for the fourth industrial revolution. In *Examining the impact of industry 4.0 on academic libraries* (227-233). Emerald Publishing Limited.

Ogbomo, O. B., & Oludayo, O. F. (2020). The role of multimedia tools in library user engagement and service delivery. *International Journal of Library Science, 12*(3), 59-71.

Ojo, A., & Adekunle, F. (2023). Readiness of LIS professionals for the 5th Industrial Revolution: A case study of selected university and public libraries in Lagos and Ogun States. *West African Journal of Library and Information Science, 12*(3), 78-95.

Okafor, E., & Umeh, P. (2021). Artificial intelligence adoption in university libraries: An evaluation of LIS professionals' preparedness in Southeast Nigeria. *African Journal of Information and Knowledge Management, 8*(4), 120-138.

Ong, Q. K. L., & Annamalai, N. (2024). Technological pedagogical content knowledge for twenty-first century learning skills: The game changer for teachers of industrial revolution 5.0. *Education and Information Technologies*, *29*(2), 189-190.

Umeh, A., Alabi, R. T., & Enemuo, A. E. (2022). The role of video conferencing tools in enhancing remote library services during the COVID-19 pandemic. *Information Technology and Libraries, 41*(3), 144-158.

Utilisation of 5th Industrial Revolution Technologies for Information Service Delivery in University Libraries in Rivers State

Dr. Juliet C. Alex-Nmecha
University Librarian, Rivers State University, Port Harcourt
juliet.anmecha@rsu.edu.ng
Dr. Oluchi C. Okeke
Head of Department, Library and Information Science
Enugu State University of Science and Technology, Agbani
oluchukwu.okeke@esut.edu.ng

Abstract

The 5th Industrial Revolution emphasizes human-centric technological integration, focusing on the synergy between advanced technologies, despite the integration of the technologies into library service delivery, there has been limited understanding of how these innovations are being utilized in university libraries in Rivers State. Thus, the study examines the Utilisation of 5th Industrial Revolution Technologies for Library Service Delivery in University Libraries in Rivers State. This study adopts a descriptive survey design. Three objectives were formulated to guide the study. The population comprised of eighty-six (86) library staff in public university libraries in Rivers State, with a sample drawn using census sampling technique. A structured questionnaire was used as the instrument for data collection. . Data was analyzed using descriptive statistics such as mean. The findings show that 5th Industrial Revolution Technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Robotics, Virtual Reality (VR), Augmented Reality (AR), Blockchain, and 5G networks are not widely implemented in the university libraries in Rivers State. The challenges identified further emphasize the barriers to adoption, such as inadequate funding, lack of skilled personnel, poor ICT infrastructure, and resistance to change. However, the study also identifies effective strategies which include staff training, collaboration with tech companies, proper budgeting for 5IRT implementation, and the development of clear policies and strategic frameworks. The study recommended that libraries should collaborate with technology companies, academic institutions, and government agencies to develop tailored solutions that meet their specific needs

Keywords: *5th industrial revolution, artificial intelligence, robotics, augmented reality, library service delivery*

Introduction

In the rapidly evolving technological advancement, the global economy has witnessed a transition from the Fourth Industrial Revolution (4IR), which emphasized cyber-physical systems, automation, and artificial intelligence, to the emergence of the Fifth Industrial Revolution (5IR). The 5th Industrial Revolution is distinguished by its human-centric approach, integrating cutting-edge technologies with human creativity, empathy, and ethical consciousness. Unlike previous revolutions that prioritized efficiency and productivity, the 5IR focuses on collaboration between humans and machines, with the aim of achieving sustainable, inclusive, and people-driven innovations. 5th Industrial Revolution Technologies (5IRT) include artificial intelligence (AI), robotics, the Internet of Things (IoT), virtual reality (VR), augmented reality (AR), blockchain, 5G connectivity, and advanced data analytics. These technologies are designed not only to enhance operational capacity but also to ensure that technological progress aligns with human values and needs (Ziatdinov et al., 2024)

University libraries, as epicenters of knowledge dissemination and academic support, stand to benefit immensely from the adoption of 5IRT in their information service delivery. These technologies can transform traditional library services into interactive, intelligent, and user-centric systems. AI-powered chatbots for instance, can provide 24/7 virtual assistance to users, while IoT can streamline inventory management and environmental control for the preservation of information resources (Rane et al., 2024). Virtual and augmented reality can be used to create immersive learning experiences, and blockchain can ensure secure and transparent digital transactions and records management. By embracing 5IRT, university libraries in Rivers State can enhance access to information, improve user engagement, and streamline internal operations for greater efficiency.

However, despite the promising potentialsof 5IRT in enhancing library services, several challenges may hinder their effective utilization. These challenges include inadequate funding, lack of infrastructure, limited technical expertise among library staff, resistance to change, and poor awareness of the capabilities of these emerging technologies. Furthermore, policy gaps and inconsistent ICT frameworks in the educational sector further complicate the integration of such advanced technologies (Abedi et al., 2024). These issues pose significant barriers to the smooth adoption and sustainability of 5IRT in library

environments. As the world moves further into the digital age, it becomes imperative for university libraries in Rivers State to explore and harness the potential of 5th Industrial Revolution technologies to remain relevant and competitive. By identifying the types of 5IRT currently in use, the challenges faced, and the strategies for their effective utilization, this study seeks to provide valuable insights and practical recommendations for the transformation of library service delivery in the region.

Statement of the Problem

The advancement of technology has significantly reshaped information access, dissemination, and management in university libraries. The global shift towards the Fifth Industrial Revolution (5IR), now lay emphasis on human-machine collaboration aimed at creating more intelligent, responsive, and inclusive systems. Thus, university libraries are expected to leverage 5IR technologies such as artificial intelligence, robotics, augmented and virtual reality, the Internet of Things (IoT), blockchain, and 5G connectivity to meet the dynamic information needs of users. However, while these technologies offer immense opportunities for innovation in library service delivery, their adoption in university libraries, especially in Rivers State, Nigeria, remains limited and underexplored. The university libraries in Rivers still rely heavily on basic digital systems that may not adequately address the expectations of modern library users who demand speed, personalization, and convenience. The underutilization of 5th Industrial Revolution Technologies (5IRT) could result in service gaps, reduced user satisfaction, and a decline in the relevance of academic libraries in the digital era. Unfortunately, there is a lack of data on the types of 5IRT currently being used, the challenges impeding their adoption, and the strategic approaches required for their effective implementation in Nigerian university libraries. This study is therefore crucial as it seeks to fill this gap by examining how 5IRT can be utilized to enhance library service delivery in university libraries in Rivers State.

Objectives of the Study

The main objective of the study was toexamines the Utilisation of 5th Industrial Revolution Technologies for Information Service Delivery in University Libraries in Rivers State**.** The specific objectives of the study are to:

1. identify the types of 5th Industrial Revolution technologies used for information service delivery in university libraries in Rivers State
2. discover the challenges faced in the use of 5th Industrial Revolution Technologies for information service delivery in university libraries in Rivers State.
3. find out or proffer strategies to enhance the use of 5th Industrial Revolution technologies for service delivery in university libraries in Rivers State

Literature Review

The concept of the **Fifth Industrial Revolution (5IR)** is sparking a lot of conversation, particularly because it marks a shift from purely technological advancement to a more **human-centered approach**. As Enakrire et al. (2024) point out, 5IR integrates advanced technologies with human intelligence and empathy, aiming to create solutions that are not just efficient but also personalized, sustainable, and inclusive. This is a significant departure from the Fourth Industrial Revolution (4IR), which largely emphasized automation, digital integration, and machine learning. As Ziatdinov et al. (2024) observe, the hallmark of 5IR is its emphasis on **collaboration between humans and machines**, rather than the replacement of human roles. When looked at the technologies driving this revolution including AI, IoT, Robotics, VR, AR, Blockchain, 5G, and advanced data analytics (Oyedokun, 2024), it becomes clear that these tools are no longer just about efficiency; they're also about enriching human experiences.

This has profound implications for fields like **Library and Information Science (LIS)**. 5IR technologies for instance, offer new ways to enhance access, improve user engagement, and automate routine tasks in libraries. This was supported by Adigun et al. (2024) when they suggested that artificial intelligence is already playing a crucial role. AI-powered systems can now automate cataloguing, provide real-time assistance through chatbots, and offer personalized reading suggestions. These tools not only help users find information more quickly but also reduce the workload for librarians (Enakrire & Oladokun, 2024). Ogwueleka (2025) even notes that AI can aid in digital archiving, plagiarism detection, and summarizing content innovations that clearly boost both **user experience and resource management**. The role of the **Internet of Things (IoT)** is equally transformative. According to Okeke et al. (2024), IoT technologies can turn conventional libraries into "smart libraries." RFID-tagged books enable automated borrowing processes, while smart shelves can track inventory in real time. Sensors can even monitor environmental conditions like temperature and humidity to preserve physical materials (Omehia et al., 2021).

Furthermore, Omame and Alex-Nmecha (2020) discuss how robots can handle repetitive tasks like shelving and retrieving books especially useful in large university libraries with high foot traffic. But the applications don't stop there. Service robots can guide users, give tours, or even interact with visitors to help them find what they need. When combined with AI, these robotic systems can also collect user data to help libraries continuously refine their service

In the context of the Fifth Industrial Revolution (5IR), technologies like **Virtual Reality (VR)** and **Augmented Reality (AR)** are opening new frontiers for engagement and learning within university libraries. VR, in particular, is being recognized for its ability to create immersive, experiential learning environments that deepen user engagement. As Moseikina and Toktamysov (2024) note, libraries can leverage VR to offer virtual tours, simulate historical events, or deliver subject-specific content such as anatomy labs for medical students. This type of interactive content doesn't just enhance understanding it also makes library services more inclusive by providing **remote access** to educational experiences through digital storytelling and virtual exhibitions. Alongside VR, **Augmented Reality (AR)** is emerging as a practical tool to enrich physical library spaces. AR overlays digital information onto the real world, helping users navigate facilities or interact with collections in real time. Imagine pointing a smartphone at a shelf and receiving instant information about available books or links to related e-resources. Such applications not only improve the **discovery process** but also enhance orientation particularly for new users or students unfamiliar with the library's layout.

Another transformative technology is **Blockchain**, which brings transparency, authenticity, and security to digital asset management in university libraries. Omame and Alex-Nmecha (2021) highlight its utility in protecting intellectual property, authenticating scholarly outputs, and decentralizing records such as borrowing histories. Additionally, smart contracts enabled by blockchain can streamline **inter-library resource sharing**, fostering more open and collaborative academic ecosystems. Meanwhile, the deployment of **5G networks** stands to dramatically improve digital services in libraries. With its high-speed, low-latency capabilities, 5G supports the seamless operation of bandwidth-heavy tools like VR, AR, and real-time AI services. This opens the door to **mobile library services**, remote learning platforms, and efficient access to cloud-based databases enhancing both reach and responsiveness.

Further supporting this digital transformation is the application of **advanced data analytics**. By analyzing user behavior, resource usage, and service performance, libraries can make data-driven decisions that improve collection development, space utilization, and overall user experience. Predictive analytics even allows for **personalized services** based on academic needs and preferences, aligning library offerings more closely with user demand. However, despite this transformative potential, the integration of 5IR technologies in **Nigerian university libraries** remains limited. Omehia et al. (2021) note that many institutions continue to operate in environments with constrained infrastructure and limited access to emerging technologies. While some progress has been made such as experimental use of AI and RFID tagging full-scale implementation remains elusive. Enakrire et al. (2024) attribute this gap to **financial, technical, and human resource challenges**. A significant barrier is the shortage of skilled personnel who can manage, maintain, and innovate with these advanced systems.

The adoption of 5IRT in university libraries faces several challenges, including inadequate funding, poor ICT infrastructure, lack of training and professional development opportunities for staff, and resistance to change (Oyedokun, 2024). Policy and regulatory gaps also limit the incorporation of advanced technologies into public institutions, including libraries as well as the absence of a strategic framework for technology adoption contributes to fragmented and unsustainable efforts at integrating these innovations.

To ensure effective utilisation of 5IRT in university libraries, scholars advocate for continuous staff training, user education, and strategic investment in infrastructure (Ogwueleka (2025). Collaborative partnerships with tech firms, academic institutions, and international agencies can facilitate access to advanced technologies and best practices. Further, policy advocacy aimed at integrating library technology into national development agendas is critical.

Methodology

This study adopted a descriptive survey design to examine the Utilisation of 5th Industrial Revolution Technologies (5IRT) for information service delivery in university libraries in Rivers State. The descriptive survey design is appropriate for this study as it allows for the collection of data from a large group of respondents to provide an accurate and comprehensive description of the current state of 5IRT adoption in Rivers State university libraries, offering insights into both the barriers to implementation and the strategies that could be employed to enhance the use of these technologies. The population for this study consisted of eighty-six (86) library staff working in public university libraries in Rivers State. This because public university libraries are accessible many users, thus the study will be beneficial to a larger population upon

implementation of the recommendations. A census sampling technique was used, meaning that the entire population were included as the sample size. This approach was chosen to ensure that every relevant individual involved in library service delivery in the state is represented in the research, providing a more comprehensive and accurate understanding of the situation. The primary instrument for data collection is a structured questionnaire. The questionnaire was designed using a Likert scale with four response categories: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). This scale is used to measure the extent of agreement or disagreement with each item in the questionnaire. The items are carefully constructed to align with the research objectives and are designed to capture the views and experiences of the respondents regarding the use of 5IRT in their respective libraries. 82 copies of the questionnaires were found valid for analysis. The data collected from the questionnaire was analyzed using descriptive statistics, primarily the mean score for each item.. The mean score help determine the level of agreement or disagreement with each statement, and the results interpreted to draw conclusions about the adoption, challenges, and strategies related to 5IRT in the libraries. A criterion mean of 2.5 was used to assess the acceptance or rejection of each item. Items with a mean score of 2.5 and above was considered accepted, while items with a mean score below 2.5 was rejected. The findings were presented in tables to make the results clear and easily understandable.

Findings and Discussion

Table 1: Summary of Mean Scores on Utilisation of 5IRT for Library Service Delivery in University Libraries in Rivers State

Item	Mean Score	Decision
Artificial Intelligence (AI) tools such as chatbots or smart search engines are used to respond to users queries	2.37	Rejected
Internet of Things (IoT) devices like smart shelves or RFID are implemented.	2.37	Rejected
Robotics are used to automate sorting, shelving, or retrieval of library materials.	2.18	Rejected
Virtual Reality (VR) is used to support immersive learning or virtual library tours.	2.09	Rejected
Augmented Reality (AR) applications are used for navigation and enhanced user experience.	1.90	Rejected
Blockchain is used for secure transactions or digital rights management.	1.97	Rejected
5G networks are used to support high -speed internet and real-time digital services.	2.27	Rejected
Weighted Mean	**2.16**	**Rejected**

The findings from table 1 indicate that none of the 5th Industrial Revolution Technologies (5IRT) currently in use for library service delivery in Rivers State university libraries. This is because they all have a mean score above the acceptance threshold of 2.5 indicating that all the items were rejected. This suggests that advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Robotics, Virtual Reality (VR), Augmented Reality (AR), Blockchain, and 5G networks are not yet widely adopted or utilized in these libraries. This could be due to factors such as lack of funding, insufficient infrastructure, or resistance to technological change. Although, Ajani and Oladokun (2024) discovered key technologies such as AI, machine learning, data analytics, IoT, blockchain, AR/VR, and 5G are examined for their impact on library operations and user engagement, the low mean scores indicate that these technologies have not yet been implemented on a significant scale, possibly due to the early stages of digital transformation in these institutions.

Table 2: Summary of Mean Scores on the Challenges of Utilisation of 5IRT for Library Service Delivery in University Libraries in Rivers State

Items	Mean	Decision
Inadequate funding limits the acquisition of 5IR technologies in the library.	2.55	Accepted
There is a lack of skilled personnel to manage and maintain 5IR technologies.	3.07	Accepted
Poor ICT infrastructure hampers the implementation of emerging technologies.	2.67	Accepted
Library staff are resistant to adopting new technologies due to fear or lack of awareness.	2.56	Accepted
There is insufficient training and professional development on 5IRT.	2.71	Accepted
Policies and regulations governing technology use are inadequate or unclear.	3.00	Accepted
Power supply challenges affect the smooth operation of 5IRT-based systems.	2.66	Accepted
Weighted Mean	**2.74**	**Accepted**

the results reveal that the challenges to the implementation of 5IRT in university libraries are perceived as substantial, with all items being accepted. The mean scores range from 2.55 to 3.07, indicating a strong agreement among respondents about the challenges faced. These challenges include: Inadequate funding for the acquisition and maintenance of 5IRT technologies, Lack of skilled personnel to manage these technologies, Poor ICT infrastructure that hinders the implementation of advanced technologies, Resistance to change from library staff due to fear or unfamiliarity with the new technologies, Insufficient training and professional development programs to ensure staff are capable of operating 5IRT tools, Inadequate policies to govern and regulate the use of 5IRT in libraries, Power supply challenges, which negatively affect the smooth operation of 5IRT-based systems. These findings are consistent with the challenges identified by Oyedokun (2024) and emphasized the barriers of funding, reliable power supply, and collaboration for effective 5th IR adoption. These findings highlight significant barriers that need to be addressed before 5IRT can be effectively integrated into library operations. Libraries in Rivers State appear to face common infrastructural and organizational issues that could delay the adoption of these technologies.

Table 2: Summary of Mean Scores on the Strategies to Enhance the Utilisation of 5IRT for Library Service Delivery in University Libraries in Rivers State

Items	Mean	Decision
Staff should be regularly trained on the use of 5IRT tools.	3.33	Accepted
Libraries should collaborate with tech companies and academic partners.	2.68	Accepted
Institutions should allocate specific budgets for 5IRT implementation.	2.91	Accepted
Awareness programs should be organized to reduce resistance to new technologies.	3.21	Accepted
Government and educational bodies should develop clear policies to support 5IRT use.	2.74	Accepted
Libraries should have strategic implementation frameworks for integrating technologies.	3.14	Accepted
Improved infrastructure and reliable power supply should be prioritized	3.29	Accepted
Weighted Mean	**3.04**	**Accepted**

The result from table 3 indicates that all items related to strategies for the effective utilization of 5IRT were accepted. The positive responses indicate strong agreement with the need for specific strategies to improve 5IRT adoption. These strategies include: Regular staff training on the use of 5IRT tools to ensure that personnel are equipped with the necessary skills, Collaboration with tech companies and academic partners to foster innovation and share resources, Budget allocation specifically for 5IRT implementation to ensure adequate funding for the technologies, Awareness programs to reduce resistance from staff and ensure buy-in for the adoption of new technologies, Clear policies and frameworks to support the integration of 5IRT in

library services, Strategic implementation plans that outline the steps and processes for integrating technologies into library operations, Improvement of infrastructure, particularly in terms of power supply and internet connectivity, to ensure that 5IRT can be used effectively. This study aligns with the study of Ekwueme (2024) on the impact of Fifth Industrial Revolution (5th IR) technologies on enhancing diversity and inclusive services in Open and Distance Learning libraries and identified key implementation strategies, including awareness-raising, curriculum updates, training, collaboration, and skill enhancement.

Conclusion

There is indeed a growing recognition that the 5th Industrial Revolution Technologies (5IRT) are reshaping service delivery across various sectors, including education and information management. University libraries, as vital hubs of knowledge dissemination and academic support, must adapt to these technological advancements to remain relevant and effective. Despite the global move towards the integration of technologies like Artificial Intelligence, Internet of Things, Robotics, Virtual and Augmented Reality, Blockchain, and 5G networks, there has been limited understanding of how these innovations are being utilized in university libraries within Rivers State. This study was therefore conducted to assess the utilisation of 5IRT , identify the challenges impeding their implementation, and propose strategies for effective utilization to enhance library services in the digital age. The findings show that 5IRT technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Robotics, Virtual Reality (VR), Augmented Reality (AR), Blockchain, and 5G networks are not yet widely implemented in the university libraries in Rivers State. The challenges identified further emphasize the barriers to adoption, such as inadequate funding, lack of skilled personnel, poor ICT infrastructure, and resistance to change. However, the study also identifies effective strategies which include staff training, collaboration with tech companies, proper budgeting for 5IRT implementation, and the development of clear policies and strategic frameworks. These strategies, if properly implemented, could help overcome the challenges and facilitate the effective integration of 5IRT into library services. While the adoption of 5IRT in university libraries in Rivers State faces several challenges, there is a clear pathway for improvement through targeted strategies. With the right investments in infrastructure, training, and policy development, university libraries in the region can successfully harness the potential of 5IRT to enhance their service delivery and meet the demands of the digital age.

Recommendations

Based on the findings from the study, the following recommendations are made to enhance the integration and effective use of 5IRT technologies in university libraries:

1. University libraries in Rivers State should allocate specific funds to acquire and maintain 5IRT technologies. It is essential for university management to prioritize investments in modern technologies that will enhance the quality and efficiency of library services.
2. Continuous professional development and training programs should be organized to equip library staff with the skills necessary to operate and manage 5IRT tools effectively. This includes training in AI-based search engines, the use of IoT devices for inventory management, and basic knowledge of blockchain and other emerging technologies.
3. Improving ICT infrastructure is crucial for the effective implementation of 5IRT. This includes enhancing internet connectivity, improving power supply, and investing in reliable hardware. Libraries should collaborate with technology providers to ensure that their infrastructure can support advanced technological systems, such as 5G networks, AI, and VR/AR tools.
4. Libraries should collaborate with technology companies, academic institutions, and government agencies to develop tailored solutions that meet their specific needs. Partnerships with local and international tech firms could provide access to the latest technologies, expertise, and resources. Collaboration could also lead to cost-sharing arrangements for implementing 5IRT systems.

References

Abedi, E. A. (2024). Tensions between technology integration practices of teachers and ICT in education policy expectations: implications for change in teacher knowledge, beliefs and teaching practices. *Journal of computers in education*, *11*(4), 1215-1234.

Adigun, G. O., Ajani, Y. A., & Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) Industrial Revolution. *Libri*, *74*(3), 211-223.

Ajani, Y., & Oladokun, B. (2024). Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution. *Folia Toruniensia*, *24*, 29-51.

Balaji, K. (2025). Human-Centric Innovation: Building Sustainable Organizations for Industry 5.0. In *Human-Centric, Sustainable, and Resilient Organizations in the Digital Age* (pp. 101-124). IGI

Global Scientific Publishing.
Ekwueme, L. O., Oluwaseun, B. O., AJIE, I. A., OFODU, P. N., & Ambrose, S. E. (2024). The impact of 5th industrial revolution technologies on academic libraries: Improving diversity and inclusive services in open and distance learning. *Indonesian Journal of Library and Information Science*, *5*(2), 100-108.
Enakrire, R. T., & Oladokun, B. D. (2024). Artificial intelligence as enabler of future library services: How prepared are librarians in African university libraries. *Library Hi Tech News*, *41*(3), 1-5.
Enakrire, R. T., Oladokun, B. D., Nsirim, O., & Gaitanou, P. (2024). Paperless libraries: The trending way to go in the fifth industrial revolution. *Business Information Review*, 02663821241289793. journals.sagepub.com

Moseikina, M., & Toktamysov, S. (2024). Virtual tours and digital libraries in history education at the university: How to make the study of history attractive to students?. *International Journal of Information and Education Technology*, *14*(8), 1068-1077.
Ogwueleka, F. N. (2025). Plagiarism Detection in the Age of Artificial Intelligence: Current Technologies and Future Directions. *AI and Ethics, Academic Integrity and the Future of Quality Assurance in Higher Education*, 10.
Okeke, O. C., & Ogbara, C. I. (2024). Relevance of advanced technologies to the current day library and information science research. Information Managers: A Journal of Nigerian Library Association Rivers State Chapter, 7 (1). 90. https://doi.org/10.61955/ENGTKZ
Omame, I. M., & Alex-Nmecha, J. C. (2021). Application of blockchain in libraries and information centers. In *Handbook of Research on Knowledge and Organization Systems in Library and Information Science* (pp. 384-397). IGI Global.
Omame, I. M., & Alex-Nmecha, J. C. (2020). Artificial intelligence in libraries. In *Managing and adapting library information services for future users* (pp. 120-144). IGI Global Scientific Publishing.
Omehia, A. E.,Okwu, E., &**Nsirim, O.** (2021). Librarians' ICT competencies and utilisation of emerging technologies in academic libraries in Rivers State. Library Philosophy and Practice. https://digitalcommons.unl.edu/libphilprac/5410
Oyedokun, T. T. (2024). Reimagining libraries in the fifth industrial revolution (5IR): The impact of robotics, artificial intelligence (AI), metaverse, blockchain, and emerging technologies. *Business Information Review*, 02663821251328839.
Rane, N., Choudhary, S., & Rane, J. (2024). Artificial Intelligence (AI), Internet of Things (IoT), and blockchain-powered chatbots for improved customer satisfaction, experience, and loyalty. *Internet of Things (IoT), and blockchain-powered chatbots for improved customer satisfaction, experience, and loyalty (May 29, 2024)*.
Ziatdinov, R., Atteraya, M. S., & Nabiyev, R. (2024). The fifth industrial revolution as a transformative step towards society 5.0. *Societies*, *14*(2), 19.

NIGERIAN LIBRARY ASSOCIATION

A Publication of Nigerian Library Association

