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 1

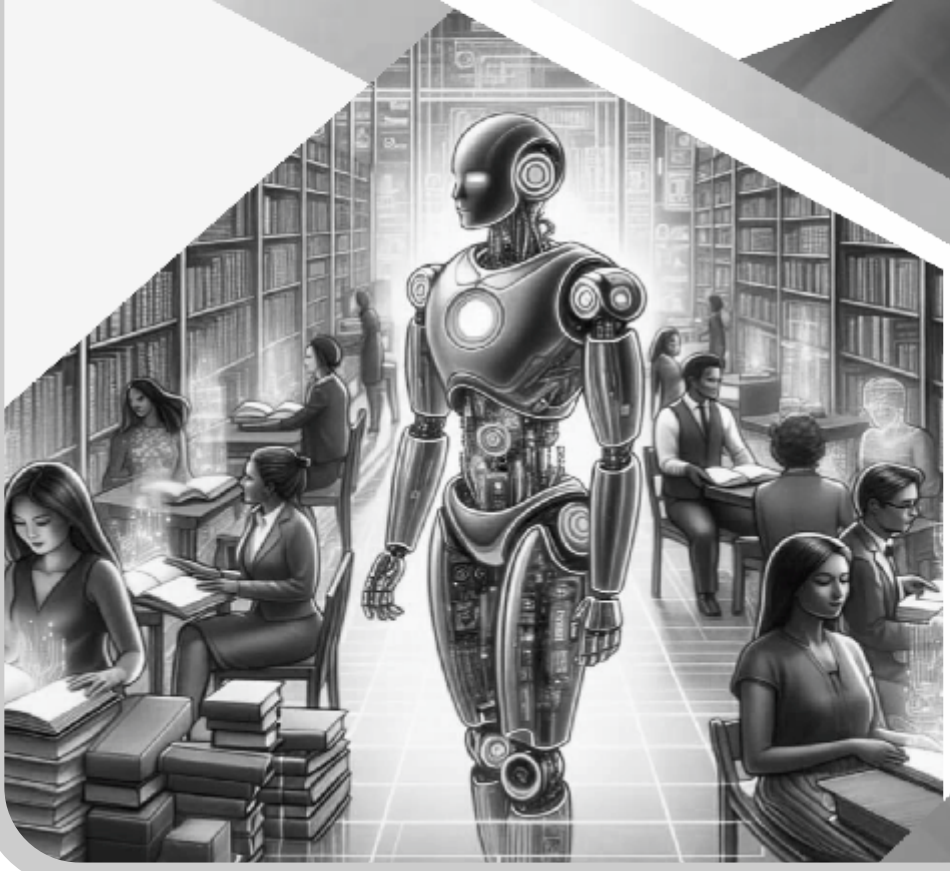


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Preface

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

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A Descriptive Analysis of Adoption of Innovative Technologies for Information Service Delivery in Nigerian Libraries

By

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Abstract

This study is a descriptive analysis of adoption of innovative technologies in enhancing information service delivery in Nigerian libraries, with a focus on academic libraries in Cross River State, Nigeria. It identifies the technologies currently in use, areas of library services they support, and their impact on library professionals. A survey of 130 librarians revealed high awareness of mainstream technologies like IoT, cloud computing, and AI, but limited familiarity with emerging tools like virtual reality and immersive technology. These technologies support services such as electronic publishing, SMS communication, online training and workshops, and digital reference services. The study also showed that librarians must be prepared to collaborate, embrace change, and undergo adequate training to remain relevant. The study recommends among others that; it is essential to incorporate training in emerging technologies like Virtual Reality (VR), Artificial Intelligence (AI), and blockchain technology into Library and Information Science (LIS) curricula and Continuing Professional Development (CPD) programs. Additionally, increasing funding for digital infrastructure in libraries will enable them to effectively integrate these technologies.

Keywords: ***Innovative technologies, Information service delivery, Librarianship, Emerging technologies, Nigerian academic libraries***

Introduction

Technological innovations have drastically transformed library services, impacting how information is accessed, stored, and delivered. In alignment with Ranganathan's fifth law, "the library is a growing organism," libraries have transitioned from physical spaces to digital and virtual environments. These changes are not merely operational but redefine the roles and skillsets required of librarians. As such, the need to explore the scope, application, and implications of innovative technologies in library service delivery is more urgent than ever. According to Khanzode and Sarode (2024), libraries should ambitiously embrace new technologies while also assessing their viability and costs. Decisions about technology adoption should be forward-looking, anticipating future user needs. Technological evolution affects media, content, information-access methods, and the physical aspects of libraries. These shifts also influence how patrons interact with technological tools, such as digital devices, media, networks, servers, and audio-visual systems.

Information service delivery

Librarians provide daily services to meet users' information needs. Traditionally, information delivery was accomplished through conventional methods of collection and dissemination. However, the advent of ICT has revolutionized these methods. In today's era of "information explosion," users can access virtually any information with a single click. Librarians must acquire new competencies to manage these changes effectively. Lawal (2022) argues that knowledge in the 21st century functions like energy—dynamic and networked—rather than static and siloed. Thus, librarians must be flexible, innovative, and quick to learn, possessing strong interpersonal and independent working skills to remain effective custodians of information.

Innovation and innovative technologies in libraries

Innovation is the process of developing new ideas, services, or solutions that improve efficiency and effectiveness. Technological innovation refers to the creation of significantly improved products or processes that are introduced to the public. An innovation is typically accepted in an organization if it offers tangible benefits. Khanzode and Sarode (2024) noted that innovative technologies—including those still emerging—may significantly impact library operations in the next five to ten years. These include AI, biotechnology, digital innovations, nanotechnology, telecommunications, and web technologies. Despite

financial and technical uncertainties, innovations such as AI, blockchain, IoT, quantum computing, and 5G have transformative potentials.

Statement of the problem

The information environment in libraries has undergone significant changes due to information and communication technology, and librarians are interested in not only adjusting to these broad changes but also, and perhaps more importantly, encouraging creative ideas from their staff in order to stay on the cutting edge of knowledge rather than merely being passive observers. In spite of this important technological changes in libraries, the researchers observed that most libraries in the study area are not making use of these innovations probably as a result of the absence of some of these technologies in libraries, while the available ones are not being utilized as a result of lack of training and their inability to adapt and use the latest information handling and communication technologies for information service delivery. This study therefore, is a descriptive analysis of adoption of innovative technologies in enhancing information service delivery in libraries in Nigeria to bridge the gap between technology and library service delivery.

Objectives of the study

1. To determine librarians' awareness of innovative technologies for information service delivery.
2. To identify library service areas that utilize innovative technologies.
3. To examine the implications of innovative technologies on librarianship.

Research questions

1. Are librarians aware of the innovative technologies used in libraries?
2. What library service areas utilize innovative technologies?
3. What are the implications of innovative technologies on the field of librarianship?

Review of related literature

Librarians' awareness of innovative technologies used for information service delivery

According to a study by Saibakumo (2021) on the acceptance and awareness of emerging technologies for extended information service delivery in Nigerian academic libraries, librarians' knowledge of the emerging technologies that are helpful in academic libraries is extremely high (mean = 2.21, 73.7%). WebOPAC (89%), RFID (85.4%), the Internet of Things (81.3%), social media (93.5%), and institutional repositories (90.7%) were the most frequently used technologies by librarians. While the ones with least awareness were Google partnered Libraries Ready-to-Code Initiative (52.4%), Digital storytelling (50.8%) and 3D/2D Digital printing (48.8%). This means that librarians are aware of innovative technologies and are willing to embrace more technologies for optimum information service delivery in libraries.

Akparobore, Omosekejimi, and Nweke (2020), conducted a study to find out librarians awareness, positive attitude and ICT skills: A panacea for effective services delivery in the fourth industrial revolution (4th IR) era in academic libraries in Southern Nigeria. The findings from the study showed a weighted mean of 2.40 which was less than the criterion mean of 2.50, it was therefore concluded that the extent of librarians awareness of the technological innovations associated with the 4th IR era is low. The result of this finding could be as a result of lack of training and re-training of librarians in the study area.

Edam-Agbor et al (2025), in their study “librarians' awareness, acceptability, and application of artificial intelligence in academic research libraries: Multigroup analysis via PLS–SEM” concluded that librarians exhibit a high level of awareness, acceptance, and application of AI in research libraries. It highlights that awareness directly influences both the acceptance and use of AI, with acceptance positively mediating the relationship between awareness and AI application. The findings reveal that this relationship is significant for both males and females, though the impact is stronger for females in terms of awareness and acceptance, while males show a higher advantage in awareness and application. Additionally, private institutions exhibit a stronger effect in the relationships studied compared to public institutions, except in the case of awareness and application where public schools perform better. Artificial Intelligence (AI), the Internet of Things (IoT), cloud computing, big data, robotics, blockchain technology, QR codes, social media and mobile applications, RFID technology, virtual reality, and immersive technology are a few of the cutting-edge technologies utilized in libraries. AI is "the development of machines to accomplish tasks and reproduce thought processes that are normally seen in humans" (Hervieux & Wheatley, 2022).

Areas of library operations and services that can be performed using innovative technologies

Makori (2020), opined that blockchain technology (BT) can potentially facilitate the sharing and authenticating of unique digital objects for cultural institutions, such as libraries, museums, archives, and art galleries. WorldCat, in the form of consortium blockchain, has been performing this function with the catalogue records of libraries all over the world. With BT, the actual content of libraries' digital assets and data can be stored, circulated, tracked, and validated securely on the Internet. Digital rights management of these assets can be enhanced with BT, which are best suited for “uniquely identify, verify, control and transfer content”.

Applications of BT in libraries include digital preservation and tracking, development of community-based collections, interlibrary loan systems, enhancing reliability and trustworthiness of data, and improving library services. Panda and Kaur (2023) suggested that BT may be applied in libraries to enhance their services, including circulation services, collection development, storage, and data management. BT's applications in the following areas appear to be also applicable in academic libraries: scholarly publishing – the decentralized feature of BT may address the publisher-centric, piracy, author rights issues; secure online access – BT can create a secure and private digital identity protecting users' privacy and personal identity; Research Data Management – BT can help with the planning, organization, storage, protection, security, curation, and support of research data for open scholarship.

McCaffrey, (2021) asserted that in an ASRS system, books are stored in large metal trays of bins which are arranged according to their sizes accommodating various dimensions of books that are usually divided into small, medium, and large. These bins are stacked vertically in a high vault and can be identified by its barcode or built-in senor, such as radio frequency identification (RFID). Typically, when an item is requested, a robotic arm kicks into action to find the right bin and brings it to the staff station to retrieve the exact item in the bin. The item will be delivered to a service point for pickup by the user while the bin will be taken back to the vault by the robotic arm. The new space created by ASRS opens up new inspiration leading libraries to provide innovative services and centres. One of them appears to be makerspace which is equipped with various robotic tools, equipment and workstations addressing the "increased interest in learning practical skills and crafts" (Carlson, 2022).

Kirsch (2020), observed that immersive technology has been adopted in libraries and education institutions in many contexts. Academic libraries have begun to purchase and circulate virtual reality (VR) equipment, and facilitate the creation of VR content for library services, including gaming, simulations, tours, exhibits, therapeutic programming, virtual events, and library instruction. For example, Google Expeditions is used in classrooms and library outreach for students and library users to virtually visit foreign countries and immerse in important cultural events. Realizing the therapeutic benefits of VR, some libraries offer relaxation and mindfulness programs and events by providing VR services. Offering immersive technology to library community helps the libraries become more visible, possibly leading to increased publicity, recognition, donations, or grants. Additional benefits include enhancing immersive, active, deeper, and experiential learning because VR makes course content more real and helps students "remember content better, ask more questions, and experience a place rather than just viewing it" (Kirsch, 2020).

According to Hahn, (2020), IoT enables remote control of doors, lighting, self-service kiosks, and public computers in library buildings. It allows the opening and management of libraries without staff members, significantly extending library opening hours and services while optimizing energy consumption. Library materials embedded with sensors, such as RFID or Bluetooth beacons, support mobile wayfinding and recommender services. They allow automated inventory check, searching for or tracking of a specific item, better security mechanism, and user check out and in of library materials. Apart from early applications of IoT in self-checkout, stock-taking, access control, asset tracking, and monitoring network and space, coupled with immersive technology and AI, the libraries may develop innovative, responsive, situated, and tailored services to meet the twenty-first century library users' needs (Liang, 2020).

Implication of innovative technologies on librarianship

Funmilayo and Ayo (2020), stressed that librarians, are required to upgrade themselves along with the system in order to furnish user-oriented services through adherence to the latest online technologies utilised worldwide to provide library services because any librarian who is unaware of trending problems and adoption of the newest technology will be redundant and left behind. Saibakumo (2021), posited in his study that there was a strong level of awareness among Nigerian librarians towards many developing technologies (such as RFID, institutional repositories, Cybrary, library websites, social media, Internet of Things, use of Library Guide application, Integrated library management system and WebOPAC for effective service delivery) and their relevance to university libraries.

Abubakar and Attahir (2018), explained certain skills that must be built up in the librarians from time to time in order to be in sync with the fast-growing world. These skills include leadership, interpersonal relationship, technological awareness and understanding skills, problem-solving, knowledge of intervention skills, etc. Barathi, Loganathan and Rajan (2017), on their part, asserted that the aim is to share resources with existing information leveraging modern technologies, enhancing community growth, improving services for library members and providing a wide variety of time-saving features.

Mwaniki (2017), stated that librarians must always increase their professional abilities to reflect technological progress. The professional abilities of librarians and their educational growth must change radically. The technology librarians have been branching off and becoming more connected with the library rather than just managing library databases and Integrated library System (ILS) (Ratledge & Sproles, 2017). Chingath (2020) illustrates a roadmap for Library and Information Science (LIS) professionals, in particular among the younger generation, to integrate library technology and enhance library image.

Ajie (2019) focused on the opportunities and dangers Nigerian information professionals face in this era of globalisation. Furthermore, the author addresses the constraints of the libraries. The literature states that earlier training methods for library professionals were mostly designed for freshly enrolled graduates who were prepared for employee participation. The development of new technology requires libraries to develop

new ways of exposing professionals to new technological abilities; which is based on a collaborative employee learning model. Enweani, (2018), envisaged adequate/qualified staff recruiting and library staff training/retraining. Also young professional librarians should develop a greater interest in Web 2.0 technological activities, this will go a long way in equipping librarians technologically in the area of emerging technological innovations in libraries.

Methodology

This study was conducted in Cross River State. The survey research design was used for the study. The design was adopted because of its relative ease at enabling a researcher study a sample of a particular population, the result which can be used in generalizing the whole population. The population of the study was made up of one hundred and thirty (130) professional librarians from four tertiary institution libraries in Cross River State. The selection was done through the non-probability sampling technique involving the purposive sampling technique. A structured questionnaire was used to collect data from the respondents and was validated by experts in measurement and evaluation. One hundred and thirty (130) questionnaires were administered, however, only one hundred and twenty one (121) questionnaires were retrieved and used for the study. The entire population of the study was used as the sample of the study making the study a census. Collected data were analysed using descriptive statistics.

Presentation of Results

Table 1

Demographic variables

AGE	**Frequency**	**Percent**
Below 25	7	5.8
26-35	50	41.3
36 and above	64	52.9
Total	**121**	**100.0**
Marital status		
Single	8	6.6
Married	110	90.9
Divorce	1	.8
Widow	2	1.7
Total	**121**	**100.0**
Religion		
Christianity	110	90.9
Moslem	11	9.1
Total	**121**	**100.0**
Educational Qualification		
B.LIS/B.SC/HND	13	10.7
MLS/M.SC	62	51.2
Ph.D	46	38.0
Total	**121**	**100.0**

Table 1 provides a detailed demographic breakdown of a sample population consisting of 121 individuals, categorized by age, marital status, religion, and educational qualification. The majority of the population, 52.9%, is aged 36 and above. Those aged 26-35 make up 41.3% of the population, while individuals below 25 years old represent only 5.8%. In terms of marital status, the population is overwhelmingly married, with 90.9% falling into this category. A small proportion, 6.6%, are single, while divorced and widowed individuals make up 0.8% and 1.7%, respectively. Religiously, the group is predominantly Christian, with 90.9% identifying as such. A smaller minority, 9.1%, identify as Moslem, indicating a largely homogeneous religious composition. The educational qualifications of the population reveal a highly educated group. Over half, 51.2%, hold a Master's degree (MLS/M.SC), while 38.0% have a Ph.D. Only 10.7% possess a Bachelor's degree or equivalent (B.LIS/B.SC/HND). This suggests that the population is academically accomplished, with the majority holding advanced degrees.

Research question 1

Are librarians aware of the innovative technologies used for information service delivery in libraries? To answer this research question, the item-by-item analysis was done using frequency and percentage count. The result is shown in table 2.

Table 2

Descriptive analysis showing librarians awareness of the innovative technologies used for information service delivery in libraries. (N=121)

S/N	Items	Yes	No
1.	Artificial intelligence	111 (91.7%)	10(8.3%)
2.	Internet of things	118 (97.5%)	3(2.5%)
3.	Cloud computing	115 (95.0%)	6(5.0%)
4.	Big data	107 (88.4%)	14(11.6%)
5.	**Robotics**	**88 (72.7%)**	**33(27.3%)**
6.	Block chain technology	105 (86.8%)	16(13.2%)
7.	QR Codes	74 (61.2%)	47(38.8)
8.	Social media and mobile application	105 (86.8%)	16(13.2%)
9.	RFID Technology	53 (43.8%)	68 (56.2)
10	Virtual Reality and Immersive Technology	31 (25.6%)	90(74.4%)

The data analysis in Table 2 above reveals that the majority of librarians are highly aware of several key technologies. For instance, Internet of Things (IoT) has the highest awareness level, with 97.5% of respondents indicating familiarity. This is closely followed by cloud computing, with 95.0% awareness, and artificial intelligence (AI), with 91.7% awareness. Similarly, big data and blockchain technology also showed high levels of awareness, with 88.4% and 86.8% of librarians, respectively, acknowledging their familiarity. Social media and mobile applications share the same awareness level as blockchain technology, at 86.8%. Also, robotics is recognized by 72.7% of librarians, while QR codes show a moderate awareness level of 61.2%. In contrast, RFID technology has a notably lower awareness rate, with only 43.8% of librarians indicating familiarity. The least recognized technologies are virtual reality and immersive technology, with only 25.6% of librarians aware of their applications in library services.

Research question 2

What are the areas of library operations and services that are performed using innovative technologies? To answer this research question, the item-by-item analysis was done using frequency and percentage count. The result is shown in table 3.

Table 3

Descriptive analysis showing the areas of library operations and services that are performed using innovative technologies. (N=121)

S/N	Items	Yes	No
1.	Blogging service	115 (95.0%)	6(5.0%)
2.	Electronic publishing services	121 (100%)	
3.	Short message services	121 (100%)	
4.	Online information search services	109(90.1%)	12 (9.9%)
5.	Online Training and workshops	121 (100%)	
6.	Digital references services	121 (100%)	
7.	Database production/distribution services	104 (86.0)	17 (14.0%)
8.	Mobile application services	118 (97.5%)	3 (2.5%)
9.	Digital marketing service	118 (97.5%)	3 (2.5%)
10.	Digital preservation	114 (94.2%)	7 (5.8%)

The data analysis in Table 3 reveals that all respondents (100%) reported that innovative technologies can be used in electronic publishing services, short message services (SMS), online training and workshops, and digital reference services. Other highly prevalent areas include blogging services (95.0%), mobile application services (97.5%), digital marketing services (97.5%), and digital preservation (94.2%). Additionally, online information search services can be widely adopted, with 90.1% of respondents confirming that. Similarly, respondents who believed that database production and distribution services can be utilized in libraries were 86.0%.

Research question 3

What are the implications of innovative technologies on librarianship? To answer this research question, the item-by-item analysis was done using frequency and percentage count. The result is shown in table 4.

Table 4
Descriptive analysis showing the implications of innovative technologies on librarianship (N=121)

S/N	Items	Yes	No
1.	Risk taking	119 (98.3%)	2 (1.7%)
2.	Collaboration	121 (100%)	
3.	Willingness to adapt to innovative changes	121 (100%)	
4.	Marketing	121 (100%)	
5.	Adequate funding	121 (100%)	
6.	Adequate training and re -training of library and information professionals	121 (100%)	
7.	Adequate deployment of Information and Communication Technology	121 (100%)	
8.	Reading outside the profession	115 (95.0%)	6 (5.0%)
9.	Constant assessment	118 (97.5)	3 (2.5%)
10.	Ability to adapt to change	118 (97.5)	3 (2.5%)

The data analysis in the above Table reveals that all respondents (100%) identified collaboration, willingness to adapt to innovative changes, marketing, adequate funding, adequate training and re-training of library professionals, and adequate deployment of information and communication technology (ICT) as critical implications of innovative technologies on librarianship. Additionally, risk-taking was acknowledged by 98.3% of respondents as a significant implication. Similarly, constant assessment and the ability to adapt to change were each supported by 97.5% of respondents. Furthermore, reading outside the profession was cited by 95.0% of respondents as an implication.

Discussion of findings

Librarians' awareness of innovative technologies

The findings of this research question revealed that the majority of librarians are highly aware of several key technologies used for information service delivery in libraries. For instance, internet of things (IoT), cloud computing, and artificial intelligence (AI), are widely recognized among librarians as significant tools for modern information service delivery. Similarly, big data, blockchain technology, social media, mobile applications, and blockchain technology also showed high levels of awareness. This indicates that these technologies are also well-integrated into librarians' understanding of innovative service delivery. This is in line with Edam-Agbor et al (2025), who concluded that librarians exhibit a high level of awareness, acceptance, and application of AI in research libraries. However, awareness levels drop significantly for other technologies like robotics, QR codes, RFID technology, virtual reality and immersive technology. On the whole, while librarians demonstrate strong awareness of mainstream technologies like IoT, cloud computing, and AI, there is a noticeable decline in familiarity with more specialized or emerging technologies such as RFID, virtual reality, and immersive technology. This findings agrees with Akparobore, Omosekejimi, and Nweke (2020), who concluded that the extent of librarians' awareness of the technological innovations associated with the 4th IR era is low. This suggests a need for increased training and exposure to these less-recognized tools to ensure comprehensive adoption of innovative technologies in library services.

Areas of library operations and services that are performed using innovative technologies

The findings of this research questions showed that all respondents reported that innovative technologies can be used in electronic publishing services, short message services (sms), online training and workshops, and digital reference services. This indicates that librarians' are ready to embrace this technologies provided these technologies are made available in libraries. For instance, electronic publishing and digital reference services are likely supported by tools such as cloud computing, AI, and mobile applications, while SMS and online training platforms leverage communication and e-learning technologies. This is in line with Panda and Kaur (2023), who suggested that BT may be applied in libraries to enhance their services, including circulation services, collection development, storage, and data management.

Other highly prevalent areas include blogging services, mobile application services, digital marketing services, and digital preservation. These results suggest that libraries can actively use technologies to enhance

user engagement, promote services, and ensure the long-term accessibility of digital resources. Mobile applications and digital marketing, in particular, reflect a strong focus on reaching users through modern, technology-driven channels. Additionally, online information search services can be widely adopted. This highlights the importance of technologies like search algorithms, AI, and database systems in facilitating efficient information retrieval for library users. Similarly, respondents who believed that database production and distribution services can be utilized in libraries were 86.0%, indicating a significant reliance on technologies for managing and disseminating data. These findings demonstrate that innovative technologies can be extensively integrated into a wide range of library operations and services. From core functions like electronic publishing and digital reference services to user-centric activities such as blogging, mobile applications, and digital marketing, libraries are leveraging technology to enhance service delivery and operational efficiency. This is in line with Hahn, (2020), who opined that IoT enables remote control of doors, lighting, self-service kiosks, and public computers in library buildings. It allows the opening and management of libraries without staff members, significantly extending library opening hours and services while optimizing energy consumption. However, the slightly lower adoption rates in areas like online information search services and database production/distribution services suggest that there is still room for further technological integration in these domains. Overall, the results affirm that libraries are actively embracing innovative technologies to modernize their operations and meet the evolving needs of their users.

Implications of innovative technologies on librarianship

In this research question, the findings revealed that all respondents identified collaboration, willingness to adapt to innovative changes, marketing, adequate funding, adequate training and re-training of library professionals, and adequate deployment of information and communication technology (ICT) as critical implications of innovative technologies on librarianship. This unanimous agreement underscores the transformative impact of technology on the profession, particularly in fostering teamwork, adaptability, and the need for continuous professional development. Abubakar and Attahir (2018), supports this finding as they explained certain skills that must be built up in the librarians from time to time in order to be in sync with the fast-growing world. These skills include leadership, interpersonal relationship, technological awareness and understanding skills, problem-solving, and knowledge of intervention skills. The emphasis on marketing highlights the role of technology in promoting library services, while the focus on funding and ICT deployment reflects the necessity of financial and infrastructural support to sustain technological advancements. Additionally, risk-taking was acknowledged by the respondents as a significant implication, indicating that librarians recognize the need to embrace uncertainty and experiment with new technologies to stay relevant. Similarly, constant assessment and the ability to adapt to change were each supported by majority of the respondents, emphasizing the importance of ongoing evaluation and flexibility in responding to technological shifts. These findings suggest that librarians are not only adopting new tools but are also committed to refining their strategies and approaches to ensure effective implementation. This agrees with Enweani, (2018), who envisaged adequate/qualified staff recruiting and library staff training/retraining. Also young professional librarians should develop a greater interest in Web 2.0 technological activities. Furthermore, reading outside the profession was also cited by the respondents as an implication, highlighting the need for librarians to broaden their knowledge beyond traditional library science to stay informed about technological trends and innovations. This cross-disciplinary approach is essential for integrating new technologies into library services effectively.

Conclusion

Based on the findings of the study, it was concluded that while Nigerian academic librarians are generally aware of and open to technology, full adoption of emerging tools remains limited. There is a pressing need to train and re-train librarians, fund technological adoption, and implement forward-looking policies.

Recommendations

It was recommended that library services should be modernized and ensure they remain relevant in the digital age, it is essential to incorporate training in emerging technologies like Virtual Reality (VR), Artificial Intelligence (AI), and blockchain technology into Library and Information Science (LIS) curricula and Continuing Professional Development (CPD) programs. Additionally, increasing funding for digital infrastructure in libraries will enable them to effectively integrate these technologies. Collaboration with tech providers should be actively fostered to facilitate sustainable innovations that benefit library operations and services. Moreover, formulating policies that support the implementation of emerging technologies will provide a framework for their successful adoption. Finally, encouraging librarians to engage in interdisciplinary reading and research will empower them to stay informed and adapt to the rapidly evolving technological landscape.

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Access to and Utilization of Online Databases for Research Activities by Academics in Polytechnics in Katsina State

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Abstract

The study investigated on access to and utilization of online databases for research activities by academics in Polytechnics in Katsina state. The study set to determine the level of access to and utilization of online databases provided by libraries for research activities in the polytechnics under study. Cross sectional survey research design was adopted for the study and the population of the study comprised a total number of six hundred and fifty-nine (659) academics from three (3) Katsina state Polytechnics including Federal Polytechnic Daura (FPD, Hassan Usman Katsina Polytechnic (HUK) and Katsina State Institute of Technology and Management. The Total enumeration sampling technique was employed for the study using questionnaire as the data collection instrument. The Instrument was personally distributed by the researcher and the data collected was analysed using frequency Tables, Percentages, Means and Standard deviation. The findings of the study indicated that while some online databases like ***Elsevier*** *and* ***EBSCOhost*** *are accessible to academics, many others, such as* ***Scopus*** *and the* ***Journal of Social Sciences****, are either not accessible or have limited access. This signified the need for improved access to a wider range of research databases in polytechnic libraries leading to moderately level of utilization to few of the online databases by academics for research purposes. Based on the findings, the study recommended that efforts should be made by polytechnic libraries to enhance access to essential but underutilized databases such as Scopus and HINARI Contents, through institutional subscriptions or open-access alternatives, ensuring that all academics have equal access to vital research resources among others.*

Key words: *Access to, Utilization, Online Databases, Research Purposes, Polytechnics*

Introduction

The ICT revolution of the early 1990s sparked a significant transformation in the way academics store, access and utilizes research materials. The advent of digital technology has bridged geographical gaps, providing unparallel access to comprehensive, trustworthy and standardized databases for various academic disciplines. This has made online databases a very significant and essential tool for accessing and utilizing academic resources. Online database according to Abubakar and Akor (2017) is an organized collection of information accessible over a network. It is also seen as a database accessible from a local network or the internet as opposed to one that is stored locally on an individual computer or its attached storage (such as CD). These online databases are hosted on websites, made available as software as a service products accessible via a web browser. However, the exciting aspect of the online resources database according to Chigbu (2021) is that it is widely available, could be accessed from anywhere at any time and by many users at the same time and at the researcher's convenience. These online databases provided could include; online books, online journals, online magazine, online newspaper, online thesis, online dissertations, e.t.c. (Mohammed, Hamza & Idris, 2017) which researchers and scholars greatly benefit from in their academic pursuit.

Academics are major recipients' of using online databases as it helps in facilitating their research endeavours. It enables them to access a vast array of academic journals, papers and publications as well as enhance the quality and validity of their research findings. These academics rely heavily on online databases to advance their research and scholarly work. Online databases in the context of this work are therefore seen as indispensable tools provided by libraries for academics, enabling them to conduct in depth research and analysis. Thus, the availability of online databases has revolutionized the way academics conduct research, making it more accessible, efficient and effective for use in Polytechnics.

The integration of online databases into academic institutions has revolutionized access to information enabling academics use to enhance their research and in facilitating collaboration and knowledge sharing. Today, the use of online databases provides access to timely, relevant and high quality information to researchers with a view to keep them abreast with new developments and discoveries as materials in all fields are accessible on the internet. Polytechnic Libraries in Katsina State subscribe to several online databases which are made accessible to academics and students of polytechnics. In polytechnic, the availability of these online databases enriches research through proper utilization. However, these polytechnics spend substantial percentage of their budget and also with the support of tetfund in acquiring and making online databases available for academics but the question is are the resources accessible and utilized effectively by these academics? Therefore, there is a need to examine the level of access to and utilization of online databases provided by libraries for research purposes, from the perspective of academic staff in polytechnics in Katsina State.

Statement of the Problem

Online Databases have brought about a shift in the provision of library services and information by providing wide access to resources from different part of the world with ease. These online databases have become an integral and substantial component of academic library collections worldwide. The resources are regarded as essential for teaching, learning and research activities. Most polytechnics across the globe as indeed polytechnics in Nigeria subscribe to a number of online databases. Some are free whereas others are been paid for. Polytechnics spend substantial amount of money on subscription of these databases in libraries in order to enhance research purposes.

In-spite of the above, it is both fitting and cost effective to maximize the use of these databases in order to contribute to research activities of the academics. However, contrary to expectations, observations have revealed the opposite to be true as the use of online databases for research purposes in Nigerian polytechnics were very low, this could be due to several factors as identified by Abubakar, Ahmad and Umar (2024) like; insufficient technical expertise, unreliable power supply and technical issues, among others, this makes the polytechnic libraries' efforts in this regard futile and highlights the need for a revised approach. This problem of low usage of online databases therefore lays the groundwork for this investigation. Also, the researcher has found out that there is no evidence that research has been conducted on the use of online databases provided by libraries for research among academics of polytechnics in Katsina State.

Research Objectives

The study was guided by the following research objectives:

1. To assess the level of access to online databases among academic staff in polytechnics in Katsina State.
2. To examine the extent to which academic staff in polytechnic in Katsina State utilize Online research Databases for research activities

Literature Review

In Polytechnics, Academic libraries play a significant role in providing access and use of online databases. These online databases provided are crucial for academics as they help in increasing productivity, improving collaboration, expanding knowledge, developing skills and enhancing research quality among others. This literature review explores the relevance of access and utilization of online databases provided by libraries for research among academics of polytechnics in Katsina State.

Types of Online Databases Provided, Accessed and Utilized by Polytechnic Libraries:

Polytechnic libraries play an important role in facilitating the availability and utilization of different types of online databases that are accessible. Online databases are becoming more and more important to researchers and in order to appreciate the use of online databases, it is very expedient to examine some types of online databases subscribed by polytechnic libraries. A study conducted by Ofua (2021) in Delta State university revealed that libraries subscribe to seven (7) internet databases, including Agora, Proquest, Hinari, Oare, Ajor, Sciendirect, and Ebscohost, showing that the university did not subscribe to a large number of online databases particularly in the sciences despite the fact that several databases were interdisciplinary. More so, Ivwighreghweta and Eireyi-Fidelis (2022) revealed that the JSTOR, Elsevier, DOAI, ProQuest, ScienceDirect, and LexisNexis where been put to maximum use, meanwhile, NUC Virtual Library, Hinari, Research4life, Agora and Ebscohost were used less frequently in another study conducted in Delta State. This shows the need for extensive review to fill more gaps in terms of providing access to and use of different types of online databases in polytechnic libraries.

Accessibility of information resources is an important recurring theme in the literature. Aguolu and Aguolu (2006) was of the view that resources may be available in the library and even identified bibliographically as relevant to ones subject of interest but the user may not be able to lay hands on them. One may identify citations in indexes but may not have access to the resources containing the relevant articles. Therefore, the more accessible information resources are, the more likely, they are to be used. A study conducted by Tenenge (2019) on access to electronic information resources revealed that the extent of accessibility for research by students is low. Khan & Haridasan (2015) carried out a study on the use for research and the study reveals that majority of users access the online databases for retrieving information mainly for teaching and research purposes. This shows that access to online databases could play a very significant role in its use enhancing research development of academics in Polytechnics.

The utilization of online databases is a very significant process as it offers numerous benefits especially in terms of research activities in Polytechnics. These libraries often subscribe to various online databases to support research and academic endeavours. By leveraging online databases, Polytechnic libraries empower students, faculty and researchers to conduct comprehensive and innovative research, driving academic success and discovery. Vartharaman (2014) revealed that the user community of both universities uses the online databases for their research work without visiting the library for their research. Similarly, Ani & Edem (2012) in their study indicated that although vast majority of the academic staff are accessing and using relevant online databases in teaching and reserch, the frequency of usage is rather low, as most respondents only use these databases “occasionally.”. This shows the relevance in ensuring that the available online databases are used and are enhanced by libraries in Polytechnics.

Research Design

Cross sectional survey research design was adopted for the study. The population of the study comprised of a total number of six hundred and fifty-nine (659) academics from three (3) Katsina State polytechnics including Federal Polytechnic Daura (FPD) located in Daura local Government in Katsina State, Hassan Usman Katsina Polytechnic (HUK) located in Batagarawa Local Government in Katsina state and Katsina State Institute of Technology and Management, located in Katsina, Katsina State. Total enumeration sampling technique was employed. Questionnaire using closed ended questions was the instrument used for data collection and inter-item reliability test was used to ensure the consistency of the research instrument and result was tested using Cronbach alpha formulae and was .919. The Instrument was personally distributed by researchers and the data collected was analysed using frequency Tables, Percentages, Means and Standard deviation.

Results and Discussion

Response Rate

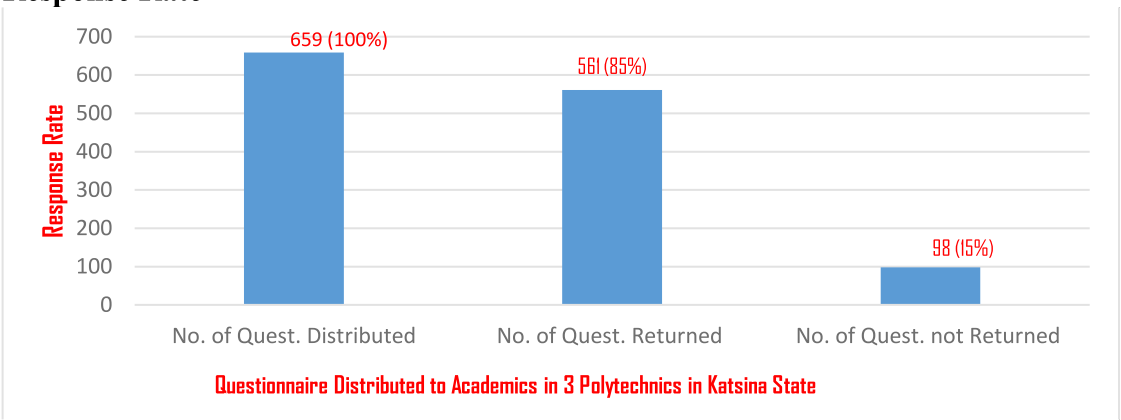


Figure 1: Response Rate of Questionnaire Distributed to respondents

Figure 1 above highlighted that a total of six hundred and fifty nine (659) questionnaires were distributed to the respondents in the study. Out of the distributed questionnaire, 561 (85%) were duly filled and returned and this high response rate was achieved as a result of subsequent follow-ups by the researcher alongside the research assistants for the study.

Table 1: Level of access to Online Databases provided by libraries for research among academics (N=561)

Items	NA		MA		A		HA		Mean	STD
	F	%	F	%	F	%	F	%		
Scientific publications	185	33.0	186	33.2	140	25.0	50	8.9	2.10	.96
Direct Open Access Journal DOAJ databases	293	52.2	114	20.3	104	18.5	50	8.9	1.84	1.02
Multidisciplinary scholarly peer reviewed	365	65.1	150	26.7	44	7.8	2	0.4	1.43	.65
Journal of social sciences	490	87.3	61	10.9	10	1.8	0	0	1.14	.40
Katsina state library system databases	149	26.6	246	43.9	117	20.9	49	8.7	2.12	.90
Scholar google databases	496	88.4	63	11.2	2	.4	0	0	1.14	.40
Subscribed Online Databases										
Science direct contents	201	35.8	92	16.4	218	38.9	50	8.9	2.21	1.03
Elsevier	115	20.5	112	20.0	251	44.7	83	14.8	2.54	.98
EBSCO host	90	16.0	196	34.9	225	40.1	50	8.9	2.41	.86
Scopus Database	512	91.3	45	8.0	4	.7	0	0	1.09	.32
J-store Database	91	16.2	250	44.6	156	27.8	64	11.4	2.51	.90
Trip medical Database	293	52.2	210	37.4	44	7.8	14	2.5	1.61	.74
HINARI contents	508	90.6	43	7.7	10	1.8	0	0	1.11	.37
AGORA contents	508	90.6	43	7.7	10	1.8	0	0	1.11	.37
ARDI contents	513	91.4	48	8.6	0	0	0	0	1.09	.28

OARE contents	555	98.9	6	1.1	0	0	0	0	1.01	.10
Law and social sciences	558	99.5	3	.5	0	0	0	0	1.00	.07
African journals Online	553	98.6	8	1.4	0	0	0	0	1.03	
SAGE journals	185	33.0	186	33.2	140	25.0	50	8.9	2.10	.96
Open courseware	560	99.8	1	.2	0	0	0	0	1.00	.04

NA= Not Accessible; 1 MA= Moderately Accessible; 2 A= Accessible; 3 HA= Highly Accessible; 4 (Field Survey, 2024)

The study was to find out the level of access to online databases provided by libraries for research among academics in polytechnics, based on the responses from 561 participants. The mean scores were used to determine the level of access, with a score above 2.5 indicating accessible databases and a score below 2.5 indicating databases that are not accessible. The results show that databases such as **Elsevier**(Mean = 2.54), **EBSCOhost** (Mean = 2.41), and **Science Direct** (Mean = 2.21) fall into the "Accessible" category, as their mean scores are above 2.5. On the other hand, databases like **Scopus**(Mean = 1.09), **Journal of Social Sciences** (Mean = 1.14), and **HINARI Contents** (Mean = 1.11) fall into the "Not Accessible" category, with mean scores significantly below 2.5. Other databases such as **Katsina State Library System** (Mean = 2.12) and **DOAJ** (Mean = 1.84) are considered "Moderately Accessible," with mean scores below 2.5 but above 1.The findings highlight a significant disparity in the accessibility of online databases across the polytechnics under study. While databases like **Elsevier, EBSCOhost,** and **Science Direct**are accessible, many others such **as Scopus, Journal of Social Sciences,** and **HINARI Contents** are either not accessible or have very limited access. This suggests that academics at these institutions may face challenges in accessing a variety of crucial research resources, which can hinder the quality and scope of their research.

Table 2 Level at which academics utilize Online Databases provided by libraries for research in the Polytechnics (N=561)

Items	**Never**		**Sometimes**		**Often**		**Always**		**Mean**	**STD**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
Scientific publications	186	33.2	185	33.0	140	25.0	50	8.9	2.10	.96
Academic publication	293	52.2	114	20.3	104	18.5	50	8.9	1.84	1.02
Multidisciplinary scholarly peer reviewed	365	65.1	150	26.7	44	7.8	2	0.4	1.43	.65
Journal of social sciences	487	86.8	64	11.4	10	1.8	0	0	1.14	.40
Katsina state library system databases	157	26.6	240	42.8	117	20.9	49	8.7	2.12	.90
Scholar google databases	499	88.9	60	10.7	2	.4	0	0	1.14	.40
Subscribed Online Databases										
Science direct contents	203	36.2	90	16.0	218	38.9	50	8.9	2.21	1.03
Elsevier	116	20.7	111	19.8	251	44.7	83	14.8	2.54	.98
EBSCO host	91	16.2	225	40.1	196	34.9	49	8.7	2.40	.86
Scopus Database	512	91.3	45	8.0	4	.7	0	0	1.09	.32
J-store Database	91	16.2	250	44.6	156	27.8	64	11.4	2.51	.90
Trip medical Database	293	52.2	210	37.4	44	7.8	14	2.5	1.61	.74
HINARI contents	508	90.6	43	7.7	10	1.8	0	0	1.11	.37
AGORA contents	508	90.6	43	7.7	10	1.8	0	0	1.11	.37
ARDI contents	513	91.4	48	8.6	0	0	0	0	1.09	.28
OARE contents	555	98.9	6	1.1	0	0	0	0	1.01	.10
Law and social sciences	558	99.5	3	.5	0	0	0	0	1.00	.07
African journals Online	553	98.6	8	1.4	0	0	0	0	1.03	
SAGE journals	185	33.0	186	33.2	140	25.0	50	8.9	2.10	.96

N= Never; 1 Sometimes= S; 2 O= Often; 3 A= Always; 4(Field Survey, 2024)

The study aimed to determine the level at which academics utilize online databases provided by libraries for research in polytechnics. Based on the mean scores, the study categorized the frequency of usage, with a score above 2.5 indicating high utilization (often or always), and below 2.5 indicating lower utilization (never, sometimes). The results show that databases like Elsevier (Mean = 2.54), EBSCOhost (Mean = 2.40), Science Direct (Mean = 2.21), and JSTOR (Mean = 2.51) fall into the "often" or "always" utilization category, as their mean scores are above 2.5. Conversely, databases such as Scopus (Mean = 1.09), Journal of Social Sciences

(Mean = 1.14), and HINARI Contents (Mean = 1.11) are barely or never used, with mean scores significantly below 2.5, indicating low utilization. The findings revealed a wide variation in the utilization of online databases among academics in the polytechnics under study. While databases like Elsevier, EBSCOhost, and Science Direct are utilized for research, others such as Scopus and HINARI Contents are rarely or never used. This points to a gap in the awareness, accessibility, or relevance of certain databases, which could limit research opportunities.

Discussion of Findings

Determine the level of access to Online Databases provided by libraries for research among academics in the Polytechnics under study. The study found that while some online databases like **Elsevier** and **EBSCOhost**are accessible to academics, many others, such as **Scopus** and the **Journal of Social Sciences**, are either not accessible or have limited access. This signified the need for improved access to a wider range of research databases in polytechnic libraries. Similar findings were reported by Ivwighreghweta and Eireyi-Fidelis (2022), who found that limited access to databases significantly restricts academic research. These access gaps may hinder academic output, as the inability to access diverse research materials can affect the depth and breadth of research work.

Determine the level at which academics utilize Online Databases provided by libraries for research in the Polytechnics under study. The findings show that while databases like Elsevier, EBSCOhost, Science Direct, and JSTOR are utilized by academics, databases such as Scopus, Journal of Social Sciences, and HINARI Contents are rarely or never used. This indicates a disparity in the utilization of online databases, with some resources being more widely accessed than others. The study found that accessibility significantly influences the utilization of online databases for academic research, with a positive relationship between the two variables. Improved accessibility explains about 17.6% of the variance in database utilization among academics. This is consistent with the work of Ofua (2021), who reported that academics tend to use more familiar and widely available databases, leading to uneven utilization across different platforms. According to Obiamalu et al. (2021), the lack of awareness and training on underutilized databases contributes to lower usage levels.

Conclusion

Based on the finding of the study, it is concluded that there is a significant disparities in both the accessibility and utilization of online databases among academics in polytechnics. While some databases like *Elsevier*, *EBSCOhost*, and *Science Direct* are accessible and moderately utilized, others such as *Scopus*, *Journal of Social Sciences*, and *HINARI Contents* are either not accessible or underutilized, indicating gaps in availability, awareness, and engagement. This imbalance can hinder the research capacity of academics and affect the overall quality of research output.

Recommendation

The study offered the following recommendations:

1. Efforts should be made by polytechnic libraries to enhance access to essential yet underutilized databases, such as Scopus and HINARI Contents, through institutional subscriptions or open-access alternatives, ensuring that all academics have equal access to vital research resources.
2. Increase awareness and training by polytechnic libraries in Katsina state: Institutions should implement comprehensive training programs to raise awareness about the availability and utilization of online databases, helping academics to maximize their research potential by utilizing the full range of accessible tools effectively.
3. Libraries should enhance institutional subscriptions and access so as to ease academic staff research productivity
4. The library should play a major role in Improving the internet infrastructure within the polytechnics.
5. The libraries should also monitor and evaluate usage of the databases available

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Adoption and Use of Artificial Intelligence for Access and Use of Information Resources in Nigerian University libraries: Challenges and Opportunities

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Abstract

Artificial intelligence (AI) has proven to be a breakthrough for information sectors. AI have had positive impacts on academic libraries leading to changes in search of or access to and retrieval of information and its strategic use. This paper explores AI as a tool for promoting access and use of information resources in Nigerian university Libraries. Through critical analysis and review of the related literature and harmonization of the theoretical submission the paper provides a conceptual evaluation of AI as technological tool for adoption and use in library and information science environment. It detailed how AI can be used for effective access and use of information in academic libraries. In particular, issues of discovery search, chatbots, text and data mining as forms of information retrieval and use were critically evaluated and reported. In addition, the paper detailed how AI as a latest digital transformation (DT) can be used to provide library users with alternative educational services for retrieving and sharing information for learning and research. The paper identified identifies behavioral/attitudinal, societal, and technological factors such as low adoption rate of AI technological tools in university libraries as some of the challenges that hinders effective use of AI in academic libraries. The paper concludes with recommendations on how to encourage library and information professionals, staff, administrators, and other stake holders adopt AI to complement effective information service delivery in academic libraries. In addition, Academic libraries in Nigeria should fully embrace artificial intelligence like chatbots, barcodes, RFIDs, and robots for delivering quality services and libraries should also leverage on the opportunities presented by artificial intelligence to reconnect their remote users, and consequently re-establish their relevance among the user community.

Keywords: *Artificial Intelligence, Library Resources, Library Services, Access, Use Information Resources, University Libraries.*

1. Introduction

Artificial Intelligence (AI) in the field of Library and Information Science (LIS) refers to the deployment of intelligent computational systems to perform tasks that usually require human cognition. These tasks include reasoning, learning, and problem-solving, understanding language, and interpreting data (Goh & Ng, 2020). Libraries leverage AI through tools such as machine learning algorithms, natural language processing (NLP), computer vision, and expert systems to automate workflows and enhance services (Cox, Pinfield, & Rutter, 2019). The landscape of academic libraries in Nigeria is undergoing a significant transformation, driven by the rapid advancement of information and communication technologies (ICTs). In particular, Artificial Intelligence (AI) has emerged as a pivotal force in reshaping how libraries manage, access, and disseminate information resources. AI encompasses a range of technologies, including machine learning, natural language processing, and expert systems, which enable systems to mimic human intelligence and perform tasks such as data analysis, user interaction, and content recommendation.

In Nigerian university libraries, the integration of AI promises to enhance operational efficiency, improve user engagement, and facilitate personalized information retrieval. In addition, AI can handle repetitive tasks such as cataloging, metadata generation, and indexing, which traditionally consume significant staff time. Automated systems using AI can classify and organize materials with high accuracy, reducing manual errors (Savage, 2022). AI helps libraries understand user behavior, resource usage, and trends, supporting evidence-based decision-making for collection development and user services (Cox et al., 2019). Other library services that can be handle and transformed by AI include Digital Preservation and Curation as well as enhance accessibility and inclusion. The theoretical contribution of (IFLA, 2020) is worth noting in this regard: "AI supports digital preservation by recognizing patterns in old texts, enhancing image quality, and automating metadata extraction. These capabilities are crucial for archiving historical documents and multimedia collections.

However, despite the potential benefits, the adoption and utilization of AI in these libraries remain limited. This disparity is particularly evident when compared to global trends, where academic libraries have increasingly embraced AI to streamline services and meet the evolving needs of users. In Nigeria, factors such as inadequate infrastructure, limited technical expertise, and financial constraints pose significant challenges to the widespread implementation of AI technologies.

2 Problem Statement

While AI holds transformative potential for Nigerian university libraries, its adoption is hindered by a combination of infrastructural, technical, and socio-cultural barriers. These challenges impede the effective integration of AI, thereby limiting the ability of libraries to fully leverage its capabilities in enhancing information access and use. Moreover, the absence of a cohesive strategy for AI adoption exacerbates the situation, leaving libraries ill-prepared to navigate the complexities associated with AI implementation.

3 Research Objectives

This paper aims to:

i. **Examine** the current state of AI adoption in Nigerian university libraries, identifying existing practices and technologies in use.
ii. **Identify** the key challenges impeding the effective integration of AI, including infrastructural, technical, and socio-cultural factors.
iii. **Explore** the opportunities that AI presents for enhancing information access and use in these libraries.
iv. **Propose** a conceptual framework to guide the strategic adoption and utilization of AI in Nigerian university libraries.

4 Methodological Approach

Using a **literature review as a methodological approach** involves systematically identifying, analyzing, and synthesizing existing scholarly works related to a particular topic. In the context of the research titled **"Adoption and Use of Artificial Intelligence for Access and Use of Information Resources in Nigerian University Libraries: Challenges and Opportunities"**, the literature review serves not just as a background or preliminary section, but as a **central research method.** The method was to ensure mapping existing knowledge on AI adoption in libraries, particularly in the Nigerian context by:

- Identifying gaps in the literature concerning AI usage for information resource access in university libraries.
- Examining challenges and opportunities reported in existing studies from similar contexts or comparable regions.
- Providing a conceptual framework for understanding how AI technologies are integrated into academic library services.

5. Literature Review

The integration of Artificial Intelligence (AI) into academic libraries has been a subject of extensive research globally. AI technologies, such as machine learning, natural language processing, and expert systems, have been employed to enhance various library services, including information retrieval, cataloging, and user engagement. Studies have demonstrated that AI can significantly improve operational efficiency, user satisfaction, and access to information resources in academic libraries worldwide. For instance, AI-driven chatbots have been utilized to provide real-time assistance to library users, while machine learning algorithms have been applied to recommend relevant resources based on user behavior. These applications have the potential to transform library services, making them more efficient and user-centered. In contrast to global trends, the adoption of AI in Nigerian university libraries has been relatively slow. Research indicates that while there is awareness of AI technologies among librarians, their application in library services remains limited. For example, a study by Igbo et al. (2025) identified the prerequisites for AI adoption in Nigerian academic libraries, including policy frameworks, digital infrastructure facilities, human capital development, and data generation for AI training . Similarly, Adeleke et al. (2024) assessed the patterns and issues with AI deployment in Nigerian university libraries and found that AI use is still in its infancy, constrained by factors like inadequate funding, poor infrastructure, and limited technical expertise. Aminu (2024) investigated the types of AI technologies available in university libraries in North West Nigeria and found that while some libraries utilize AI tools like social media and online public access catalogs, the adoption of more advanced AI technologies is limited. Artificial Intelligence (AI) is revolutionizing library and information services globally, and Nigerian university libraries are beginning to embrace this transformation. AI technologies offer new pathways for improving access to and the use of information resources by automating tasks, enhancing user interactions, and personalizing services. Despite infrastructural and policy limitations in Nigeria, AI presents a unique opportunity to modernize university libraries and improve academic research and learning outcomes.

6 Opportunities for AI in Nigerian University Libraries

Despite the challenges, there are significant opportunities for leveraging AI to enhance library services in Nigerian universities. AI can facilitate personalized user interactions, automate routine tasks, and improve information retrieval processes. For example, AI-driven chatbots can provide real-time assistance to library users, while machine learning algorithms can recommend relevant resources based on user behavior. Wagwu et al. (2024) investigated the use of AI-driven chatbots for library services in Nigerian university libraries and found that librarians perceive chatbots as beneficial tools for handling routine inquiries, offering continuous support, and enhancing scalability. Additionally, Abba (2023) explored the use of AI technologies in rendering library services in university libraries in Africa and found that AI tools like chatbots, RFID, and robots are used to render different library services, such as answering reference questions, cataloging information, and assisting in the charging and discharging of library materials.

7. Challenges to AI Integration in Nigerian University Libraries

Several studies have highlighted the challenges impeding the integration of AI in Nigerian university libraries. Agboke and Oladokun (2024) conducted a systematic review and identified barriers such as inadequate

infrastructure, financial constraints, limited tech nical expertise, and societal resistance due to fears of job displacement and privacy concerns. Suleiman et al. (2024) emphasized ethical considerations, including data privacy, intellectual property, algorithmic bias, and the risk of unequal access to AI-driven services, which necessitate the development of a robust ethical framework for AI implementation in Nigerian university libraries. Ajani et al. (2023) examined the readiness to adopt robotic technology in Nigerian public libraries and found that while librarians acknowledge the potential benefits of robotics, challenges such as the need for strong technological infrastructure, sufficient funding, and staff training hinder the adoption of robotic technologies.

The challenges facing AI adoption in Nigerian libraries—such as inadequate infrastructure, the need for professional development, and ethical concerns—can be mitigated through targeted strategies. For example, increasing investment in digital infrastructure and providing training programs for librarians are critical steps for improving the technological readiness of libraries. Additionally, creating national policies that promote ethical AI usage, safeguard user privacy, and address algorithmic biases will be essential for building trust and fostering responsible AI adoption in libraries.

To foster AI adoption in Nigerian university libraries, this paper recommends the following actions:

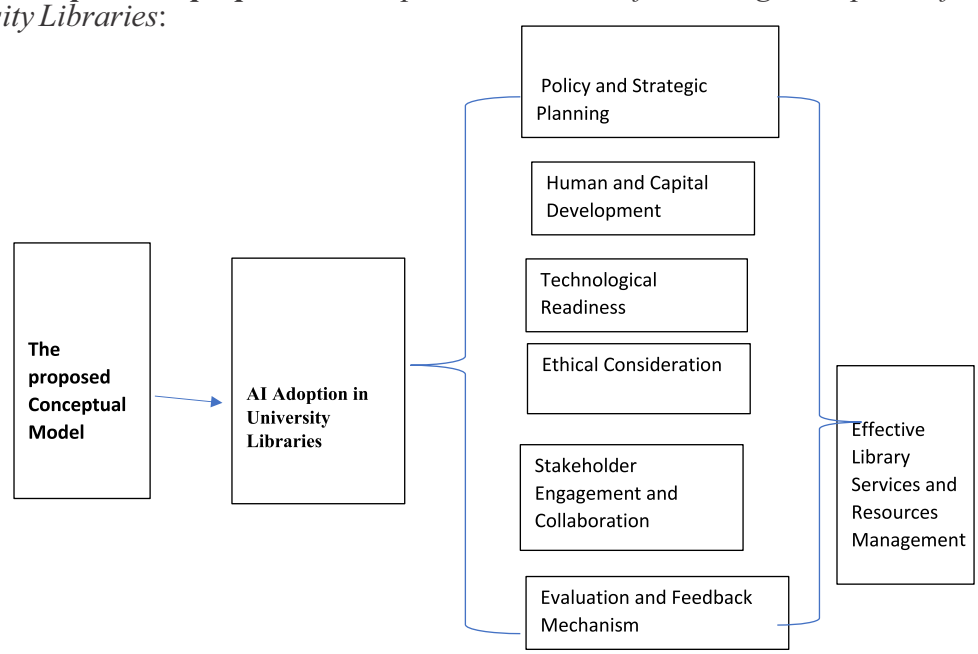
- **Infrastructure Development**: Governments and universities should prioritize investment in the technological infrastructure required to support AI technologies, including stable internet access, reliable power supply, and advanced hardware.
- **Capacity Building**: Librarians should be trained in AI-related skills, such as machine learning, data analytics, and ethical AI use, to enable them to manage and utilize AI tools effectively.
- **Policy Frameworks**: Developing and implementing clear policies that guide AI integration, ensuring ethical use, protecting user data, and addressing the socio-cultural impact of AI, will promote responsible adoption.
- **Stakeholder Collaboration**: Libraries should collaborate with technology providers, governmental bodies, and academic institutions to share resources, exchange knowledge, and secure funding for AI initiatives.
- **Continuous Evaluation**: Libraries must establish robust evaluation frameworks that allow them to assess the effectiveness of AI tools and make necessary adjustments to meet users' evolving needs.

8. Conceptual Framework for strategic adoption of AI Adoption in Nigerian University Libraries

A conceptual framework provides a structured approach to understanding the multifaceted process of adopting Artificial Intelligence (AI) in Nigerian university libraries. This framework outlines the interrelationships between various factors that influence AI integration, offering a roadmap for successful implementation. This paper proposed a framework for strategic adoption of AI in Nigerian University libraries (Figure 1). The proposed framework have the following key components:

1. Policy and Strategic Planning
2. Human and Capital Development
3. Technological Readiness
4. Ethical Consideration
5. Stakeholder Engagement and Collaboration
6. Evaluation and Feedback Mechanisms

Figure 1: Depicts the proposed *Conceptual Framework for strategic adoption of AI Adoption in Nigerian University Libraries*:



The first component of the framework suggests the need for Policy and Strategic Planning on the adoption and use of AI for university library services. This would include the establishing clear policies and strategic plans which are essential for guiding AI adoption. Policy documents should outline the vision, objectives, and roadmap for integrating AI technologies into library services. In practical scenario, a university library in Nigeria could develop a strategic plan that includes the phased implementation of AI tools, such as chatbots for user assistance and machine learning algorithms for personalized resource recommendations. Igbo et al. (2025) emphasize the necessity of policy frameworks to guide AI adoption in Nigerian academic libraries, highlighting the importance of strategic planning in the successful integration of AI technologies. The second component highlights the need for Infrastructure and Technological Readiness. In other words, adequate infrastructure, including reliable internet connectivity, power supply, and hardware, is crucial for supporting AI applications. In fact, implementing AI-driven services like RFID-based book tracking and robotic book retrieval requires robust infrastructure to ensure seamless operation. The submission of Aminu (2024) is worth of reporting here and now. The writer identifies the availability of digital infrastructure facilities as a prerequisite for AI adoption in Nigerian academic libraries, underscoring the importance of technological readiness. Human Capital Development is also yet another important component of the proposed framework. It signifies the necessity for training and capacity building for library staff in order to equip them with the necessary skills to manage and utilize AI technologies effectively. This may include but not limieted to Organizing workshops and training sessions on AI tools and their applications in library services can enhance staff competence and confidence. According to Igbo et al. (2025) adequate training or manpower development and continuous professional development initiatives to prepare librarians for AI adoption are essential for any tangible outcome in any type of library system. The other components of the framework focused on Ethical and Legal Considerations, Stakeholder Engagement and Collaboration and the aspect of Evaluation and Feedback Mechanisms. Ethical and legal consideration involves addressing ethical issues such as data privacy, algorithmic bias, and intellectual property rights is essential to ensure responsible AI use.in addition, developing guidelines for ethical AI use in libraries can help mitigate risks and promote trust among users. According to Suleiman et al. (2024) the importance of ethical considerations in AI adoption, including data privacy and algorithmic bias, to ensure responsible and inclusive AI integration in library services cannot be overemphasized. Suleiman et al. (2024) emphasize the necessity of stakeholder collaboration in AI adoption, advocating for a balanced approach that preserves human involvement and upholds ethical standards. Involving various stakeholders, including university management, faculty, students, and external partners, fosters a collaborative approach to AI adoption. Establishing advisory committees comprising representatives from different university departments can facilitate the integration of AI into library services. The last component should focus on s**upporting Literature**: 5.1.6 Continuous Evaluation and Feedback Mechanisms. Implementing systems for monitoring and evaluating AI applications ensures their effectiveness and alignment with user needs. In addition, by conducting regular surveys and feedback sessions with library users, library staff can provide insights into the performance of AI services and areas for improvement. Suleiman et al. (2024) advocate for continuous monitoring and evaluation of AI applications to ensure their effectiveness and alignment with user needs, emphasizing the importance of feedback mechanisms in AI integration. Conclusively therefore, the proposed conceptual framework is designed to be adaptable to the unique contexts of Nigerian university libraries.

9. Conclusion and Recommendations

In conclusion, while AI adoption in Nigerian university libraries faces significant challenges, there is immense potential to transform the way libraries manage information and interact with users. By addressing the infrastructural and ethical concerns, equipping staff with the necessary skills, and establishing clear policies for AI integration, Nigerian libraries can begin to harness the power of AI for more efficient and user-centric services. With a strategic and collaborative approach, AI adoption can significantly improve library services, supporting the broader educational and research goals of Nigerian universities. The integration of Artificial Intelligence (AI) into Nigerian libraries presents both significant challenges and exciting opportunities. As this paper has highlighted, AI has the potential to revolutionize library services, enhancing resource management, user engagement, and operational efficiency. However, for AI adoption to succeed in Nigerian university libraries, various factors need to be addressed, including infrastructure limitations, the need for technical expertise, ethical considerations, and the establishment of clear policies and strategic frameworks.

Given the identified challenges and opportunities, it is clear that the successful adoption of AI in Nigerian university libraries requires a well-defined policy and strategic planning framework. Suleiman et al. (2024) advocate for the development of a national AI adoption policy that can guide libraries in the effective use of AI technologies while addressing challenges such as infrastructure gaps and ethical concerns. Additionally, Igbo et al. (2025) stress the need for universities to invest in digital infrastructure and to provide librarians with the necessary skills and training to manage AI tools effectively. Furthermore, collaborations with technology providers and external stakeholders, such as government bodies and tech companies, are essential for fostering innovation and securing funding for AI adoption. By building strong partnerships, Nigerian university libraries can overcome financial constraints and accelerate AI implementation (nigerbiblios.nln.gov.ng).

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Adoption of Artificial Intelligence Systems for Library and Information Services in University Libraries in North-West Nigeria

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Abstract

The study investigated the adoption of Artificial Intelligence systems for library and information services in university libraries in North-West Nigeria, the types of AIS were identified, criteria that influenced the selection of such AI systems for adoption and the challenges that confront full implementation of the AI systems adopted discussed. Survey research design was adopted, using the structured questionnaire as instrument which was randomly distributed among respondents in the three university libraries purposively selected for the study. Stratified random sampling technique was used to sample 142 librarians. That is; 51 from Ahmadu Bello University, Zaria, 47 from Bayero University, Kano and 44 from Usmanu Danfodiyo University, Sokoto. Findings revealed that ChatGPT, reference advisory systems, MARC, and RFID systems among others are the AI systems that are available and being used by the university libraries studied. It was found that efficiency of service quality; flexibility and interactivity among others are the criteria that influence the adoption of AI systems. It was further discovered that expertise shortage, infrastructure limitation and financial constraint among others are the major factors that impedes successful AI implementation in the university libraries studied. It was concluded that university libraries are grossly underutilizing some essential AI systems installed in the library such as automation procedures, decision-making, automation and categorization of resources among others. The paper recommended that there is need to adopt sophisticated such as robotics and ChatBots that will accommodate all core library practices including classification/cataloguing, resources curation and archiving, reference service, document delivery system among others.

Keywords: *Artificial Intelligence, Information, Library, Library and Information service, North-West Nigeria.*

Introduction

The rapid advancement of digital technologies has significantly transformed the landscape of library and information services worldwide. Among the most groundbreaking developments is the emergence of Artificial Intelligence (AI), which offers innovative solutions for enhancing service delivery, resource management, and user engagement in academic libraries. AI systems, such as chatbots, recommendation engines, intelligent search systems, and automated cataloging tools, are increasingly being adopted by libraries to improve operational efficiency and meet the evolving needs of users in the digital age. In the context of university libraries, the integration of AI technologies has the potential to revolutionize traditional library practices by automating routine tasks, enabling personalized information services, and facilitating data-driven decision-making. However, the adoption of these technologies varies across regions and institutions, often influenced by factors such as infrastructure, funding, staff expertise, and institutional readiness (Zondi, et al, 2024).

In Nigeria, particularly in the North-West geopolitical zone, university libraries play a critical role in supporting academic research and learning. Despite the growing global interest in AI applications in libraries, there is limited empirical evidence on how university libraries in this region are responding to this technological shift. This study, therefore, seeks to investigate the adoption of Artificial Intelligence systems in library and information services within university libraries in North-West Nigeria. It aims to explore the extent of adoption, the types of AI technologies employed, the perceived benefits and challenges, and the readiness of library staff and infrastructure to support this transition.

Statement of the Problem

The integration of Artificial Intelligence (AI) into library and information services holds significant potential for enhancing efficiency and user engagement. However, in the context of university libraries in

North-West Nigeria, the adoption of AI technologies remains limited. A study by Aminu (2024) revealed that while some AI tools like Online Public Access Catalogues (OPAC), search engines, and security scanners are present, more advanced technologies such as robotics, Radio-Frequency Identification (RFID), and smart cards are notably absent. This limited adoption suggests a gap between the potential benefits of AI and its practical implementation in these institutions.

Further compounding the issue, a nationwide survey involving 174 university librarians found that only 25 institutions had initiated any form of AI deployment. The study highlighted several barriers to adoption, including inadequate funding, lack of skilled personnel, and insufficient infrastructure, particularly unreliable power supply and poor internet connectivity. These challenges hinder the deliberate and effective use of AI in enhancing library operations and services. Addressing these challenges is crucial for the modernization of library services in North-West Nigeria. Investments in infrastructure, training programs for library staff, and strategic planning are essential steps toward integrating AI technologies effectively. By overcoming these barriers, university libraries can harness the full potential of AI to improve information services and meet the evolving needs of their users.

Research Questions

The study was guided by the following research questions:

1. What type AI systems are adopted in university libraries in North-West Nigeria?
2. What are the major factors influencing the adoption of AI systems in university libraries in North-West Nigeria?
3. What challenges encountered in the implementation of AI systems in university libraries in North-West Nigeria?

Literature Review

Concept and Evolution of Artificial Intelligence in Library Services

Artificial Intelligence systems (AIS) are developments in computer systems that enable the machines to perfectly perform tasks typically requiring human intelligence. These tasks encompass a wide range of activities such as learning, reasoning, problem-solving, perception, speech recognition, and language understanding (Abayomi, et al, 2021). According to Zondi, et al, (2024), described AI systems as machines or applications used to simulate human intelligence that are programmed to think, learn, and perform tasks autonomously. It encompasses a broad range of technologies and techniques, including machine learning, natural language processing, computer vision, and robotics, aiming to enable machines to perform tasks that typically requires human intelligence. Similarly, Chen, Sun and Wang (2022) assert that AI systems are designed to analyze data, recognize patterns, make decisions, and continuously improve their performance without explicit programming.

Types and Applications of AI in Libraries

Several AI systems exist but those that are mostly adopted by the university libraries are exclusively based on their applicability to library operations and services (Nombuso, et al. 2024). Notable ones among them according to Sukumar (2024) include; Robotics an AI algorithm which can handle curation and also serve as a recommendation systems for analyzing user preferences, borrowing histories, and reading habits. Similarly, Emumejakpor, Ovie and Ekuerhare (2024) identified ChatGPT, Bots, Reference Advisory Systems (RAS) AnswerMan as AI tools adopted by university libraries to make it easier for users to quickly find suitable books, articles, and other resources. Also, Lund, Omame, Tijjani & Agbaji (2020) mentioned PLEXUS, MARC, BIOSIS as AI systems adopted in the university libraries for the purpose of improving the way that information is found in databases and library catalogs by understanding and handling user queries through Natural Language Processing (NLP) approaches which increases search accuracy. Lund, Omame, Tijjani & Agbaji (2020) again mentioned Optical Character Recognition (OCR) is another AI application/tool adopted by university libraries for digital archiving, preservation and indexing of rare and delicate library collections where scanned documents are made searchable. In another dimension, Aminu (2024) remarked that automatic inquiry services, user support services among others are among the functionalities considered in implementing ChatGPT and virtual assistants' tools in the university libraries because they are used to assist patrons instantly, respond to questions, and direct them toward the resources and services available.

Global and Regional Trends in AI Adoption in University Libraries

According to Faga and Yusuf (2023), Reference Advisory System (RAS), Robotics, ChatBots among others are adopted and implemented in university libraries to conduct text analysis and data mining which enable university libraries to gather useful data from huge quantities of textual materials. These AI systems are also being used for content creation and generation through the creation of metadata, abstracts, or summaries for reference materials. Accessibility services: AI systems such as Siri, Alexa, Cortana and Bixby help to improve the accessibility of library materials for people with disabilities. These AI systems for example, can help visually impaired people navigate digital interfaces and convert text to speech including predictive analytics for collection management. Other AI systems adopted and implemented by university libraries

include QR Code Scanners, CCTV, RFID and Social Media Monitoring applications used to handle inventories, security and fraud detection, access control system monitoring, cyber asset protection thereby making resources and services more accessible to a wider range of users.

Barriers to AI Adoption in Academic Libraries

The factors that influences the adoption of AIS in Nigerian universities according to Nombuso, et al (2024) includes improve information retrieval, streamlines knowledge organization, personalises user services and enhances resource management, thereby significantly improving library services. The influence of AIS adoption goes beyond mere automation; for example 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, radio frequency identification (RFID) optimises the location of resources and work intelligently, enabling autonomous functions and saves valuable time (Okunlaya, Syed Abdullah and Alias, 2022). Librarians are freed from repetitive tasks and can spend their time getting to know and serve their clientele better through self-checkout systems and enabling 24-hour services (IFLA, 2023). Despite these influences, the adoption of AIS in university libraries faces hurdles such as expertise shortages, infrastructure limitations, financial constraints, unreliable power, poor planning, lack of collaboration and technology adoption policy (Nombuso, et al. 2024).

Methodology

The study adopted the survey research design. The population for the study comprised of library staff drawn from the Ahmadu Bello University, Zaria, Federal University Dutsin-Ma, Federal University Gusau, Federal University Birnin Kebbi, Federal University of Transportation Daura, Nigerian Defence Academy, Kaduna and Aliko Dangote University of Science and Technology, Wudil. Meanwhile, three university libraries namely: Kashim Ibrahim Library, Ahmadu Bello University, Zaria, Bayero University Libray, Kano and Abdullahi Fodiyo Library, Usmanu Danfodiyo University, Sokoto were purposively selected for the study. These federal universities were selected purposively based on generation (first and second generation) due to the fact that they share the same characteristics academically in North West Nigeria. Stratified random sampling technique was used to sample 142 librarians that are directly engaged in the interaction with AI systems adopted. That is; 51 from Ahmadu Bello University, Zaria, 47 from Bayero University, Kano and 44 from Usmanu Danfodiyo University, Sokoto. The questionnaire was the instrument used for data collection. One hundred and fout two (142) copies of questionnaires were administered and all were completed and returned and found useful for the study. This represents 100% of the entire population. The 100% response was achieved because the researchers used online community platform (WhatsApp). The data collected were analyzed descriptively using tables, frequency and simple percentage statistic tool.

Results and Discussions

The data collected through the questionnaire is analyzed and interpreted as presented below.

Table 1: Distribution of respondents Universities

Universities	**No. of questionnaire distributed**	**No. of questionnaire returned**	**%**
ABU	51	51	35.0
BUK	47	47	34
UDUS	44	44	31
Total	**142**	**142**	**100**

Key:
ABU = Ahmadu Bello University, Zaria
BUK = Bayero University, Kano
UDUS = UsmanuDanfodiyo University, Sokoto

A total of 142 questionnaires were distributed to the library staff in the university libraries studied and were all returned duly completed and were found useful for the study representing 142(100%) response rate. This was as a result of the respondents' familiarity with the instrument.

Table 2: Types of AI systems Adopted by University Libraries

Types of Serials	**Institutions and No. of Respondents**													
	ABU				**BUK**				**UDUS**				**Total**	
	Adopted	%	Not Adopted	%	Adopted	%	Not Adopted	%	Adopted	%	Not Adopted	%	Total	%
Robotics	-	-	51	100	-	-	47	100	-	-	44	100	142	100
ChatGpt	51	100	-	-	47	100	-	-	44	100	-	-	142	100
ChatBots			51	100			47	100			44	100	142	100

Reference Advisory System (RAS)	51	100	-	-	47	100	-	-	44	100	-	-	142	100
MARC	51	100	-	-	47	100	-	-	44	100	-	-	142	100
RFID	51	100	-	-	47	100	-	-	44	100	-	-	142	100
OCR	51	100	-	-	47	100	-	-	44	100	-	-	142	100
CCTV	51	100	-	-	47	100	-	-	44	100	-	-	142	100
QR Code	51	100	-	-	47	100	-	-	44	100	-	-	142	100
AnswerMan	-	-	51	100	-	-	47	100	-	-	44	100	142	100
PLEXUS	-	-	51	100	-	-	47	100	-	-	44	100	142	100
Alexa	-	-	51	100	-	-	47	100	-	-	44	100	142	100
Siri	-	-	51	100	-	-	47	100	-	-	44	100	142	100
Cortana	-	-	51	100	-	-	47	100	-	-	44	100	142	100

Key:
ABU = Ahmadu Bello University, Zaria
BUK = Bayero University, Kano
UDUS = UsmanuDanfodiyo University, Sokoto

Table 2 shows that the three university libraries studied adopted some AI systems including ChatGPT, Reference Advisory System(RAS), MARC, RFID, OCR, CCTV and QR Code which scored 142(100%) number of respondents. This is because they enhance fundamental library operations and services delivery hence they are flexible, interactive technologies and are easy to use. This finding is in agreement with Sukumar (2024) who remarked that AI systems are adopted by the university libraries in order to handle curation and also serve as a recommendation system for analyzing user preferences, borrowing histories, and reading habits. On the hand, some notable AI systems are not adopted by the university libraries among them are; Robotics, ChatBots, AnswerMan, PLEXUS, Alexia, Siri and Cortana with 142(100%) number of respondents. This may be attributed to use priority, their operational complexity, demand for expertise and requisite technology infrastructure among others. This finding is in consonant with that of Nombuso, et al (2024) where they stated that several AI systems exist but those that are mostly adopted by the university libraries are exclusively based on their applicability to library operations and services. The findings have shown that university libraries studied only adopted AI systems based on their needs to available operations and services.

Table 3: Factors Influences the Adoption of AI Systems in University Libraries

Factors of Influence	**Institutions and No. of Respondents**													
	ABU				**BUK**				**UDUS**				**Total**	
	Influence	%	Not Influence	%	Influence	%	Not Influence	%	Influence	%	Not Influence	%	Total	%
Efficiency of service quality	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Flexibility	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Interactivity	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Reliability	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Auto support sys.	-	-	51	100	-	-	47	100	-	-	44	100	142	100
Enhances resources management	14	100	-	-	47	100	-	-	44	100	-	-	142	100
Improve info. Retrieval	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Tireless nature of AIS	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Ability to analyze extensive materials	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Streamline knowledge management	14	100	-	-	11	100	-	-	9	100	-	-	142	100
Cost effectiveness	-	-	51	100	-	-	47	100	-	-	44	100	142	100

Key:
ABU = Ahmadu Bello University, Zaria
BUK = Bayero University, Kano
UDUS = UsmanuDanfodiyo University, Sokoto

Table 3 shows that the factors that influences the adoption of AIS in three university libraries studied includes efficiency of service quality, their flexibility, interactivity, reliability, improving information retrieval and enhancing resources management among others scored 142(100%) number of respondents. This mass acceptance was achieved because librarians perceived AIS as tools that introduce convenience, speed and some level of precision in library and information work. This finding confirmed the assertion of Nombuso, et al (2024) which stated adoption of AIS in university libraries are being influenced by their ability to improve information retrieval, streamlines knowledge organization, personalizes user services and enhances resource management, thereby significantly improving library services. On the other hand factors like auto support system and cost effectiveness also scored 142(100%). The reason for disagreement could be that librarians are still skeptical in relying on these innovative technologies because many of them are still out of reach of many university libraries. This finding is in line with that of IFLA (2023) which says that despite notable influences, the adoption of AIS in university libraries still faces hurdles such as expertise shortages, infrastructure limitations and financial constraints. These findings have revealed that university libraries studied considered many benefits of AIS as determinant factors that influence their decision when adopting AIS in their libraries.

Table 4: Challenges Encountered in the Implementation of AI Systems in University Libraries

Challenges	Institutions and No. of Respondents													
	ABU				BUK				UDUS				Total	
	Challenge	%	Not Challenge	%	Challenge	%	Not Challenge	%	Challenge	%	Not Challenge	%	Total	%
Expertise shortage	51	100	-	-	47	100	-	-	44	100			142	100
Infrastructure limitation	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Financial constraints	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Lack of technology adoption policy	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Poor planning	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Lack of collaboration	51	100	-	-	47	100	-	-	44	100	-	-	142	100
Inadequate power supply	51	100	-	-	47	100	-	-	44	100	-	-	142	100

Key:
ABU = Ahmadu Bello University, Zaria
BUK = Bayero University, Kano
UDUS = UsmanuDanfodiyo University, Sokoto

Table 4 points out the challenges encountered in the implementation of AIS adopted in three university libraries studied. It was revealed that expertise shortage, infrastructure limitation, financial constraints, lack of technology adoption policy and poor planning among the rest scored 142(100%) each by the respondents. Since all respondents pointed out the same problem, this signifies that implementation and adoption of AIS in university libraries in north-west Nigeria is still a mirage considering the manifestation of these fundamental challenges. This finding has validated the view of Nombuso, et al (2024) that university libraries faces a lot of challenges such as expertise shortages, infrastructure limitations, financial constraints, unreliable power, poor planning, lack of collaboration and technology adoption policy among others. The finding above reveals that there is still partial implementation of AIS adopted for library operations and information services delivery in university libraries studied.

Summary of Major Findings

It was discovered that university libraries adopted some AIS including ChatGPT, Reference Advisory System(RAS), MARC, RFID, OCR, CCTV and QR Code to enhance library operations and information services delivery.

It was also discovered that factors like efficiency of service quality, flexibility, interactivity, reliability, improving information retrieval and enhancing resources management among others influence the decision of AIS adoption in the university libraries studied.

Again, the findings revealed that university libraries studied are facing some hurdles such as expertise shortage, infrastructure limitation, financial constraints, poor planning, lack technology adoption policy and inadequate power supply among others in the adoption and implementation of AIS in their libraries.

Conclusion

The study focuses on adopting of artificial intelligence for library and information service in north-west Nigeria. This is because the integration of AIS in university libraries is a revolutionary change that is redefining the information landscape in university library services which underscore some levels of efficiency. The adoption of AIS holds immense potential to improve accessibility, accuracy, and personalized user experience. However, this promising prospects faces significant challenges, especially in developing countries like Nigeria where technology infrastructure, financial resources, expertise, and constant power supply are matters of concern, posing a lot of hurdles to the implementation of AIS.

Recommendations

The following strategies are recommended to enhance adoption and optimum implementation of AIS in university libraries:

1. University libraries should consider other sophisticated AIS such as Robotics, ChatBots, Answer Man and other web technology applications(RSS feed, Blogs, social media handles etc) and skills acquisition for adoption and implementation these systems because of their efficiency and tireless nature in handling operations and services;
2. University libraries should delve into collaboration and networking in deploying technologies into the library considering fundamental impacts as factors to influence their decision when adopting AIS for library and information service;
3. Librarians should consider adequate planning for technology adoption and should have working policy for AIS adoption and implementation;
4. University libraries should also consider open source technologies to curtail financial constraints that marred the administration of libraries; and
5. University libraries should consider alternative power supply such as solar and inverter power systems for uninterruptible power supply hence technologies are power drive.

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Adoption of Machine Learning in Library Services: Opportunities and Challenges for Library and Information Science Professionals

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Abstract

The rapid advancements in machine learning (ML) have revolutionized various sectors, including library services. This study explores the adoption of machine learning in library services, focusing on the opportunities it presents and the challenges faced by Library and Information Science (LIS) professionals. The study aims to: (i) explore the potential of machine learning technologies to enhance library services such as cataloging, search optimization, and personalized recommendations; (ii) examine the level of awareness and adoption of ML technologies among LIS professionals; (iii) identify barriers hindering the integration of ML in libraries; and (iv) propose strategies for improving ML adoption in library services. The study employs a descriptive survey research design, targeting LIS professionals in academic and research libraries that were purposively selected within tertiary institutions in Abuja, Anambra, and Enugu State. Data collection involves structured questionnaires distributed to 100 LIS professionals, complemented by a review of relevant literature. The data was analysed using descriptive analysis to identify the trends. Preliminary findings revealed that machine learning holds immense potential for transforming library services by automating repetitive tasks, improving resource discovery, and offering personalized user experiences. However, challenges such as limited technical skills, infrastructural deficits, and inadequate funding significantly hinder its adoption. Furthermore, the lack of training programs and resistance to technological change among professionals exacerbated the slow integration of ML in libraries. The study concludes that to fully leverage ML technologies, libraries must prioritize capacity-building initiatives, secure adequate funding, and foster collaborations with technology firms. Recommendations include regular training workshops, curriculum updates in LIS programs to incorporate ML concepts, and the establishment of strategic partnerships for technological support.

Keywords: *Machine Learning, Library Services, Library and Information Science Professionals, Opportunities, Challenges*

Introduction

The evolution of library services has been significantly shaped by technological advancements, and the emergence of machine learning (ML) stands out as a transformative force. Traditionally, libraries have focused on acquiring, organizing, and providing access to information resources, primarily in physical formats (Uzoagba, Agim & Ezejiofor, 2024). However, the proliferation of digital information and the increasing complexity of user needs have necessitated the adoption of more sophisticated tools and techniques. Machine learning, a subset of artificial intelligence, offers the capability to automate complex tasks, analyse vast amounts of data, and provide personalized services, thereby enhancing the efficiency and effectiveness of library operations. This technological shift presents both opportunities and challenges for library and information science (LIS) professionals, requiring them to adapt and acquire new skills to leverage the full potential of ML in their work.

The integration of machine learning in library services is multifaceted, impacting various core functions. ML algorithms can be employed to improve information retrieval through enhanced search functionalities, personalized recommendations, and semantic analysis (Kalisdha 2024). In technical services, ML can automate cataloging and classification processes, reducing manual effort and increasing accuracy. Furthermore, ML facilitates the management and preservation of digital resources by automating metadata generation, content analysis, and digital curation (Cordell, 2020). These applications not only streamline library operations but also enable LIS professionals to focus on higher-level tasks, such as user engagement, information literacy instruction, and strategic planning. The adoption of ML, therefore, has the potential to redefine the roles and responsibilities of LIS professionals in the modern library landscape.

Despite the promising applications of machine learning in library services, its widespread adoption faces several challenges, particularly for library and information science professionals. These challenges include the need for substantial investments in technological infrastructure, the scarcity of skilled personnel with expertise in ML, and concerns regarding data quality, privacy, and ethical considerations (Russell, 2016). LIS professionals must grapple with the complexities of implementing ML systems, including selecting appropriate algorithms, training models, and ensuring the reliability and validity of results. Moreover, the integration of ML into library workflows requires a shift in organizational culture and a commitment to continuous learning and professional development. Addressing these challenges as well as providing their opportunities is crucial for LIS professionals to effectively harness the opportunities presented by ML and to ensure the continued relevance and evolution of library services in the digital age.

Statement of the Problem

The rapid advancement of machine learning technologies presents both opportunities and challenges for library and information science (LIS) professionals. While ML holds the potential to significantly enhance the efficiency of library operations, improve information access, and personalize user experiences, its effective adoption requires LIS professionals to navigate a complex landscape of technological, organizational, and ethical considerations. Many LIS professionals lack the necessary skills and knowledge to implement and manage ML systems, and libraries often face challenges in securing the resources needed for successful integration. Therefore, this study seeks to address the gap in understanding the specific challenges and opportunities that ML presents to LIS professionals, the strategies they can employ to overcome these challenges, and the level of adoption of machine learning technologies among Library and Information Science (LIS) professionals in an ML-driven library environment.

Objectives of the Study

1. Explore the opportunities that machine learning presents for enhancing library services.
2. Examine the level of adoption of machine learning technologies among Library and Information Science (LIS) professionals.
3. Identify the challenges faced by LIS professionals in integrating machine learning into library services.
4. Propose strategies for improving the adoption of machine learning technologies in library services.

Overview of Machine Learning in Library Services

The integration of machine learning (ML) into library services represents a significant evolution in how libraries operate and serve their users. Traditionally, libraries have been centers for information storage and retrieval, but the digital age has presented new challenges and opportunities. ML offers powerful tools to address these challenges by automating processes, enhancing access to information, and personalizing user experiences (Ajakaye, 2021). The evolution of library services, driven by technological advancements, has paved the way for ML to be seen as a crucial component in modernizing library functions. This includes everything from improving search algorithms to predicting user needs, and reflects a move towards more dynamic and user-centric models.

The core of ML's relevance to libraries lies in its ability to analyze large datasets, identify patterns, and make predictions or decisions with minimal human intervention. This capability can be applied across various library functions, including cataloging, information retrieval, and user services. For instance, ML algorithms can automate the classification of library materials, making them more easily searchable and accessible. They can also be used to develop recommendation systems that suggest relevant resources to users based on their past behavior and preferences. Furthermore, ML can enhance digital resource management by automating tasks such as metadata extraction and content analysis (Cordell, 2020). The potential of ML to transform library operations is vast, promising to streamline workflows, improve efficiency, and ultimately provide more effective and personalized services to library users.

Fundamentals of Machine Learning and its Relevance to Libraries

Machine learning (ML) is a branch of artificial intelligence (AI) that enables systems to learn from data without explicit programming, allowing them to identify patterns, make predictions, and improve decision-making (Trappenberg, 2020). At its core, ML involves algorithms that process data to recognize statistical regularities and use these patterns to solve specific problems. There are several types of machine learning, including supervised learning, where algorithms learn from labeled data; unsupervised learning, which involves finding structures in unlabeled data; and reinforcement learning, where an agent learns to make decisions by interacting with an environment. The effectiveness of ML depends on various factors, including the quality and quantity of data, the selection of appropriate algorithms, and the careful tuning of model parameters.

The relevance of machine learning to libraries is rooted in its capacity to address long-standing challenges and enhance traditional services. Libraries are rich in data, including catalog records, circulation statistics, user demographics, and digital resource usage. By applying ML techniques, libraries can extract valuable insights

from this data to improve various functions. For example, ML can enhance information retrieval systems, automate cataloging and metadata creation, personalize user services, and predict future trends in resource demand (Marasinghe, Gunasekera & Senevirathne, 2024). This can lead to more efficient operations, better resource allocation, and ultimately, improved user satisfaction and engagement.

Potential of Machine Learning for Transforming Library Operations

Machine learning (ML) holds immense potential for transforming library operations by automating routine tasks, enhancing information retrieval, and personalizing user experiences. ML algorithms can streamline processes such as cataloging and metadata creation, reducing the workload on library staff and improving efficiency (Asemi & Asemi, 2018). Furthermore, ML can optimize resource allocation by predicting user demand and identifying trends in collection usage, allowing libraries to make data-driven decisions about acquisitions and subscriptions. This transformative potential extends to improving search functionalities, where ML can enable more accurate and context-aware results, facilitating seamless access to information for library patrons.

Moreover, ML can revolutionize user services by enabling personalized recommendations, developing intelligent virtual assistants, and providing proactive support. By analyzing user behavior and preferences, libraries can leverage ML to offer tailored content suggestions, customized learning experiences, and targeted outreach (Gujral, Shivarama & Choukimath, 2019). This personalized approach enhances user engagement, fosters a sense of community, and promotes lifelong learning. Additionally, ML can facilitate the preservation and digitization of library materials, ensuring that valuable resources are accessible to future generations. The ethical and responsible implementation of ML is crucial for libraries to maximize these benefits and uphold their mission of providing equitable access to information and knowledge.

Methodology

The study employs a descriptive survey research design, targeting LIS professionals in academic and research libraries that were purposively selected within tertiary institutions in Abuja, Anambra, and Enugu State. The population of the study comprised of 50 librarians. Data collection was done using the structured questionnaires distributed to the respondents. The instrument was validated by 3 experts (one each) from University of Abuja, Chukwuemeka Odumegbu Ojukwu University Igbariam Anambra state; and University of Nigeria Nsukka Enugu state. The Crombach Alpha a reliability method was used to test the internal consistency of the instrument. A reliability coefficient of 0.82 was gotten. All the 50 questionnaires distributed were returned and used for the data analysis. The data collected were analyzed using descriptive statistics and standard deviation

Results

1. Sex Distribution of Respondents

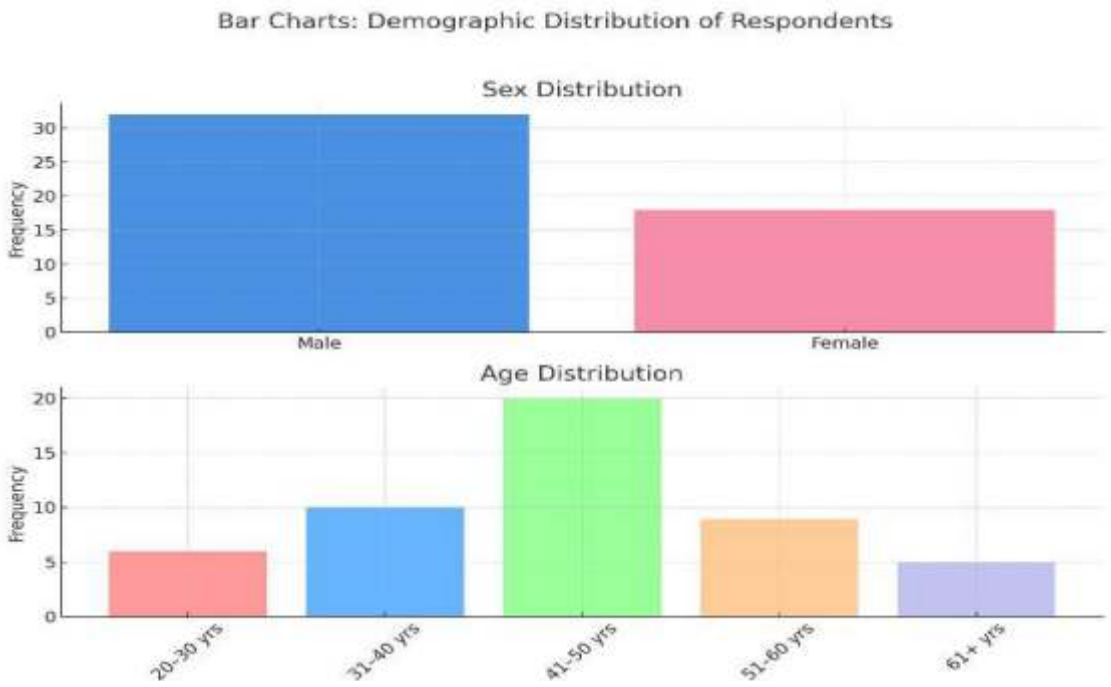
Sex	Frequency (f)	Percentage (%)
Male	32	64.0%
Female	18	36.0%
Total	**50**	**100.0%**

From the data above, it is evident that male librarians (64%) formed the majority of the study population compared to their female counterparts (36%). This may reflect a gender imbalance within the library and information science workforce or sampling frame for this study.

2. Age Distribution of Respondents

Age Group	Frequency (f)	Percentage (%)
20–30 years	6	12.0%
31–40 years	10	20.0%
41–50 years	20	40.0%
51–60 years	9	18.0%
61 years & above	5	10.0%
Total	**50**	**100.0%**

The highest proportion of respondents falls within the 41–50 years age bracket, accounting for 40% of the total sample. This suggests that middle-aged professionals are most represented in the adoption and potential application of machine learning in library services. Conversely, the least represented are those 61 years and above (10%), indicating limited participation or interest from older professionals.



Research Question 1: What are the opportunities that machine learning presents for enhancing library services?

Table 1: Mean Ratings on the Opportunities that Machine Learning Presents for Enhancing Library Services

S/N	Items	Mean	Std.D	Decision
1	Machine learning improves personalized recommendation of library resources	3.31	0.65	Strongly Agree
2	Machine learning enables predictive analytics for better library management	2.91	0.70	Agree
3	Automation of routine tasks through machine learning saves staff time	3.19	0.68	Strongly Agree
4	Machine learning enhances library search engines for better information retrieval	3.12	0.63	Strongly Agree
5	Machine learning aids in user behavior analysis for service improvement	2.84	0.74	Agree
6	Machine learning enables real-time virtual assistance for library users	2.77	0.72	Agree
7	Machine learning helps in optimizing digital resource management	2.88	0.69	Agree
	Grand Mean	3.00		Agree

The results show that librarians generally recognized several opportunities that machine learning offers for enhancing library services. Items where respondents agreed include the ability of machine learning to enable predictive analytics (Mean = 2.91), aid in user behavior analysis for service improvement (Mean = 2.84), enable real-time virtual assistance (Mean = 2.77), and help optimize digital resource management (Mean = 2.88). These reflect the perceived advantages in operational efficiency, user support, and resource optimization. Furthermore, stronger opportunities were strongly agreed upon, such as improving personalized recommendation of resources (Mean = 3.31), automating routine tasks to save staff time (Mean = 3.19), and enhancing search engines for better information retrieval (Mean = 3.12). These higher-rated items highlight the transformational role machine learning could play in creating smarter, user-centered academic libraries. The grand mean of 3.00 implies an overall positive perception, leaning towards strong agreement that machine learning can offer substantial opportunities for enhancing library services

In summary, the findings suggest that academic librarians see machine learning as a critical tool for improving both user experience and operational efficiency. There is a positive perception that machine learning can offer

substantial opportunities for enhancing library services. This result is in line with the study of Gujral, et al (2019) who found that machine learning applications, such as resource recommendation and automation of cataloging, significantly improved service delivery and efficiency. Also, Kalisdha (2024) in a global survey highlighted that machine learning enables predictive analytics and user behavior tracking, enhancing library management decisions and user experience. Similarly, Marasinghe, et al (2024) emphasized that machine learning-based virtual assistance tools and real-time support systems have positively influenced user engagement, validating items in the findings.

Research Question 2: What is the level of adoption of machine learning technologies among Library and Information Science (LIS) professionals?

Table 2: Mean Ratings on the level of adoption of machine learning technologies among Library and Information Science (LIS) professionals

S/N	Items	Mean	SD	Decision
1	LIS professionals are familiar with machine learning applications.	2.21	0.65	Disagree
2	LIS professionals are fully integrating machine learning into daily tasks.	1.30	0.52	Strongly Disagree
3	Majority of LIS professionals can independently develop machine learning models.	1.42	0.58	Strongly Disagree
4	Machine learning tools are being explored experimentally in library services.	2.14	0.67	Disagree
5	LIS professionals are actively leading machine learning research initiatives.	1.41	0.61	Strongly Disagree
6	There is occasional use of machine learning for specific projects.	2.35	0.71	Disagree
7	LIS professionals attend seminars or workshops on machine learning occasionally.	2.19	0.68	Disagree
	Grand Mean	**1.86**		**Disagree**

The table reveals that the items on LIS professionals' familiarity with machine learning applications (Mean = 2.21), experimental exploration of machine learning tools (Mean = 2.14), occasional use of machine learning for specific projects (Mean = 2.35), and attendance at machine learning-related seminars or workshops (Mean = 2.19) all had mean scores within the 2.00–2.49 range, leading to a decision of "Disagree." This suggests that while there is some minimal exposure and interest, a robust adoption is lacking. On the other hand, full integration of machine learning into daily tasks (Mean = 1.30), independent development of machine learning models (Mean = 1.42), and active leadership in machine learning research initiatives (Mean = 1.41) had mean scores between 1.00–1.49, resulting in a "Strongly Disagree" decision, indicating that LIS professionals are far from full implementation or leadership roles in machine learning technologies. Overall, the **grand mean of 1.86** shows a low level of adoption of machine learning technologies among LIS professionals in academic libraries.

In summary, the results show that while LIS professionals demonstrate occasional interactions with machine learning technologies through workshops, experimental projects, and basic familiarity, there is a significant lack of deep integration, independent development skills, and research leadership in this area. The low grand mean reinforces the conclusion that machine learning adoption among LIS professionals remains at a nascent or underdeveloped stage, requiring strategic interventions such as professional training, institutional investment, and capacity-building programs. Several empirical studies support the findings of this table. Russell (2016**)** observed that despite growing awareness, many librarians have not yet incorporated machine learning into their core workflows due to inadequate skills and resources. Similarly, Marasinghe, et al (2024**)** in their study found that while librarians show interest in data-driven technologies like machine learning, practical application remains limited, with most engagement occurring at the exploratory or experimental level. Additionally, Asemi and Asemi (2018**)** emphasized that although there are occasional workshops and training seminars on emerging technologies for LIS professionals, the transition from awareness to leadership in machine learning initiatives is slow, largely due to infrastructural and funding challenges. Together, these studies align closely with the findings of this study, confirming that LIS professionals' adoption of machine learning is at a basic, exploratory phase rather than an advanced or integrated one.

Research Question 3: What are the challenges faced by LIS professionals in integrating machine learning into library services?

Table 3: Mean ratings on challenges faced by LIS professionals in integrating machine learning into library services

S/N	Items	Mean	SD	Decision
1	Limited awareness of machine learning applications in library services.	2.33	0.64	Agree
2	Inadequate funding for technology acquisition and staff training.	2.46	0.59	Agree
3	Lack of technical expertise among LIS professionals.	3.14	0.68	Strongly Agree
4	Absence of structured training or curriculum on machine learning in LIS education.	3.29	0.61	Strongly Agree
5	Infrastructural limitations, such as poor internet and outdated systems.	3.11	0.66	Strongly Agree
6	Resistance to adopting emerging technologies among some professionals.	2.28	0.62	Agree
7	Lack of institutional support for integrating innovative technologies like machine learning.	2.44	0.60	Agree
	Grand Mean	**2.72**		**Agree**

From the analysis, LIS professionals agreed that limited awareness (Mean = 2.33), inadequate funding (Mean = 2.46), resistance to technological change (Mean = 2.28), and lack of institutional support (Mean = 2.44) are key challenges hindering machine learning integration in academic libraries. These mean scores fall within the 2.00–2.49 range, indicating moderate levels of concern. Meanwhile, the most significant challenges—lack of technical expertise (Mean = 3.14), absence of structured ML-related education (Mean = 3.29), and infrastructural limitations (Mean = 3.11)—were strongly agreed upon by the respondents, with mean scores within the 3.00–3.49 range. These suggest more acute barriers that LIS professionals confront in the bid to integrate machine learning into library services. The grand mean of 2.72 further supports the conclusion that LIS professionals face a moderately high degree of challenges in adopting machine learning—challenges that are both infrastructural and professional in nature.

The results that although librarians in academic institutions recognize general limitations such as awareness, institutional support, and funding gaps, the more pressing challenges lie in technical and educational deficiencies. Empirical studies affirm the findings in this table. Agim, Abah and Ezejiofor (2025) reported that although academic librarians acknowledge the relevance of data science and machine learning, skill gaps and lack of training are key obstacles. Similarly, Gujral, et al (2019) found that poor funding, outdated infrastructure, and resistance to technological change significantly hamper the adoption of emerging technologies in Nigerian university libraries. In agreement, Kumar and Sheshadri (2019) emphasized that LIS curricula in most African institutions lack robust content on machine learning, leading to a shortage of technically equipped professionals. These studies underscore the same challenges revealed in this study—ranging from infrastructural issues to education and professional readiness—highlighting the need for systemic reforms and capacity-building initiatives.

Research Question 4: What are the strategies for improving the adoption of machine learning technologies in library services?

Table 4: Mean Ratings on the strategies for improving the adoption of machine learning technologies in library services

S/N	Items	Mean	SD	Decision
1	Organizing regular training and workshops on machine learning applications.	3.22	0.65	Strongly Agree
2	Increasing library budget allocations for emerging technologies.	2.91	0.58	Agree
				Strongly

3	Integrating machine learning courses into LIS educational curriculum.	3.30	0.62	Agree
4	Establishing partnerships with tech companies for library innovation initiatives.	2.88	0.60	Agree
5	Providing infrastructural support like high-speed internet and modern equipment.	3.14	0.67	Strongly Agree
6	Offering incentives to librarians who upskill in emerging technologies.	2.85	0.63	Agree
7	Launching awareness campaigns on the benefits of machine learning in library services.	3.11	0.66	Strongly Agree
	Grand Mean	**3.06**		**Agree**

From the table, it is evident that librarians agreed on several strategies to enhance the adoption of machine learning, notably increasing budget allocations (Mean = 2.91), establishing partnerships with technology companies (Mean = 2.88), and offering incentives to librarians for technological upskilling (Mean = 2.85), all of which had mean scores between 2.50 and 2.99. These areas, while important, suggest moderate acceptance and feasibility. Meanwhile, strategies such as organizing training and workshops (Mean = 3.22), integrating ML into LIS education (Mean = 3.30), providing infrastructural support (Mean = 3.14), and launching awareness campaigns (Mean = 3.11) received strong agreement with mean scores within 3.00–3.49, indicating that these are seen as highly crucial measures for improving ML adoption in library services. The grand mean of **3.06** indicates a high level of agreement on the need for multiple, coordinated strategies involving training, funding, partnerships, incentives, and systemic curricular reforms to successfully integrate machine learning technologies in academic library services.

Overall, the results show a balanced perception among LIS professionals, with more emphasis on active strategies like education, training, infrastructure, and awareness creation as the most critical drivers for machine learning adoption. The findings are consistent with previous studies. Kumar and Sheshadri (2019**)** emphasized that training and skill development are pivotal for equipping librarians with machine learning competencies, pointing to the necessity for workshops and curricular reforms. Agim, et al (2025**)** also highlighted that infrastructural investment and academic-industry partnerships play a crucial role in the successful implementation of emerging technologies like AI and machine learning in libraries. Similarly, Gujral, et al (2019**)** demonstrated that without appropriate incentives, budgetary allocations, and ongoing professional development, the adoption of machine learning technologies in academic libraries remains slow and sporadic. These studies jointly reinforce the need for multifaceted strategies that combine financial, educational, and infrastructural support, just as found in the current study.

Conclusion

The study on the "Adoption of Machine Learning in Library Services: Opportunities and Challenges for Library and Information Science Professionals" reveals a promising yet cautious landscape for machine learning integration. While LIS professionals recognize the vast opportunities that machine learning offers, the low levels of adoption underscore the need for strategic interventions addressing infrastructural deficiencies, skill gaps, and institutional support systems. To harness the full potential of machine learning in academic libraries, coordinated efforts involving capacity building, curricular reforms, funding, and strong partnerships are essential. Therefore, proactive measures must be taken to ensure that the LIS profession evolves alongside technological advancements, securing its relevance and enhancing service delivery in the digital age.

Recommendations

Based on the findings, here are workable recommendations to address the issues identified in the study:

- Libraries should organize continuous professional development workshops to maintain and enhance LIS professionals' positive attitudes towards emerging technologies like machine learning.
- Academic libraries should prioritize funding and resource allocation for the acquisition of machine learning tools and applications to facilitate easy adoption.
- Libraries should collaborate with ICT departments and tech companies to upgrade technological infrastructure, including stable internet connectivity, servers, and cloud computing resources.
- Library administrators should advocate for institutional and governmental grants to support machine learning adoption initiatives, including research and training programs.
- Libraries should build partnerships with technology firms and universities to facilitate knowledge exchange, training, internships, and joint projects focused on machine learning innovations in libraries.

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Adoption of the Artificial Intelligence and Internet of Things Technologies in Libraries

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Abstract

The integration of Artificial Intelligence (AI) and Internet of Things (IoT) has posed a significant challenge for libraries in preserving the core values of knowledge access, community service, and information preservation in the 5th Industrial Revolution (5IR). This research investigated the adoption of 5IR Artificial Intelligence and Internet of Things technologies in libraries. The descriptive study employed a close-ended questionnaire to collect data from the 62 librarians and 34 library officers in 7 polytechnics in Delta State, Nigeria. A total enumeration sampling technique was used for the study. Descriptive statistics of frequency and percentage were used for data analysis. It was found that the extent of adoption of the 5IR such as Artificial Intelligence and Internet of Things in the libraries is low. The challenges encountered in using the Artificial Intelligence and Internet of Things include inadequate funding, privacy and security concerns, and staff training and adaptation. It was recommended that libraries should send their staff to trainings and workshops on the application of Artificial Intelligence and Internet of Things.

Keywords: *Artificial Intelligence, Internet of Things, Libraries, Librarians, 5th Industrial Revolution*

Introduction

Artificial Intelligence (AI) and the Internet of Things (IoT) are key drivers of the 5IR, which emphasizes the synergy between advanced technology and human-centric innovation. These tools enable smarter automation, personalized services, and data-driven decision-making, aligning with the goal of the 5IR of enhancing human productivity and experience through intelligent systems. The 5IR is an era in which sophisticated technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Robotics, and Machine Learning are combined with human-centric values in rendering services in society (Adigun et al., 2024). This revolution brings an extensive transformations in the manner people live and work in the present time. The revolution has vast potential for libraries as it transforms libraries from conventional storehouses of information into active, smart spaces that seamlessly integrate with the digital landscape (Nwobu et al., 2024).

Libraries are among the early adopters of the 5IR technologies (Agbese & Akidi, 2018). Meanwhile, the disruptive nature of technologies in the 21st-century necessitates libraries to adjust themselves to technological realities of the day by acquiring and integrating modern technologies into service provision (Adekoya & Adedimeji, 2023). The latest technologies used in libraries are AI, IoT, Machine Learning, and Robotics. However, libraries are encountering great challenges and opportunities in the modern age of technology. Even though the incorporation of AI and IoT into their operations and services has the possibility of enhancing the ability of libraries to satisfy user demands, optimize resource management, and enhance overall service delivery, there are possibilities of confronting challenges that can hamper the adoption and use of the technologies.

In Nigeria, only University of Lagos library has made significant effort to deploy AI and IoT in performing its operations, unlike libraries in developed countries. Meanwhile, AI and IoT can be tested for their effectiveness by using them in library services (Ibinaiye & Jiyane, 2021). Subaveerapandiyan (2023) affirmed that the use of AI and IoT in providing information give libraries a chance to show their value to society. However, Adekoya and Adedimeji (2023) noted that many librarians in Nigeria show apprehension that technologies could eventually replace academic libraries in the way people search for information. This highlights the struggle of many African libraries to fully tap into the application of AI and IoT (Isiaka et al., 2024). This study therefore looks into the extent of adoption of the 5IR AI and IoT tools in libraries. Its aims encompass finding out the skills needed by library staff for effective use of AI and IoT technologies, and the challenges library staff encounter in using AI and IoT technologies. This study is distinctive as its focus is on libraries within the context of Nigeria, an area that has not been widely explored.

Research Questions (RQs)

The following RQs guide the study.

RQ1: What is the level of adoption of the 5IR AI and IoT technologies in libraries?
RQ2: What are the skills needed for effective use 5IR AI and IoT technologies in libraries?
RQ3: What are the challenges encountered in using 5IR AI and IoT technologies in libraries?

Literature Review

AI and IoT in the 5IR

The 5IR is a new age in which advanced technologies (AI, IoT, robotics, and machine learning) are integrated with human-centric values to deliver services that prioritise societal advancement (Adigun et al., 2024). AI is the process of simulating human intelligence in machines that can learn, think, and make decisions based on data (Adigun et al., 2024). AI means the ability of machines or computer systems to execute activities that naturally need human intelligence. The activities comprise learning from experience, recognising patterns, making decisions, and comprehension of natural language. AI technologies which include machine learning, natural language processing, and robotics are revolutionizing libraries in modern times (Nwobu et al., 2024). The Internet of Things (IoT) on the other hand is the network of physical devices, vehicles, appliances, and other objects embedded with sensors, software, and connectivity which enable collection and exchange of data. IoT devices are heavily deployed in libraries these days as they have the capability of monitoring environmental conditions, tracking inventory, and enhancing user interactions with library resources.

In the framework of the 5IR, AI and the IoT are transforming the mode of delivering library services by integrating advanced technologies with a human-centered approach. AI permits intelligent information retrieval, personalized recommendations, automated cataloguing, and virtual assistance. It also enhances user experience and operational efficiency. Similarly, IoT expedites smart library environments by connecting devices that monitor space utilisation, manage resources, and support real-time tracking of books and equipment. Jointly, AI and IoT enable libraries to not merely simplify and restructure services but likewise to foster inclusive, accessible, and responsive learning spaces aligned with the human-centric values of 5IR.

Adoption of the 5IR AI and IoT Technologies in Nigerian Libraries

AI and IoT are 4th Industrial Revolution technologies which are comprehensively adopted in the 5IR to restructure library activities, enhance access to information, and generate personalized experiences for library users (Bayani et al., 2018). Libraries are adopting AI and IoT to transform their operations, such as automated resource management, personalized user experiences, and enhanced operational efficiency. Through the integration of AI and IoT into library systems, libraries have the possibility of enhancing their role as knowledge centres in the 5IR. AI tools such as Virtual Assistants and Chatbots can significantly enhance user interactions and optimize library operations (Mckie & Narayan, 2019). For instance, AI-powered chatbots can offer instantaneous answers to user inquiries, and assist with catalogue searches. It can also assist users in navigating library services. AI can provide personalized recommendations and search systems (Adigun et al., 2024).

Libraries in advanced countries have started adopting AI to ameliorate their operations and services. Libraries in Nigeria cannot remain docile in the face of these technological realities. However, literature emanating from Nigeria have not identified any academic libraries in Nigeria that have fully integrated AI and IoT in their operations and services despite the benefits that can be derived from the adoption of AI in libraries. Meanwhile, the readiness of libraries and librarians in Nigerian universities to adopt the technologies is pivotal. Odeyemi (2019) investigated infrastructural readiness for library services using robots and related strands such as AI and IoT in Nigerian academic libraries. The study adopted the post-positivist paradigm and a survey research design, using observation and semi-structured interviews for a focused group at the Federal University Oye-Ekiti; Ekiti State University, Ado-Ekiti; and Afe Babalola University, Ado-Ekiti. The study found a low level of adoption of AI in the libraries. In a related study, Ajani et al. (2022) surveyed the viewpoints of librarians concerning incorporation of AI for library operations and services in Nigeria. Six libraries were drawn from the six geopolitical zones in Nigeria. The study found that the level of readiness of the librarians to adopt AI systems is low.

Eiriemiokhale and James (2022) investigated the adoption of Internet of Things for effective service delivery in some university libraries in Kwara State, Nigeria. It was found that IoT technologies such as wireless sensor network, quick response code, and RFID were adopted in the libraries. In the contrary, a study by Rotimi et al. (2022) indicated that Nigerian libraries have not fully leveraged the opportunities presented by emerging innovations such as AI and IoT. Owolabi et al. (2022) averred that library services in Nigerian universities show a noticeably low level of preparedness to adopt AI and IoT in their operations. Meanwhile, with the use of AI and IoT, libraries are able to improve their service delivery and inventory management, resource tracking, and the user experience (Oyetola et al., 2023). IoT similarly provides prospects for libraries to be more energy-efficient and ecologically pleasant.

Despite their transformative potential, it is unfortunate that AI and IoT have yet to be fully integrated into service delivery and operations in Nigerian academic libraries, as a study by Aminu (2024) revealed that AI technologies have not been fully adopted by university libraries in Northwest, Nigeria. A study by Moustapha and Yusuf (2023) also found that AI has received minimal attention in university libraries in Kwara State, Nigeria. Meanwhile, the adoption of AI enables libraries to keep pace with the technological demands of the 5IR (Yusuf et al., 2022). Also, the use of IoT into libraries facilitates real-time data collection.

Skills for Using 5IR AI and IoT Technologies in Libraries

Using AI and IoT in libraries required possessing certain skills. Ibinaiye and Jiyane (2021) posited that successful adoption and use of AI and IoT in libraries require library staff to develop new skills. Among the skills are technological skills, and digital literacy skills. Digital literacy is essential for effective use of AI and

IoT in libraries. Library staff have to be sufficiently literate in the use of digital technologies in libraries. Also, libraries have a responsibility to make sure that users are digitally literate, user should have adequate skills to interact with AI-driven systems and IoT-enabled library services.

According to Subaveerapandiyan (2023), the skills for using AI and IoT technologies in libraries include ability to use AI algorithms and IoT devices, skill to analyse and interpret data from AI and IoT systems, and ability to integrate AI and IoT with current library systems. Abayomi et al. (2020) posited that making effective use of AI and IoT in libraries necessitates a blend of technical, analytical, and communication skills. Library staff should be able to have knowledge of data management and analysis by leveraging AI algorithms to organize and retrieve information proficiently. Knowledge of IoT devices is essential for the implementation of smart library systems, which include automated checkouts, environmental monitoring, and asset tracking.

Also, technical skills in software integration, cloud computing, and network security are needed for maintaining the advanced systems. Ayinde and Kirkwood (2020) acknowledged the essentiality of communication skills in ensuring that AI and IoT technologies are in tandem with the needs of library users, encouraging an inclusive and intuitive experience. Lastly, critical thinking is required to evaluate the ethical effects of data usage and to guarantee that privacy and accessibility standards are maintained. It is expected that users should be able to make adequate use of the information resources in libraries for learning, research and to increase their frontier of knowledge. The onus is on libraries to organise public outreach, educational programmes, and workshops through which users can familiarize with the evolving digital technologies and environment. Equally, according to Adetayo (2023), librarians have to ensure regular upgrading of their skills to be able to use the 5IR. Through training programmes, library staff can be equipped with the required skills for the 5IR. Such skills can also be acquired through collaboration with other universities, tech companies, and professional organisations.

Challenges of Using 5IR AI and IoT Technologies in Libraries

To remain relevant in the 5IR, libraries have to use AI and IoT tools. However, even though AI and IoT have the potential to improve library services, make information more easily available and accessible, and facilitate collaboration and knowledge sharing (Ogwo et al., 2023; Olayode, 2023; Omame & Alex-Nmecha, 2020), diverse studies in Nigeria have emphasized the challenges to the adoption of AI and IoT in university libraries. Igbo et al. (2024) noted that the adoption of AI in academic libraries in Nigeria is doubtful, mainly due to institutional shortcomings such as infrastructural deficiencies and paucity of funds. Tella (2020) similarly stressed institutional barriers such as lack of infrastructure, policies, and innovative leadership as major impediments to AI implementation in university libraries in Africa. Similarly, Odeyemi (2019) acknowledged issues such as financial constraints, incomplete automation, skill gaps, job insecurity, poor infrastructure, and unreliable power supply as limiting factors.

Ajani et al. (2022) emphasised challenges related to funding, expertise, and capacity building. In a study by Eiriemiokhale and James (2022), it was found that the major challenges to the adoption of IOT technologies in libraries in Nigeria include high cost of the technologies and the lack of required infrastructure. Also, Adetayo (2023) affirmed that one of the major challenges libraries in Nigeria are encountering in the adoption of AI and IoT is the substantial initial investment in technological infrastructure. Mobilizing such funds may pose difficulty to some libraries. Likewise, the challenge of integrating traditional systems with AI and IoT is commonplace in the 5IR as some libraries still depend on conventional systems (Mckie & Narayan, 2019). As such, integrating AI and IoT with these systems can be complex and expensive.

Libraries are particularly concerned about ethical and privacy concerns while trying to use AI and IoT (Ajani et al., 2022). For example, the application of AI and IoT raises apprehensions concerning the gathering and protection of user data. In this wise, it is expected that libraries implement strong privacy guidelines and equipment to safeguard user information. Similarly, there is a general acknowledgement of AI and IoT as 5IR disruptive innovations whose adoption and use usually face resistance from library staff. Ayinde and Kirkwood (2020) posited that library staff are usually resistant to changes. Library staff may repel the adoption and use of AI and IoT due to the fear of job displacement or enhanced workloads (Ibinaiye & Jiyane, 2021). As such the studies collectively recommend increased investment in infrastructure and the recruitment of skilled personnel to support AI integration in libraries.

Methodology

The study adopted a descriptive research design. The study had a population of 96 comprising 62 librarians and 34 library officers in the 7 polytechnics in Delta State, Nigeria. The whole population was used as sample size because of the small size of the population. Data were collected using an open-ended questionnaire. The respondents were guaranteed confidentiality and anonymity of the questionnaire filled. The items of the questionnaire were built using diverse literature that emphasise the 5IR AI and IoT technologies. The questionnaire was validated by a senior librarian and a lecturer of evaluation and measurement at Delta State University, Abraka. Ten copies of the questionnaire were administered to librarians at the Federal University Oye-Ekiti to determine its level of reliability. The Cronbach alpha method was used to analyse the paired scores obtained from the test. The index of correlation found Cronbach alpha reliability coefficient of $r = 0.71$, which meant a high reliability of the questionnaire. The researcher and two

research assistants administered the questionnaire. The questionnaire had four parts. Part 1 was on demographic information such status of the respondents; whether a librarian or library officer. Part 2 gathered data on the level of adoption of 5IR AI and IoT tools in libraries. Part 3 elicited information on the skills needed for effective use the 5IR AI and IoT technologies in libraries. Part 4 was on the challenges encountered in using the 5IR AI and IoT technologies in libraries. A 5-point Likert scale of very High Extent, High Extent, Moderate extent, Low Extent, and Very Low Extent was used for Part 2, and mean and standard deviation was used for the analysis. Yes and no was used for parts 3 and 4, and frequency counts and percentage were used for the analysis. Out of the 96 copies of the questionnaire administered, 63(65.6%) were returned and used for the study.

Results

Status of the Respondents

Table 1: Status of the Respondents

Status	No.	%
Librarians	39	61.9
Library officers	24	38.1
Total	**63**	**100**

Table 1 reveals the status of the respondents. Majority of the respondents are librarians 39(61.9%), while 24(38.1%) are library officers. This implies that there are more librarians than library officers in the universities covered in the study.

RQ1: What is the level of adoption of the 5IR AI and IoT technologies in libraries?

Table 2: Adoption of the 5IR AI and IoT Technologies in Libraries

AI and IoT Technologies	VHL	HL	ML	LL	VLL	Mean ($\bar{x}$)	Std Dev.
Autonomous library systems (robotic book check-in/check-out)	0	8	9	23	23	2.03	1.015
IoT-enabled smart shelves	1	7	11	17	27	2.02	1.100
Automated data analysis and reporting	0	5	13	17	28	1.92	.989
Predictive analytics for resource demand	0	5	13	16	29	1.90	.995
IoT-based visitor counting systems	1	17	11	10	34	1.90	1.146
Smart lighting and energy management	0	4	12	20	27	1.89	.935
Real-time location tracking of library assets	0	6	9	17	31	1.84	1.003
RFID technology for asset tracking and management	0	0	15	22	26	1.83	.794
Natural Language Processing for cataloging and search	0	4	11	16	32	1.79	.953
Intelligent recommendation systems for books	1	6	7	14	35	1.79	1.080
AI-powered Chatbots for customer service	1	7	7	8	40	1.75	1.135
Voice-activated assistants for library services	0	5	8	14	36	1.71	.974
Environmental monitoring (temperature, humidity)	0	2	10	12	39	1.60	.871
Average Mean						1.84	

Note: VHL = Very High level, HL = High level, ML = Moderate Level, LL = Low level, VLL = Very Low level

Table 2 shows that the average mean (x) is 1.84. This indicates that the level of adoption of the 5IR AI and IoT tools in libraries is low. Autonomous library systems (robotic book check-in/check-out) has the highest value (=2.03, SD=1.015). This is followed by IoT-enabled smart shelves (=2.02, SD=1.100), and automated data analysis and reporting (=1.92, SD=0.989). The least are Voice-activated assistants for library services (=171, SD=0.974), and Environmental monitoring (temperature, humidity) (=1.60, SD=0.871)

RQ2: What are the skills needed for effective use of the 5IR AI and IoT technologies in libraries?

Table 3: Skills Needed for Effective Use of the 5IR AI and IoT Technologies in Libraries

Skills	Yes		No.	
	Freq.	%	Freq.	%
Digital literacy skills	59	93.7	4	6.3
Critical thinking skills	53	84.1	10	15.9
Skill to integrate AI and IoT with current library systems	49	77.8	14	22.2
Technical skills	49	77.8	14	22.2
Analytical skill	46	73	17	27
Communication skills	46	73	17	27
Data management skills	41	65.1	22	34.9
Data analysis and interpretation skills	31	49.2	32	50.8

As revealed in Table 3, the skills needed for effective use of the 5IR AI and IoT technologies in libraries are digital literacy skills (69, 93.7%), critical thinking skills (53, 84.1%), skill to integrate AI and IoT with current library systems (49, 77,8%), and technical skills (49, 77,8%). However, the respondents disagree that data analysis and interpretation skills (31, 49.2%) are needed. Other skills identified by the respondents include conceptual skills and information literacy skills

RQ3: What are the challenges encountered in using the 5IR AI and IoT technologies in libraries?

Table 4: Challenges Encountered in Using the 5IR AI and IoT Technologies in libraries

Challenges	Yes		No.	
	Freq.	%	Freq.	%
Inadequate funding	63	100	0	0
Ineffective staff training and adaptation	58	92.1	5	7.9
Inadequate technical expertise	54	85.7	9	14.3
High system maintenance costs	54	85.7	9	14.3
Privacy and security concerns	52	82.5	11	17.5
Old librarians becoming redundant	41	65.1	22	34.9
Lack of interest in new technologies	31	49.2	32	50.8
Panic of using technological applications	27	42.9	36	57.1
Information overload on particular issues	27	42.9	36	57.1

Table 4 reveals the challenges encountered in using the 5IR AI and IoT technologies in libraries. These include inadequate funding (63, 100%), ineffective staff training and adaptation (58, 92.1%), inadequate technical expertise (54, 85.7%), and high system maintenance costs (54, 85.7%). However, the respondents did not consider lack of interest in new technologies (31, 49.2%), panic of using technological applications (27, 62.9%), and information overload on particular issues (27, 62.9%) as challenges encountered in using the 5IR AI and IoT technologies in libraries. The respondents also identified other challenges which include irregular power supply in libraries, and inadequate infrastructure.

Discussion

This study found that the level of adoption of the 5IR AI and IoT technologies in libraries is low. This may be because the technologies are new to the library personnel. More so, there is usually resistance to the adoption and use of new disruptive technologies among library staff in Nigeria. A similar study by Adekoya and Adedimeji found that libraries within the context of Nigeria (aside academic libraries) have not adequately integrated the technological innovations in carrying out their basic routine operations, compared to the libraries in the developed countries. The investigation of infrastructural readiness for library services using robots and related strands such as AI and IoT in Nigerian academic libraries by Odeyemi (2019) found a low level of adoption of AI in the libraries. A study by Rotimi et al. (2022also found that Nigerian libraries have not fully leveraged the opportunities presented by emerging innovations such as AI and IoT. The low level of adoption AI and IoT in libraries may be because of the apprehension that the technologies will gradually replace library staff, thereby making them redundant.

The study reveals that the skills needed for effective use of the 5IR AI and IoT technologies in libraries are digital literacy skills, critical thinking skills, skill to integrate AI and IoT with current library systems, and technical skill. This is in agreement with the position of Nwobu et al. (2024) that librarians can make effective

use of the 5IR AI and IoT technologies if they possess relevant skills such as digital literacy skills, and technical skill. Also, Naeem and Bhatti (2020) asserted that librarians who have requisite technological skills only need to enhance such skills so that they can make effective use of AI and IoT technologies in libraries. As such, the librarians should enhance their ability to use AI algorithms and IoT devices, develop skill to analyse and interpret data from AI and IoT systems, and also enhance their ability to integrate AI and IoT with current library systems. Meanwhile, Johnson et al. (2024) have advised librarians to ensure regular upgrading of their skills to be able to use the 5IR technologies, through training programmes, and workshop attendance.

It was found in this study that the challenges encountered in using the 5IR AI and IoT technologies in libraries include inadequate funding, ineffective staff training and adaptation, inadequate technical expertise, and high system maintenance costs. A prior study by Adekoya (2019) has identified as funding as the major problem libraries are confronting in the current era. Also, Igbo et al. (2024) and Tella (2020) expressed uncertainty about the adoption of AI in libraries in Nigeria is doubtful because of infrastructural deficiencies and paucity of funds that the universities are experiencing. A study by Odeyemi (2019) has also emphasized that financial constraints and skill gaps could inhibit the adoption of AI and IoT technologies in Nigerian libraries. The finding that ineffective staff training and adaptation hamstrings the use of AI and IoT technologies in libraries is in agreement with the position of Nwobu et al. (2024) that most of the training on technologies in libraries do not incorporate the realities about the use of AI and IoT technologies in libraries. This may be because there are no enough adequately trained personnel who can competently teach the use of AI and IoT technologies in libraries.

Conclusion

The trend in library practice in the 5IR requires libraries and library staff to adopt and use AI and IoT technologies in libraries. The low level of adoption of the 5IR AI and IoT technologies in libraries portends danger to the development of libraries in the modern era of technology. More so that most of the operations in libraries are technology-driven, library staff have to equip themselves by acquiring the necessary skills for effective use of the 5IR AI and IoT technologies in libraries. The management of the libraries should endeavor to address the various challenges encountered in using the 5IR AI and IoT technologies in libraries.

Recommendations

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

1. Libraries should send their staff to conferences, trainings and workshops on the application of AI and IoT in libraries.
2. Librarians and other library staff should embrace the revolutions brought by the use of the 5IR AI and IoT technologies as a way to ameliorate library operations.
3. The management of libraries should make available the necessary funds to acquire the 5IR AI and IoT technologies so that the libraries can match up with the libraries in the advanced countries such as the United Kingdom, Canada, and United States.

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Adoption of the Fifth Industrial Revolution Technologies for University Library Services in North Central Nigeria: A Panacea to the Effects of Covid-19 and Related Pandemics

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Abstract

Service institutions like libraries face tremendous challenges due to evolution and the resultant revolution in technology, as well as the changing service space brought about by the COVID-19 pandemic. This study investigated the adoption of the fifth industrial revolution technologies in university libraries as a panacea to the effects of COVID-19 and related pandemics in North Central Nigeria (NCN). The study adopted the descriptive survey research design guided by four specific objectives, four corresponding research questions and a null hypothesis. The population was 118, which was drawn using the complete enumeration sampling technique. A self-developed and face-validated questionnaire comprising 51 items was used to collect data for the study. Data were analysed using the percentage, mean and standard deviation, while the hypothesis was tested using the chi-square. Findings revealed that university libraries in NCN had relied on technologies, including the computer, internet, web-based technologies, digital technologies, social media technologies, OPAC, and integrated library system for services before the COVID-19 pandemic. Perceived inadequacies of these technologies identified were: limited internet bandwidth, inability to support long-term digital preservation, limited access to digital and internet resources, lack of robust analytics and reporting capabilities, etc. The fifth industrial revolution technologies proposed for enhanced library services included: virtual robots, block chain, natural language processing, intelligent virtual assistant, shelf-reading robots, face recognition, Radio Frequency Identification, book delivery drones, etc. Recommendations were drawn to include improved funding for the purchase of the latest technologies, ICT up-skilling among librarians, interdisciplinary collaboration, and drawing up a policy to get rid of all outdated technologies and services that are incompatible with modern-day information service requirements.

Keywords: COVID-19 Pandemic, Fifth Industrial Revolution, Library Services, Panacea, Technologies, University Library

Introduction

Universities and libraries are knowledge institutions of society, and like Siamese twins, are intricately connected. A university library is a library or library system established, funded and administered by a university to meet the information, research, and curriculum needs of its students and faculty members (Reitz, 2004). The responsibility of the library is solely for supporting the university's primary objectives of teaching, learning, and research by providing resources and services to meet these needs. Consequently, Aina (2004) argued that a university library is concerned with acquiring, processing, storing and disseminating recorded information for reading, studying, and consultation. Given these and many other functions of university libraries, they are regarded as the "heart" or "live wire" of their parent institutions.

Over time, university libraries have provided myriad services to satisfy their teeming and complex patrons with the help of technologies. These include photocopier, computer technology, internet technology, digitalisation, integrated library system, Online Public Access Catalogue (OPAC), etc. However, most of these technologies are inefficient in times of pandemics like COVID-19. Hence, attention has shifted to the fifth industrial revolution technologies as the means to provide cutting-edge library services and enhance user experience through contactless and personalised services. These technologies include: artificial intelligence, Internet of Things, blockchain, robotics, among others (Alojaiman, 2023). In all, the application of these technologies does not require human intervention and almost completely obliterates the need for human contact. The implication is that library services can be effectively provided and accessed during periods of pandemics like COVID-19.

Pandemics are large-scale outbreaks of infectious diseases which can greatly increase morbidity and mortality over a wide geographic area and cause significant economic, social and political disruptions. The Coronavirus Disease of 2019, otherwise known as COVID-19, which started in Wuhan, Hubei Province, China, in December 2019, is the latest of such a pandemic. The World Health Organisation (WHO) declared it a public health emergency of international concern on 30th January 2020 (WHO, 2023). The future imposed by the coronavirus remains hazy. Scientists warned that it would remain with us for the foreseeable future. True to the prediction, pockets of infections are still being reported around the world, including Nigeria, where the latest case was reported on 1st March 2024 and the last death, on 5th January 2024. Since the first index case was reported in Nigeria on 27th February 2020, up to 1st March 2024, a total of 267,188 cases have been confirmed, out of which 3, 155 deaths were recorded across the 36 states of the federation and the capital, Abuja (Nigeria Centre for Disease Control, 2024).

Given the lethal and infectious nature of COVID-19 and related pandemics, the need to adopt the fifth industrial revolution technologies to ensure seamless services to researchers who are working to stem the pandemic is compelling. University libraries are expected to position themselves to function uninterruptedly to provide needed information that would enhance the research process and do so without compromising the health of both their staff and users. This is against the backdrop that institutions of higher learning, as research centres, owe society the responsibility to contribute to combating any pandemic. They have to conduct and share essential research information about the nature of the pandemic, report data about its spread and impact, and coordinate with government agencies to shape policies that would save lives and hasten economic recovery (Daniels, 2021).

The impact of COVID-19 on most countries, including Nigeria, was far-reaching: closure of businesses, offices, and schools, including tertiary institutions of learning, restriction of inter-state travel, etcetera. The pandemic affected virtually every area of life, including library services. According to Adayi et al., (2020), library services are essential services for community recovery and should be recognised as such by governments. The authors maintain that information in the contemporary era can be rated next to oxygen, as there can be no meaningful progress in society without it. Consequently, libraries, particularly research and university libraries, must evolve ways to cope with social disasters like COVID-19 and probable future pandemics. One of the critical ways is by the adoption of the fifth industrial revolution technologies for uninterrupted services. This research, therefore, seeks to investigate the adoption of the fifth industrial revolution technologies by academic libraries in North Central Nigeria (NCN) as a panacea to the effects of COVID-19 and related future pandemics.

Statement of the Problem

Seamless university library services are crucial for all times and seasons as a cornerstone of research and development, as well as teaching and learning. It is even more critical in periods of social dislocation induced by pandemics. This is especially true because university libraries, by their sophistication, should assist in contributing information services to facilitate research to curb pandemics and for enhanced community recovery. However, it has been observed and sadly, that most libraries in Nigeria, including those in universities, are bereft of the required technologies to power innovative services for research during times of pandemics. The consequences of such a lacuna are grievous. This may be the reason why libraries are shut down along with other institutions considered not of essential service during pandemics. As attested to in the literature, the fifth industrial revolution technologies, which emphasise a harmonious human-machine relationship, seem to possess the cutting edge to provide viable information services during periods of pandemics. These technologies, if adopted in university libraries, may be strategic in breaking the information service barrier brought about in times of COVID-19, and also critical as a proactive measure against pandemics of a similar nature (Oduwole et al., 2023). Adoption of these technologies could make university libraries both indispensable and safe during periods of pandemics like COVID-19. The rationale for this study, therefore, is to investigate the adoption of the fifth industrial revolution technologies in university libraries as a panacea to the effects of COVID-19 and related pandemics.

Objectives of the Study

The general objective of this study is to investigate the adoption of the fifth industrial revolution technologies in university libraries as a panacea to the effects of COVID-19 and related pandemics in NCN. In this regard, the study was specifically designed to:

1. Identify the technologies adopted for university library services in NCN before the COVID-19 pandemic.
2. Determine the perceived inadequacies of the technologies adopted for university library services in NCN before the COVID-19 pandemic.
3. Ascertain the technologies adopted for university library services in NCN as a panacea to the effects of COVID-19 and related pandemics.
4. Propose the fifth industrial revolution technologies for possible adoption in university library services in NCN as a panacea to the effects of COVID-19 and related pandemics.

Research Questions

The following research questions guided the study:

1. What are the technologies adopted for university library services in NCN before the COVID-19 pandemic?
2. What are the perceived inadequacies of the technologies adopted for university library services in NCN before the COVID-19 pandemic?
3. What are the technologies adopted for university library services in NCN as a panacea to the effects of COVID-19 and related pandemics?
4. What are the fifth industrial revolution technologies that can be proposed for possible adoption in university library services in NCN as a panacea to the effects of COVID-19 and related pandemics?

Hypothesis

A null hypothesis was tested at a 0.05 level of significance. It is stated as:

Ho_1: There is no significant difference in the technologies adopted in university libraries in NCN before and after the COVID-19 pandemic.

Literature Review

University libraries are dynamic social institutions and indispensable resource centres for reliable information. They are established, administered, and funded by the university to meet the information, research and curriculum needs of students, faculty and staff (Reitz, 2006). University libraries also support research activities by facilitating scholarly communication and promoting research output, managing institutional repositories, developing research collections, and training in database searching. At the centre of all these service provisions is technology.

According to Lane (2006), technology concerns itself with an understanding of how knowledge is creatively applied to organized tasks involving people and machines that meet sustainable goals. In this wise, Asom and Suleiman (2017) opined that computers, increased reliance on computer networks, the rapid growth of the internet and the explosion in the quality and quantity of information have compelled academic libraries to adopt innovative technologies for storage, retrieval and dissemination of information. In addition, as pointed out in Vijayakumar and Vijayan (2011) and Olubiyo (2022), technologies employed in libraries include library networking, audio-video technology, desk-top publishing, CD-ROM, scanners, electronic database, telephone, e-mail, video recorders, digital projectors and storage devices.

Several inadequacies have been found to accompany the technologies that have been deployed in university libraries, particularly in NCN. These include; inability to support long-term digital preservation, limited access to the internet and digital resources, exposure of users' data and library systems to risks due to lack of robust security features, lack of robust analytics and reporting capabilities. In addition, the technologies cannot operate remotely with users and they do not support contactless/personalised services (Ullah et al., 2023; Olumide, 2022). The inherent inadequacies of these technologies have necessitated the adoption of those of the fifth industrial revolution to adequately address the information demands of this century.

The fifth industrial revolution (5IR) encompasses the notion of harmonious human-machine collaborations, with a specific focus on the well-being of the multiple stakeholders (in this context, society, library, librarians and users). The 5IR emphasises synergistic collaboration rather than competition and possible replacement. In other words, humans should collaborate closely with technology to exploit the strengths of each and compensate for their corresponding weaknesses (Nobel et al., 2022). In the 5IR, emerging technologies such as Artificial Intelligence (AI), machine learning, blockchain, and augmented reality are reshaping the landscape of Library services (Nwobu et al., 2024). The authors further argue that librarians can leverage AI to develop personalised recommendation systems for patrons or use blockchain technologies to ensure the authenticity of digital assets. The era heralds a profound societal and technological transition underpinned by extensive automation, global interconnectedness, and data-driven decision-making that permeate every aspect of our lives (Collaghan, 2023).

AI-driven recommendation systems and virtual assistance provide real-time support for information retrieval and enhancing user engagement. The systems utilise natural language processing algorithms to understand user queries and assist them in finding library resources and access services. Almost every area of library service has been influenced by the application of AI and robotic technologies. Accordingly, Das and Islam (2021) further identify AI technologies in library services, such as recommender systems, expert systems, agent technology, intelligent shelves, Natural Language Processing (NLP), Radio Frequency Identification (RFID), Pointer, Answer-man Online Reference Assistance (ORA), etcetera. The stance of Xiao and Gao (2020) is that these recommendation algorithms help to improve library services and provide personalised services to users. Some university libraries in Africa, including Nigeria have employed the use of humanoid robots for a variety of tasks, including welcoming guests and giving them directions, providing reference services, taking body temperatures of users and guests, and triggering an alarm in the event of an unusually high temperature (this was during the COVID-19 pandemic). Others include shelf-reading robots, automated book delivery systems, etc. (Tella, 2020; Cox, 2022). However, application of AI technologies in academic libraries in many developing countries, including Nigeria, appears to be in their infancy.

The literature reviewed in this study indicates that library services are continuously changing in response to societal demands. Many core library services, such as reference assistance, research support, and teaching, for example, are being provided in new and often more accessible and inclusive ways than ever before, with the help of innovative technologies like the fifth industrial revolution technologies. While many of these technologies and the resultant services were identified in the literature, the researcher did not encounter any earlier study that investigated the adoption of the fifth industrial revolution in academic libraries in NCN, nor were they concerned with mitigating the effects of COVID-19 and related pandemics.

Methodology

The descriptive survey research design was adopted for the study due to its inherent quality to allow for the collection of valid and reliable responses to investigate phenomena of this nature. The NCN, made up of six states including the Federal Capital Territory (FCT), Abuja, is the area for this study. Seven federal universities with a population of 118 librarians were chosen for the study because it is expected that, given their sources of funding and complexity, they would have in stock technologies that would facilitate the adoption of the fifth

industrial revolution for library services. The complete enumeration sampling technique was applied to draw the entire population for the study. A self-developed and structured questionnaire titled "Fifth Industrial Revolution Technologies in University Libraries Questionnaire (FIRTALQ), made up of 51 items and four clusters, was used for the study. The instrument was face-validated by three experts: two in the field of Library and Information Science and one in the field of Measurement and Evaluation. The Internal consistency of the instruments was ensured using Cronbach's Alpha. The overall reliability index was .899 and thus judged reliable. Data collected from respondents through Google Forms were coded and analysed using the percentage, mean and standard deviation. Percentage scores of 50 per cent and above are considered positive and accepted, while scores below 50 per cent are considered negative and rejected. The criterion mean for this study shall be 2.50. Hence mean score equal to or above the criterion mean indicates the agreed region, whereas a mean response below the criterion score denotes the disagreed region. A null hypothesis was tested at a 0.05 level of significance using the Chi-Square.

Results

In line with the research questions and the null hypothesis that guided the study, the summary of the analysis of data collected is presented in the tables below:

Research Question 1: What are the technologies and services provided in university libraries in NCN before the COVID-19 pandemic?

Table 1: Percentage scores of technologies and services provided in university libraries in NCN before the COVID-19 pandemic (n = 100)

S/N	Items	Provided	Not Provided
1	Circulation Service	60%	40%
2	Reference Service	75%	25%
3	Virtual Reference Service	25%	75%
4	User Instruction	40%	60%
5	Selective Dissemination of Information	55%	45%
6	Computer	60%	40%
7	Online Database	50%	50%
8	Institutional Repository	20%	80%
9	Integrated Library System	25%	75%
10	Subject Gateway	10%	90%
11	Open Source Repository	55%	45%
12	Digital Resources	25%	75%
13	Electronic Mail Service	25%	75%
14	Social Media Technologies	25%	75%

From table 1 above, six items, namely, circulation, reference service, selective dissemination of information, computer, online database and open source repository, have scores of 50 per cent or above. Those technologies and services are considered to be provided in university libraries in NCN before the COVID-19 pandemic.

Research Question 2: What are the perceived inadequacies of technologies and services provided in university libraries in NCN before the COVID-19 pandemic?

Table 2: Mean ratings and standard deviations on perceived inadequacies of technologies and services provided in university libraries in NCN before the COVID-19 pandemic. (n = 100)

S/N	Item Statement	Mean	St.D	Decision
1	The technologies did not support modern metadata standards	2.32	1.016	Agreed
2	The technologies provided limited access to electronic and online resources.	2.18	.970	Disagreed
3	The technologies did not support fast and reliable internet access	2.77	.965	Agreed
4	The technologies did not support the optimisation of mobile devices	2.25	1.060	Disagreed
5	The technologies expose users' data and library systems to risks due to a lack of robust security features	2.74	1.057	Agreed

6	The technologies could not support long-term digital preservation	3.13	.899	Agreed
7	The technologies lacked robust analytics and reporting capabilities	3.04	.993	Agreed
8	The technologies could not operate remotely with users.	3.07	.949	Agreed
9	The technologies did not support contactless/personalised services	3.17	.929	Agreed
	Aggregate Scores	**2.74**	**.770**	**Agreed**

The table above shows that respondents agree on all the items listed, except items 1, 2 and 4. The aggregate mean score of 2.74 is higher than the mean score benchmark of 2.50, therefore, the items listed are the considered inadequacies of technologies and services provided in university libraries in NCN before the COVID-19 pandemic.

Research Question 3: What are the innovative technologies and services adopted in university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics?

Table 3: Percentage scores of innovative technologies and services adopted in university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics. (n = 100)

S/N	Items	Adopted	Not Adopted
1	Online Database	27%	73%
2	Subject Gateway	28%	72%
3	Web OPAC	38%	62%
4	Digital Resources	55%	45%
5	Social Media Technologies and Services	36%	64%
6	Block Chain	11%	89%
7	Natural Language Processing	11%	89%
8	Intelligent Virtual Assistant	38%	62%
9	Face Recognition	21%	79%
10	Shelf-Reading Robots	10%	90%
11	Book Delivery Drones	5%	95%
12	Radio Frequency Identification	38%	62%
13	Information Alert Service	16%	84%
14	Quick Response (QR) Code Access	5%	95%

None of the items listed in Table 3 above has a percentage score up to 50, except digital resources, which scored 55%. This shows that it is the only innovative service adopted in university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics.

Research Question 4: What are the innovative technologies and services for possible adoption by university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics?

Table 4: Mean ratings and standard deviations on innovative technologies and services for possible adoption by university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics. (n = 100)

S/N	Item Statements	Mean	St.D	Decision
1	Adoption of Online Database	3.50	.500	Agreed
2	Adoption of Subject Gateway	3.05	.497	Agreed
3	Adoption of Web OPAC	3.20	.601	Agreed
4	Adoption of Digital Resources	3.40	.490	Agreed
5	Adoption of Social Media Technologies and Services	3.45	.592	Agreed
6	Adoption of Blockchain	2.80	.815	Agreed
7	Adoption of Natural Language Processing	2.95	.669	Agreed
8	Adoption of Intelligent Virtual Assistant	2.70	.843	Agreed
9	Adoption of Face Recognition	2.65	1.015	Agreed
10	Adoption of Shelf-Reading Robots	2.50	.866	Agreed
11	Adoption of Book Delivery Drones	2.64	.673	Agreed

12	Adoption of Radio Frequency Identification	2.70	.843	Agreed
13	Adoption of Information Alert Service	3.15	.654	Agreed
14	Adoption of Quick Response (QR) Code Access	3.05	.590	Agreed
	Aggregate Scores	**2.98**	**.624**	**Agreed**

The table above shows that respondents agree on all the items listed as innovative technologies and services for possible adoption by university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics. The aggregate mean score of 2.98 is higher than the mean score benchmark of 2.50.

Null Hypothesis: There is no significant difference in the technologies and services adopted in academic libraries in NCN before and after the COVID-19 pandemic. Data testing this hypothesis is contained in Table 5 below:

Table 5: Summary of Chi-square analysis of differences in the technologies and services adopted in academic libraries in NCN before and after the COVID-19 pandemic. (n = 100)

Variable	Adopted O(E)	Not Adopted O(E)	Chi-Square value	Df	P-value	Remark
Adopted before COVID-19	41(16.4)	26(50.6)	81.759[a]	1	0.000	Significant
Adopted after COVID-19	41(41)	101(76.4)				

P>0.05

The table above shows the calculated Chi-square values and the corresponding p-values of technologies and services adopted in academic libraries in NCN before and after the COVID-19 pandemic. The p-values are less than 0.05. This implies that there is a significant difference in the technologies and services adopted in academic libraries in NCN before and after the COVID-19 pandemic. The null hypothesis that there is no significant difference in the technologies and services adopted in academic libraries in NCN before and after the COVID-19 pandemic is therefore rejected.

Discussion

Findings in the study indicate that circulation service, reference service, selective dissemination of information, computer, online database and open source repository are the technologies and services provided in university libraries in NCN before the COVID-19 pandemic. This finding aligns with those of Asom and Suleiman (2017), who mentioned computer and internet services as part of the technologies and services provided in academic libraries. This finding implies that technologies and services in university libraries in Nigeria are still behind.

The data presented in Table 2 provided an answer to research question two, which shows perceived inadequacies of technologies and services provided in university libraries in NCN before the COVID-19 pandemic. The results showed, among others, that the technologies did not support fast and reliable internet access, nor support long-term digital preservation. They could not also operate remotely with users nor encourage personalised services. These findings are corroborated by the studies of Ullah et al. (2023) and Olumide (2022). Their studies identified inability to support long-term digital preservation, limited access to digital and internet resources, lack of robust analytics and reporting capabilities, etc., as inadequacies of traditional technologies and services in libraries. Sustained adoption of these technologies and services robs libraries, particularly university libraries, of the power to address the rapidly changing information needs of the 21st-century users. This is not to talk of the ability to provide information in periods of pandemics like COVID-19.

That digital resources are the only service provided up to an acceptable degree in university libraries in NCN as a panacea to the effects of COVID-19 and related pandemics is disheartening, as it is extremely inadequate. This was revealed in the findings shown in Table 3. University Libraries cannot stand the test of pandemics without the deployment of adequate, innovative and cutting-edge technologies like those of the 5IR. By the very nature of university libraries, they are more complex and sophisticated than all the others. It is expected that all other libraries should take a cue from them. However, they have not lived up to their expectations.

Findings on the 5IR technologies and services to be proposed for possible adoption by university libraries in NCN as a panacea to the effects of COVID19 and related pandemic show that all 14 items were accepted for adoption in university libraries. For example, adoption of artificial intelligence-related technologies and services such as blockchain, natural language processing, intelligent virtual assistant, face recognition, shelf-reading robots, information alert service, etc., were all accepted for possible adoption by university libraries. These findings are in agreement with studies by Nwobu et al. (2024), Xiao and Gao

(2020), Tella (2020), and Cox (2022). All the studies pointed out that AI-related technologies and services are critical for enhanced and personalised library services in the current information age.

Insight from the null hypothesis tested shows a significant difference between the innovative technologies and services adopted in university libraries in NCN before and after the COVID-19 pandemic. This difference could be attributed to the variation in technologies and services provided for analysis. It is likely that if the same items were presented and analysed, there would be no significance. This could be a limitation of this study.

Conclusion

Adoption and utilization of the 5IR technologies in University libraries in NCN is extremely low. Consequently, these libraries are largely ineffective and inefficient in service provision at times of pandemics like the COVID-19. These shortcomings as revealed in this study are bore out of the inadequacies of outdated technologies which are still applicable in the libraries.

University libraries can only justify their organic nature as a growing organism by adopting the 5IR technologies which would empower them to provide effective library services in this hi-tech era, including doing so seamlessly in periods of pandemics like the COVID-19.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. University and library managements should, as a matter of urgency and policy get rid of all outdated technologies and services that are incompatible to modern day information service requirements.
2. University libraries should set infrastructure in place to adopt the 5IR technologies that would place the library in position to provide cutting edge services at all times, including periods of pandemics like the COVID-19.
3. Librarians in university libraries in NCN should be adequately trained to apply the 5IR technologies for services. The success of adoption of these technologies depend heavily on the technology competence of the librarians.
4. Librarians and other information service professionals like computer scientists should collaborate for effective deployment and management of the 5IR technologies in libraries.

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Aligning Library and Information Science Education with Fifth Industrial Revolution Competencies: A Critical Analysis of the National University Commission Curriculum

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Abstract

The rapid evolution of the Fifth Industrial Revolution (5IR) and the convergence of exponential technologies, including big data, the Internet of Things (IoT), Artificial Intelligence (AI), nanoscience, and biotechnology have intensified the demand for a workforce equipped with advanced technological and human-centric competencies. In this context, traditional occupations face obsolescence, which facilitated the urgent need for re-skilling and upskilling among industry professionals. With a view to solve this skill gap, the Nigerian National Universities Commission (NUC) in 2023 introduced a new curriculum (CCMAS) aimed at aligning graduates with the competencies required in the 5IR era. In this regard therefore, Library and Information Science (LIS) education was envisaged to align with these innovative and emerging skills to prepare graduates for dynamic professional roles. This study therefore critically examines the NUC LIS curriculum, assessing its alignment with twenty skill domains essential for LIS professionals in the 5IR era. Employing a analytical approach of thwe descriptive methodology, the study systematically examines various sections of the updated LIS NUC-CCMAS curriculum to identify both explicit and implicit efforts to equip students with necessary skills useful in the 5IR era. The study found out that the curriculum shows very strong support for Entrepreneurship skill domain. The findings strongly support Technology Design and Programming; and Technical Skills domains. Several domains including Analytical Thinking and Innovation; Critical Thinking and Analysis; Complex Problem Solving; System Analysis and Evaluation; Soft Skills, Workforce Readiness, People Management, and Services Orientation received moderate support. Furthermore, several skill domains received weak support, these include Active Learning and Learning Strategies; Creativity, Originality, and Initiative; Reasoning, Problem Solving, and Ideation; Coordinating with Others; Judgement and Decision Making; and Negotiation. The curriculum has very weak support for Leadership and Social Influence; Emotional Intelligence; and Cognitive Flexibility. The study emphasizes the need for curriculum reforms that integrate emerging technological advancements with human-centered skills, ensuring LIS graduates remain competitive in the evolving 5IR era.

Keywords: *Fifth Industrial Revolution (5IR), Library and Information Science Education, NUC Curriculum, Curriculum Analysis,Competency Gap, AI in LIS, Human-AI Collaboration*

Introduction

The Fifth Industrial Revolution (5IR) presented people with new realities, possibilities and potentials. The development necessitates the re-engineering of educational programmes for re-skilling, up-skilling and up-skilling the students to fit into the new realities. In contrast, Igwe (2024) recognized a wide gap between the provision of Library and Information Science (LIS) education in Nigeria and the skills needed by LIS graduate to prosper in the 5IR job market. Tella et al. (2023) stated that there were new committees set up on curriculum development between October 2020 and February 2021 and in 2023, there was a new curriculum from the National Universities Commission (NUC) in name of Core Curriculum and Minimum Academic Standards for the Nigerian University System (CCMAS). On the other hand, Igwe's (2024) was a direct responded to LIS CCMAS curriculum with alternative. Therefore, there is need to investigate the extent to which the LIS CCMAS curriculum addresses the skill gap identified by Tella et al. (2023). This is the major objective of the present study which critically analyzed the alignment between LIS CCMAS curriculum and skills requirements of the 5IR era. This paper intends to answer the following research questions;

1. Is the NUC CCMAS incorporating skills relevant for the Fifth Industrial Revolution job market?
2. To what extent do the LIS Curriculum of the NUC CCMAS incorporates skills needed by LIS graduates to participate in the Fifth Industrial Revolution job market?

Literature Review

Historically, industrial revolutions have marked significant shifts in economic structures and societal norms. The First Industrial Revolution began in the late 18th century with the advent of steam power and mechanization. The Second Industrial Revolution followed in the late 19th century, introducing electricity and

mass production techniques. The Third Industrial Revolution emerged in the mid-20th century with the rise of computers and digital technology. Each revolution built upon its predecessor, leading to increasingly complex systems of production and communication (Frederick, 2019). The Fourth Industrial Revolution (4IR) distinguished itself by not only accelerating technological integration but also by fostering a more interconnected global economy that blurs traditional boundaries between industries and disciplines (Ajah & Chigozie-Okwum, 2019). The revolution also marked a continuous move to replace human control in the production of good and services in order to increase efficiency qualitatively and quantitatively. 4IR paved way to the ongoing Fifth Industrial Revolution (5IR). Therefore, this understanding of the 4IR has lead to the development of the 5IR.

The Fifth Industrial Revolution 5IR entails a rationalization and focusing of 4IR achievements for the benefit of humans. It attempts to balance the human-machine interactions and integrations in carrying tasks efficiently without creating havoc to humans or the environment. More importantly, human and machine interaction under the 5IR is designed as harmonious collaboration rather than a competition.5IR marks a significant evolution building upon the foundations of previous industrial revolutions, particularly the Fourth Industrial Revolution (4IR). While the 4IR was characterized by automation, artificial intelligence (AI), and the Internet of Things (IoT), the 5IR places humans back at the center of technological advancements, emphasizing harmonious human-machine partnerships and a focus on the well-being of humanity and the planet (Enakrire et al., 2024). Furthermore, data is considered incredibly valuable in the 5IR, driving innovation and decision-making through advanced AI and complex analytics (Adigun et al., 2024). That is to say the focus of 4IR was more on developing and perfecting systems while 5IR is an attempt to rationalize the for the benefits of humans and the planets. The 5IR modifies our working approaches, ensuring that technology serves human needs and societal problems (Noble et al., 2022). Specifically, the 5IR holds the promise of solving societal problems such as natural resource exhaustion, and unfavourable climatic and social conditions as well as economic disparity by connecting people and technologies to create resource-efficient smart societies (Taj & Zaman, 2022).

The 5IR entails the emergence of a "super smart society" where humans are the pivotal link overseeing technology (Nel-Sanders, 2023). Ziatdinov et al. (2024) describes this integration as "Mind Meets Machine", while Noble et al. (2022) describes it as “Humans and machines dance together”.However, it is important to note that the 5IR is still in its initial stages, and research on its implications is still emerging (Pathak et al., 2019). However, its core principles suggest a significant shift in how we approach technology and its role in society.

As the 5IR continue to unfold, many studies envisaged that most of the skills needed to work in the 5IR era are not being supported by the present educational programmes. While, most of the learners under the programmes today will eventually work in professions and occupations that are not yet in existence.This indicates to the need for education programmes and curriculum to prepare learners for the revolution. Learners need to have digital skills that are central to the revolution, more importantly they need to have soft skills that make them flexible and adaptable to fil in the era which is characterized as fast changing. Therefore, therelevance of curriculum and education is paramount in preparing graduates for the Fifth Industrial Revolution (5IR). The 5IR, characterized by a deep collaboration between humans and machines, rapid technological advancements, and a focus on human well-being and sustainability, demands a workforce equipped with a new set of skills and knowledge (Pang et al., 2023). The 5IR is driven by cutting-edge technologies such as AI, IoT, big data, cloud computing, robotics, nanotechnology, and 6G (Ayandokun & Nworu, 2022).

Therefore, curricula must be constantly updated and re-engineered to incorporate these emerging technologies and provide students with exposure to them. The 5IR necessitates increased digital literacy and technology-related skills across all educational curricula. Graduates need to be digitally skilled and technologically driven, capable of utilizing and working alongside advanced technologies. This includes understanding how to interpret and integrate data into decision-making, particularly in fields like healthcare. The core of the 5IR lies in the collaboration between humans and machines. Thus, education must prepare students to work effectively alongside machines and technology, leveraging the strengths of both human intelligence and artificial capabilities (Pang et al., 2023).

Alongside technical skills, the 5IR places significant emphasis on soft skills such as critical thinking, complex problem-solving, creativity, innovation, communication, collaboration, leadership, and adaptability (Ziatdinov et al., 2024). These non-routine, metacognition-based skills are crucial in a future where routine tasks may be automated. Curricula need to be designed to actively cultivate these skills. Given the rapid pace of technological evolution, lifelong learning is essential for individuals to remain relevant in the 5IR job market. Education should foster a culture of continuous skill development and knowledge acquisition (Enakrire et al., 2024a). Furthermore, integration of different technologies and fields in the 5IR necessitates interdisciplinary and transdisciplinary education. Students need to cultivate skills that transcend traditional subject boundaries to address complex, real-world problems (Ziatdinov et al., 2024).Consequently, educational institutions need to transform their teaching methodologies to create engaging and collaborative learning environments. This may involve incorporating technology-based teaching-learning models, personalized project-based learning, and learning from successful case studies. Seminar environments that encourage self-directed learning are also important (Loose & Jagielo-Manion, 2023). As 5IR integrates technology into human lives, education must also address the ethical, legal, and societal implications of the integration. This includes topics like data

privacy, security, and responsible use of technology (Taj & Zaman, 2022). Synergy between educational institutions and industry is also crucial to ensure that curricula align with the demands of the evolving job market. Collaboration with ICT professionals and practical exposure are essential for preparing graduates for the 5IR (Pang et al., 2023).

Consequently, scholars such as Ayandokun and Nworu (2022); Igwe (2024); Tella et al. (2023) express concern regarding the preparedness of the Nigerian Library and Information Science curriculum education in preparing students with the skills required for employability in the 5IR era. There is a perceived disconnection between the nature of education and training for LIS in Nigeria and the actual practice in the era of the knowledge economy and the emerging 5IR.Similarly, LIS programmes in Nigerian universities need to be aligned with current reality as the programmes are criticized for running contrary to the urgent need for training librarians and information professionals for the 5IR era. There are constraints in the utilization of emerging information technologies for library services delivery, teaching, and learning (Ayandokun & Nworu, 2022; Igwe, 2024). For instance, among the key technologies of the 4IR and 5IR, only cloud computing is widely taught in Nigerian library schools. The curriculum and course content of many LIS programmes do not adequately address the practical applications of digital technologies, including AI, big data, IoT, cloud-based services, and other emerging technologies. Therefore, there is the urgent need for curriculum review and re-engineering in Nigerian LIS education to align with global trends and the demands of the 5IR. This includes incorporating emerging technologies and in-demand soft skills to produce graduates who can meet the job demands of this era.

In the context of the 5IR, particularly in academic libraries, data science skills and techniques are crucial for improving data management services. The curriculum should equip future data librarians with the ability to utilize these skills effectively (Ibinaiye & Jiyane, 2021). Beyond technical skills, the 5IR also emphasizes the importance of soft skills such as emotional intelligence, cognitive flexibility, critical thinking, creativity, innovation, people management, and complex problem-solving. The current LIS curriculum may not adequately address the development of these crucial competencies (Enakrire et al., 2024). Also, it is important to note that some universities, like the University of Lagos, are taking steps to incorporate advanced technologies such as robotics in their library services, which may eventually influence curriculum development. Furthermore, the recognition of the importance of digital inclusion and literacy for libraries in the 5IR (Ajani et al., 2023). Enakrire et al. (2024) suggests a potential area for curriculum enhancement.

Conclusively, there is a significant gap between the current provision of LIS curriculum in Nigeria and the skill requirements of the Fifth Industrial Revolution. To adequately prepare graduates for this evolving landscape, a fundamental and holistic review and re-engineering of the curriculum is necessary. This must include a greater emphasis on emerging digital technologies, data science skills, crucial soft skills, and potentially the exploration of specialized degree programs within the broader discipline of information studies. Addressing infrastructural challenges and fostering collaboration between academia and industry are also vital for bridging this gap.

Methodology

The study adopted the analytical research design to carry out a content analysis of the NUC-CCMAS which was updated and issued in August 2023 (Igwe, 2024). The analysis was carried out to assess how the curriculum support the skills requirements of 5IR era. This approach is suitable for identifying themes, concepts, and skills relevant to the 5IR environment. The researchers adopted the 20 skills by Tellaet al. (2023), and used ChatGPT and Perplexity generative AI tools to determine synonyms for each domain of the skills. An outline of the domain skills and their consequent synonyms are presented in the Appendix. The text of the curriculum was analysed to identify the occurrence of specific words, phrases or sections related to each skills domain. Frequencies of each skill identified across the curriculum were calculated to determine which skills are most emphasized. The terms in each domain as well as the implicit and explicit attempt to cover the skills in the curriculum was considered. The aim was to identify evidence of incorporating or supporting 5IR relevant skills in the new curriculum. A Google generative Artificial Intelligence tool called notebookLM was used as assistance in the content analysis. The original lists of the 20 skills used by Tella et al. (2023) are as follows; Analytical thinking and innovation; Active learning and learning strategies; Creativity, originality and initiative; Technology design and programming; Critical thinking and analysis; Complex problem solving; Leadership and social influence; Emotional intelligence; Reasoning, problem solving and ideation; System analysis and evaluation; Technical skills – Knowledge, and capabilities to perform specialized tasks; Entrpreneurship – knowledge, and abilities that support success in creating and building a workplace opportunity or idea; Soft skills – Personal attributes, social skills, and communication abilities that support interpersonal relationship and interaction with others; Workforce readiness – Foundational to individual entry and ongoing success in the workplace, ranging from initial job search to maintaining continuous employment; People management; Coordinating with others; Judgement and decision making; Services orientation; Negotiation; and Cognitive flexibility

Consequently, the skill domains were rated from 1 to 5, whereas; **5 = Very Strong Support:** The curriculum provides substantial coverage and dedicated courses for the skill domain; **4 = Strong Support:** Several courses directly aim to impart skills in this domain, and it is well-supported by curriculum content and resources; **3 = Moderate Support:** The curriculum implicitly addresses or partially covers this skill domain through learning outcomes or related courses, but it may not be a central or explicitly taught focus; **2 = Weak**

Support: The curriculum provides limited or indirect support for this skill domain, with no dedicated courses and minimal explicit emphasis; and **1 = Very Weak Support:** The curriculum does not explicitly focus on or address this skill domain, with no relevant courses or learning outcomes identified.

Presentation of the Findings

Based on content analysis of the CCMAS LIS Curriculum, here is an assessment of how each of the 20 skill domains supported the teaching of 5IR relevant skills. The findings were presented here domain after domain as follows:

1. **Analytical Thinking and Innovation:** 3 **(Moderate Support)**. Out of the 7 skills under this domain only 2 appeared in the curriculum. Though courses like GST 111, GST 212 and ENT 211 have their intent and focus, however the courses mentioned and emphasized on improving **logical and critical thinking**. And some LIS courses require problem-solving [e.g., LIS 326], "**innovation**" as key concept under this domain is not consistently emphasized beyond entrepreneurship-focused courses [e.g., ENT 211]. Another course LIS 326 which is about research method but in extension covers **data analysis**. Therefore, this skill domain is moderately supported by the CCMAS LIS curriculum.
2. **Active Learning and Learning Strategies:2 (Weak Support)**. Out of the 11 skills under this domain none appeared in the curriculum. The curriculum's structure implies active learning engagements [e.g., through learning outcomes like "define," "discuss," "explain"], but explicit teaching of learning strategies is not evident in any of the courses of the curriculum. Therefore the curriculum is weak in supporting this skill domain.
3. **Creativity, Originality, and Initiative:2 (Weak Support)**. Out of the 12 skills under this domain only 1 appeared in the curriculum. Entrepreneurship courses [e.g., ENT 211, LIS 423] touch on creative thinking, innovation and initiative, but these are not strongly emphasized within the core LIS practices described in the curriculum. Therefore the curriculum is weak in supporting this skill domain.
4. **Technology Design and Programming:4 (Strong Support)**. Out of the 29 skills under this domain only 12 appeared in the curriculum. The curriculum demonstrates a strong commitment to equipping students with essential foundational ICT skills for library and information work. Several LIS courses directly address technology [LIS 114, LIS 125, LIS 212, LIS 225, LIS 325, LIS 421], focusing on digital libraries, application packages, ICT in LIS, hardware and software, information systems analysis, design and development; and database management. The minimum equipment list further supports this. Nevertheless, the absence of explicit coverage of rapidly evolving technologies like robotics, 3D printing, virtual reality, block chain and others means that the curriculum's support, when measured against the most contemporary technology is weak. Therefore the curriculum is strongly supporting this skill domain.
5. **Critical Thinking and Analysis:3 (Moderate Support)**. Out of the 10 skills under this domain none appeared in the curriculum. There is no course in the curriculum specifically designed to teach this skill domain. However, GST 111 and GST 212 aim to develop these skills, and some LIS course learning outcomes require evaluation and logical assessment within library and information science contexts [e.g., LIS 312, LIS 313]. Therefore the curriculum is moderately supporting this skill domain.
6. **Complex Problem Solving:3 (Moderate Support)**. Out of the 12 skills under this domain only 1 appeared in the curriculum. The curriculum presents scenarios and challenges in LIS [e.g., managing collections in LIS 312, meeting diverse user needs in LIS 121, and applying technology in LIS 212] that implicitly require complex problem-solving, although explicit methodologies are not a central focus. Therefore the curriculum is moderately supporting this skill domain.
7. **Leadership and Social Influence:1 (Very Weak Support)**. Out of the 12 skills under this domain none appeared in the curriculum. The curriculum does not explicitly focus on developing leadership skills or social influence within the LIS courses. While management is covered in LIS 214, it doesn't delve into the nuances of leadership and social influence. In addition, there is no GST course on teaching leadership skills. Overall, the curriculum doesn't have provision to teach the students leadership skills. Therefore the curriculum is very weak in teaching leadership skill domain.
8. **Emotional Intelligence:1 (Very Weak Support)**. Out of the 9 skills under this domain none appeared in the curriculum. There are no specific courses or learning outcomes in the curriculum that address the components of emotional intelligence. Therefore the curriculum is very weak in teaching leadership skill domain.
9. **Reasoning, Problem Solving, and Ideation:2 (weak)**. Out of the 10 skills under this domain none appeared in the curriculum. Reasoning and problem-solving are implicitly integrated in some LIS courses [e.g., LIS 326]. While ideation is mainly addressed in entrepreneurship-related courses [e.g., ENT 211, LIS 423]. But no course specifically designed to teach this skill domain. Therefore, the curriculum is weak in teaching this skill domain.
10. **System Analysis and Evaluation:3 (Moderate Support)**. Out of the 11 skills under this domain none appeared in the curriculum. LIS 317 directly addresses library systems. Evaluation is emphasized in courses like LIS 312, LIS 313, and LIS 413, but a comprehensive focus on system analysis methodologies is not strongly evident. Therefore, the curriculum is moderate in teaching this skill domain
11. **Technical Skills:4 (Strong Support)**. Out of the 11 skills under this domain none appeared in the

curriculum. Courses such as LIS 125, LIS 212, LIS 225, and LIS 421 directly aim to impart technical skills in library automation, database management, and digital resources, supported by the minimum equipment list. Therefore, technical skills domain is strongly supported by the curriculum.

12. **Entrepreneurship:4 (Very Strong Support)**. Out of the 12 skills under this domain only 5 appeared in the curriculum. Dedicated courses ENT 211, ENT 312 provide substantial coverage of entrepreneurship concepts, theories, and practical applications. While, LIS 423 is particularly exposes the students to entrepreneurship within the context of library and information filed. Therefore, entrepreneurship skills domain is very strongly supported by the curriculum.
13. **Soft Skills:3 (Moderate Support)**. Out of the 7 skills under this domain only 2 appeared in the curriculum. No course specifically designed to overall teach soft skills. However, GST 111 focuses on communication skills, while, GST 312 focuses on conflict resolution. On the other hand, user-centric courses [e.g., LIS 121, LIS 215, LIS 223, LIS 313] implicitly require and may develop some interpersonal skills, although this is not a primary focus. Therefore, Soft skills domain is moderately supported by the curriculum.
14. **Workforce Readiness:3 (Moderate Support)**. Out of the 11 skills under this domain none appeared in the curriculum. The curriculum as a whole aims to prepare students for the LIS workforce, with practical experience through SIWES being a key element. Various courses cover aspects of library operations and services relevant to employability. However, there is no course that specifically intends to prepare the students for general or specific career choice and development as well as employability. Therefore, Soft skills domain is moderately supported by the curriculum.
15. **People Management:3 (moderate Support)**. Out of the 14 skills under this domain only 4 appeared in the curriculum. LIS 214 covers management concepts relevant to libraries, though it does not provide in-depth coverage of people management skills such as team coordination, staff development, and performance leadership, it exposes learners to managing people, goal setting and designing action plans which are important in people management. In addition, GST 312 covers conflict management which is also important in domain. Therefore, people management skills domain is moderately supported by the curriculum.
16. **Coordinating with Others:2 (Weak Support)**. Out of the 8 skills under this domain none appeared in the curriculum. Teamwork and coordination are not explicitly emphasized in the learning outcomes of most core LIS courses. But, LIS 223 mentions cooperation, which has some overlap with coordination. SIWES might involve some coordination but is not a primary focus of the curriculum content. Therefore, supporting coordinating with Others skills domain is weak in the curriculum.
17. **Judgement and Decision Making:2 (Weak Support)**. Out of the 10 skills under this domain none appeared in the curriculum. Librarians make judgments in areas like collection development [LIS 312] and service provision [LIS 313]. While these activities involve decision-making, the curriculum does not explicitly teach frameworks for judgment and decision-making as a specific skill. Therefore, supporting **judgement and Decision Making** skills domain is weak in the curriculum.
18. **Services Orientation:3 (Moderate Support)**. Out of the 11 skills under this domain only 1 appeared in the curriculum. No course specifically teaches service orientation generally however, ENT 312 partly teaches customer engagement. Other LIS courses such as [LIS 121, LIS 213, LIS 215, LIS 223, LIS 313] are dedicated to understanding users and providing a wide range of library and information services, indicating a strong service orientation in the context of library and information work. Therefore, Services Orientation skills domain is moderately supported by the curriculum.
19. **Negotiation:2 (Weak Support)**. Out of the 11 skills under this domain only 2 appeared in the curriculum. There is no explicit mention or focus on negotiation skills or conflict mediation within the core Library and Information Science curriculum provided in the sources. GST 312 addresses conflict resolution in a broader context, and the content of ENT 312 covers negotiation and bargaining. Therefore, Negotiation skills domain has weak support by the curriculum.
20. **Cognitive Flexibility:1 (Very Weak Support)**. Out of the 12 skills under this domain only 2 appeared in the curriculum. The breadth of topics in the LIS curriculum implicitly encourages some adaptive thinking. However, there is no direct or strong emphasis on developing multi-perspective reasoning or dynamic problem reframing as specific skills within the defined learning outcomes. Therefore, Cognitive Flexibility skills domain has weak support by the curriculum.

Analytical Discussion

1. Is the NUC CCMAS Incorporating Skills Relevant for the Fifth Industrial Revolution Job Market?

Why this observed phenomenon occurs

The National Universities Commission's Core Curriculum Minimum Academic Standards (NUC CCMAS) aims to standardize undergraduate education across Nigerian universities, including LIS programmes (https://nuc-ccmas.ng/disciplines). The 5IR emphasizes human-technology symbiosis, advanced digital skills, artificial intelligence, and ethical use of technology. The CCMAS for LIS, launched in December 2022, includes several courses that reflect emerging digital competencies such as digital technologies and applications, artificial intelligence for libraries, digital curation, cyber security, and media and information

literacy (Igwe, 2024). This indicates an awareness and attempt by the NUC to integrate 5IR-relevant skills into the curriculum.

However, the persistence of gaps in fully embedding 5IR competencies can be attributed to several factors. First, the CCMAS process is inherently conservative and consensus-driven, involving multiple stakeholders from diverse academic backgrounds (https://www.nuc.edu.ng/nuc-committee-of-experts-finalise-ccmas/). This often results in a curriculum that balances traditional disciplinary knowledge with emerging trends but may lack the agility to rapidly incorporate cutting-edge 5IR skills. Second, the positioning of LIS under the Faculty of Education in the CCMAS framework risks diluting the technical and digital focus required for 5IR readiness, as the curriculum is influenced by education-centric priorities rather than technology-driven imperatives (Igwe, 2024).

How this phenomenon occurs

The NUC CCMAS incorporates 5IR skills through a structured course framework that mandates core and elective courses covering digital literacy, programming, data management, and emerging technologies. For example, courses like "Artificial Intelligence and Allied Emerging Technologies for Libraries," "Digital Transformation and Network Infrastructure," and "Information and Cyber Security" are explicitly designed to equip students with relevant skills (Igwe, 2024). The inclusion of practical components such as Students Industrial Work Experience Scheme (SIWES) further supports experiential learning aligned with 5IR demands.

Nonetheless, the extent of incorporation varies across universities due to differences in resource availability, faculty expertise, and institutional commitment to curriculum innovation. Some universities may offer these courses as electives or lack the infrastructure to deliver them effectively, resulting in uneven 5IR skill acquisition among LIS graduates.

In summary, the NUC CCMAS is making deliberate efforts to incorporate 5IR-relevant skills into LIS education, but structural, institutional, and policy-related factors limit the full realization of this goal. The curriculum reflects a hybrid of traditional LIS knowledge and emerging digital competencies, with room for enhancement to meet the dynamic demands of the 5IR job market.

2. To What Extent Does the LIS Curriculum of the NUC CCMAS Incorporate Skills Needed by LIS Graduates to Participate in the Fifth Industrial Revolution Job Market?

Why this phenomenon persists

The dearth of comprehensive 5IR-based course content in the LIS curriculum can be linked to several underlying causes. One major factor is the historical orientation of LIS education in Nigeria, which has traditionally emphasized classical librarianship skills—cataloguing, classification, and archival management—over advanced digital and technological competencies (Igwe, 2024). This legacy orientation creates inertia against rapid curricular change.

Additionally, the bureaucratic nature of curriculum development within the NUC and Nigerian universities slows the integration of novel 5IR skills. The CCMAS documents allocate approximately 70% of the curriculum to core courses, leaving limited flexibility for rapid inclusion of emerging topics (https://nuc.edu.ng/wp-content/uploads/2022/12/Agriculture-CCMAS.pdf). The process of curriculum review and approval involves multiple layers of committees and expert panels, which can delay the adoption of innovative content.

Furthermore, there is a shortage of qualified faculty with expertise in 5IR technologies within many LIS schools. This skills gap among educators constrains the development and delivery of advanced courses on artificial intelligence, big data, Internet of Things (IoT), and other 5IR pillars (Igwe, 2024). The lack of synergy between LIS schools and industry also limits exposure to real-world 5IR applications, reducing the curriculum's relevance.

How this phenomenon can be addressed

Addressing these challenges requires a multifaceted approach:

- **Curriculum Overhaul and Flexibility:** The NUC and LIS academic departments should adopt a more dynamic curriculum review mechanism that allows for periodic updates reflecting rapid technological advancements. Increasing the proportion of elective courses focused on 5IR skills can provide flexibility for universities to tailor programmes to emerging needs.
- **Faculty Development:** Investment in continuous professional development for LIS educators is essential to build capacity in 5IR technologies. Partnerships with industry and international LIS schools can facilitate knowledge transfer and curriculum co-creation.
- **Industry Collaboration:** Strengthening collaborations between LIS schools and the information technology sector can enhance curriculum relevance and provide students with practical exposure to 5IR tools and environments.
- **Policy Advocacy:** The LIS profession must advocate for repositioning the discipline outside the Faculty of Education to a more interdisciplinary faculty that reflects its evolving technological focus, thereby influencing curriculum priorities.

- **Resource Allocation:** Universities need to invest in infrastructure—labs, software, and digital libraries—that support hands-on learning of 5IR competencies.

Summary

The LIS curriculum under the NUC CCMAS incorporates foundational 5IR skills but falls short of comprehensive coverage due to legacy curriculum structures, bureaucratic inertia, faculty skill gaps, and limited industry linkage. A strategic overhaul emphasizing flexibility, faculty capacity building, and stronger industry partnerships is critical to bridging this gap.

Conclusion

Through an analytical qualitative lens, this study highlights the urgent need for the NUC LIS curriculum to align with the demands of the 5IR. The findings underscore that while the curriculum includes foundational LIS knowledge, it falls short in addressing emerging competencies required for a technology-driven information landscape. Without timely interventions, LIS graduates may struggle to compete in a rapidly evolving digital economy. It is clear that while the NUC CCMAS has made commendable strides in incorporating 5IR competencies into the LIS curriculum, systemic and structural challenges hinder full alignment with the demands of the 5IR job market. The persistence of traditional curricular focus, coupled with institutional and resource constraints, explains why the phenomenon of limited 5IR-based content persists. If the NUC will address these issues, it will require collaborative efforts among regulatory bodies, academia, industry, and policymakers to ensure LIS education produces graduates ready to thrive in the emerging digital knowledge economy.

Recommendations

1. NUC should integrate AI, machine learning, and blockchain applications into the LIS curriculum to enhance graduates' technological competencies.
2. NUC should incorporate interdisciplinary learning opportunities to strengthen LIS professionals' adaptability to diverse digital environments.
3. There is the need for the NUC through her ICT partner agencies to expand training on soft skills, including digital ethics, problem-solving, and collaboration with AI-driven systems.
4. NUC will need to develop strategic partnerships between universities, technology firms, and library organizations to provide practical exposure and up-to-date training in emerging LIS technologies.

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Appendix I

5IR Relevant Skills Domain as application in LIS

S/N	Skills Domains	Skills domains that appeared in the NUC LIS curriculum
1.	**Analytical Thinking and Innovation**; Critical thinking, Logical reasoning, Systematic problem-solving, Strategic analysis, Innovative thinking, Deductive reasoning, Cognitive problem-solving, Data analysis, Strategic thinking, Innovation management, Research and development, Pattern recognition	**2**
2.	**Active Learning and Learning Strategies**; Experiential learning, Self-directed learning, Collaborative learning, Inquiry-based learning, Reflective practice, Adaptive learning techniques, Lifelong learning, Continuous improvement, Skill development, Knowledge acquisition, Learning agility	**0**
3.	**Creativity, Originality, and Initiative**; Inventive thinking, Novelty generation, Imaginative solutions, Proactive ideation, Resourcefulness, Pioneering approaches, Out-of-the-box thinking, Innovation, Entrepreneurial mindset, Inventiveness, Proactiveness, Imagination	**1**
4.	**Technology Design and Programming;** Software development, Systems engineering, Technology, Information and Communication Technology, ICT,Computational design, Coding proficiency, Technical problem-solving, Algorithmic logic, UX/UI design, Programming,Systems design, Digital literacy, App development, Algorithm design, Tech innovation, Application software, database management, Digital, information systems, Robotics, Block-Chain, Artificial Intelligence, 3D Printing, Virtual Reality, Internet of Things, Cloud Computing, Augmented Reality, Simulation	**12**
5.	**Critical Thinking and Analysis**; Objective evaluation, Evidence-based reasoning, Logical assessment, Skeptical inquiry, Discerning judgment, Logical analysis, Problem decomposition, Argument evaluation, Hypothesis testing, Inductive reasoning	**0**
6.	**Complex Problem Solving**; Multi-faceted troubleshooting, Systemic reasoning, Intricate decision-making, Advanced troubleshooting, Adaptive problem resolution, Systems analysis, Multidisciplinary problem-solving, Scenario planning, Root cause analysis, Strategic problem-solving, Adaptive problem-solving, Decision analysis	**1**
7.	**Leadership and Social Influence**; Team leadership, Motivational management, Collaborative influence, Stakeholder engagement, Visionary guidance, Change management, Influence and persuasion, Mentorship, Visionary leadership, Stakeholder management, Inspirational leadership, Collaborative leadership	**0**
8.	**Emotional Intelligence**; Interpersonal awareness, Empathetic communication, Self-regulation, Social perceptiveness, Self-awareness, Empathy, Relationship management, Interpersonal skills, Emotional resilience	**0**
9.	**Reasoning, Problem Solving, and Ideation**; Cognitive reasoning, Solution-oriented, brainstorming, Hypothesis-driven analysis, Creative ideation, Logical thinking, Hypothesis generation, Solution design, Conceptual thinking, Convergent thinking (0)	**0**
10.	**System Analysis and Evaluation**; Process optimization, Systems thinking, Performance assessment, Operational diagnostics, Quality assurance, Process evaluation, Performance metrics, Feedback loops, Optimization, Systems mapping, Impact assessment	**0**

11.	**Technical Skills**; Specialized expertise, Hands-on competencies, Domain-specific knowledge, Applied technical proficiency, Hard skills, Domain expertise, Specialized knowledge, Operational skills, Industry-specific skills, Functional expertise, Applied skills	**0**
12.	**Entrepreneurship**; Venture creation, Business acumen, Opportunity identification, Innovative enterprise, Risk management, Business development, Startup skills, Risk-taking, Opportunity recognition, Market analysis, Business planning	**5**
13.	**Soft Skills;** Interpersonal communication, Collaborative aptitude, Adaptability, Conflict resolution, Communication skills, Networking, Cultural competence	**2**
14.	**Workforce Readiness**; Career preparedness, Employability skills, Job market adaptability, Professional competencies, Career readiness, Job preparedness, Workplace skills, Professionalism, Time management, Work ethic, Career development	**0**
15.	**People Management**; Team coordination, Staff development, Performance leadership, Organizational leadership, Team management, Performance management, Talent development, goal setting, Employee engagement, Supervision, Coaching, Delegation, Conflict management, action plan	**4**
16.	**Coordinating with Others**; Collaborative planning, Cross-functional teamwork, Project synchronization, Stakeholder alignment, Collaboration, Teamwork, Partnership building, Project management, Synergy	**0**
17.	**Judgement and Decision Making;** Prioritization, Informed prioritization, Strategic choices, Risk-benefit analysis, Data-driven decisions, Risk assessment, Strategic decision-making, Ethical judgment, Critical evaluation, Scenario analysis	**0**
18.	**Services Orientation;** Client-centric focus, Customer satisfaction strategies, Support service design, User experience optimization, Customer focus, Client management, Customer Solution, Service delivery, User experience (UX), Support services, Client engagement	**1**
19.	**Negotiation**; Negotiation, Bargaining, Conflict mediation, Consensus-building, Persuasive communication, Bargaining tactics, Persuasion, Deal-making, Diplomacy, Consensus building, Compromise	**2**
20.	**Cognitive Flexibility;** Adaptive thinking, Mental agility, Multi-perspective reasoning, Dynamic problem reframing, Multitasking, Open-mindedness, Perspective-taking, Context switching, Resilience	**0**

An Evaluative Study of Selected Webinars by Nigerian Libraries and Associations for Enhancing Learning Opportunities in Nigeria

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Abstract

There is evidence that Nigerian libraries and associations are committed to continuous learning and adjusting to the dynamic field of library and information science, especially in this 5th industrial revolution. For instance, the National Library of Nigeria and the Nigerian Library Association IT Section have organised specific webinars. However, there is little empirical and analytical evidence on these webinars. Therefore, this study aims to determine the relevance of the content of selected webinars organised by Nigerian Libraries to the learning needs of participants in Nigeria, the resources and delivery methods used during these webinars and the influence of selected webinars on participants' knowledge, skills and practice. Three webinars have been purposefully selected for this study because of their popularity and the availability of information online. They include the Digital Literacy Training Webinar Series by the National Library of Nigeria, Nigerian Library Association IT Section Workshop Series 4 and Webinar Series: Librarying SDGS - Sharing Experiences from WLIC 2023. The study population consists of all participants in the selected webinar. Snowball sampling techniques was used to recruit webinar attendees. Data was collected via a Google Form questionnaire to analyse the webinars' relevance, delivery techniques, and impact on participants' professional practices. The items in the questionnaire were developed using the CIPP model checklist (Context, Input, Process, and Product model), a framework proposed by Daniel Stufflebeam in the 1960s. The preliminary investigation and reports found that the webinars covered relevant themes and provided valuable resources. However, delivery quality and professional application differed. The results of this study will assist Nigerian libraries and associations in planning, executing, and implementing future webinars. It will also assist in enriching the profession with the knowledge and skills required for the 5th Industrial Revolution.

Keywords: Digital Literacy, Nigerian Libraries and Association, Webinars for the 5th Industrial Revolution, Professional Development

Introduction

In the 5th Industrial Revolution, digital technologies, artificial intelligence, and automation are being brought into many industries, making webinars more important (Pang *et al.,*2023; Malik *et al.,* 2024). This revolution focuses on learning, relearning, and upskilling to succeed in a rapidly changing technology. Webinars are a flexible, affordable and accessible approach to professional development in library and information science (Idhalama *et al.,* 2021). Librarians and information professionals handle and access great amounts of digital content. Thus, webinars help them understand and use technology. Librarians must also stay up to date with new trends, methodologies and technologies as the world grows more data-driven and linked. Thus, webinars are essential for skill development and prepare Nigerian libraries and staff for the 5th Industrial Revolution, placing them as vital stakeholders in the digital ecosystem (Ekwueme *et al.,* 2024).

Recently, webinars have become prevalent and crucial for continuing education and professional development, especially in library and information science. Webinars are being used more by Nigerian libraries and associations to train library staff and students. For example, Idhalama et al. (2021) examined how Nigerian library and information professionals use webinar tools for teaching and learning. These studies show that webinars improve librarians' service delivery skills and professional expertise. In addition, Anene and Idiedo (2021) noted that Zoom-based webinars help Nigerian LIS professionals share knowledge and progress professionally, while Okwudibe (2023) found that Nigerian librarians are increasingly using virtual training programs to improve their digital literacy and skills. Again, Oweipere and Mayowa-Adebara (2022) assessed the participation of Nigerian librarians in professional development sessions during the COVID-19 pandemic. They found that few librarians attended seven or more webinars using Zoom during the study period. Most webinar themes focused on writing high-quality academic papers for publication.

Despite the rising number of research on webinars in Nigerian libraries, significant gaps exist, especially in evaluating their effectiveness in satisfying users' learning needs. Much research has examined webinar tools

and platforms (Idhalama *et al.,* 2021; Anene & Idiedo, 2023), but few have examined their effects on participants' knowledge, abilities, and professional practice. There is very little data on how webinar resources and distribution strategies affect their performance. Therefore, using the CIPP (Context, Input, Process, and Product) evaluation technique, this paper evaluates the chosen Nigerian library webinars' relevance, distribution methods, and impact to fill these gaps. The findings will help optimise future webinars to meet participants' requirements and improve library professional practices in the 5th Industrial Revolution.

Statement of the Problem

Nigerian libraries and associations increasingly deliver webinars for professional development and capacity building. However, there is no empirical evidence that these webinars are effective and fulfil the learning needs of the participants. Many studies have examined the library and information science sector's use of webinar tools and platforms. However, not many of these studies evaluate the impact of webinars on the participants' knowledge, skills and professional practices. Moreover, it is unclear how these webinars' resources and delivery mechanisms contribute to their success or failure in enhancing learning outcomes. This could prevent libraries and associations from continuing to enhance or fine-tune their programs as necessary to better serve library professionals' needs. Therefore, this study intends to fill these gaps by looking at the relevance, modes of delivery and impact of selected webinars hosted by libraries in Nigeria by assessing the extent to which webinars create learning opportunities and enhance the learning opportunities available to users in an increasingly digital age.

Objectives of the study

The objectives of the study are:

1. To determine the relevance of the content of selected webinars organised by Nigerian Libraries to the learning needs of participants in Nigeria.
2. To evaluate the resources and delivery methods used during these webinars.
3. To assess the influence of selected webinars organised by Nigerian Libraries and Associations on participants' knowledge, skills and practice in their profession.

Literature review

The Context, Input, Process, and Product Evaluation Model (CIPP Framework)

The CIPP model was developed by Daniel Stufflebeam in the 1960s. It is regarded as a decision-oriented model that methodically gathers data about a program to determine its delivery or content strengths and limitations, enhance program effectiveness, or plan for its future (Yale University, 2021; Umam & Saripah, 2018). Zhang et al. (2011) recommend adopting the CIPP evaluation methodology to improve service-learning program conception, execution, and assessment. This provides a structured strategy that is needed to evaluate the effectiveness of service-learning initiatives, which are complicated and include several stakeholders. The CIPP methodology identifies needs, designs useful programs, and evaluates outcomes, promoting continual improvement and accountability.

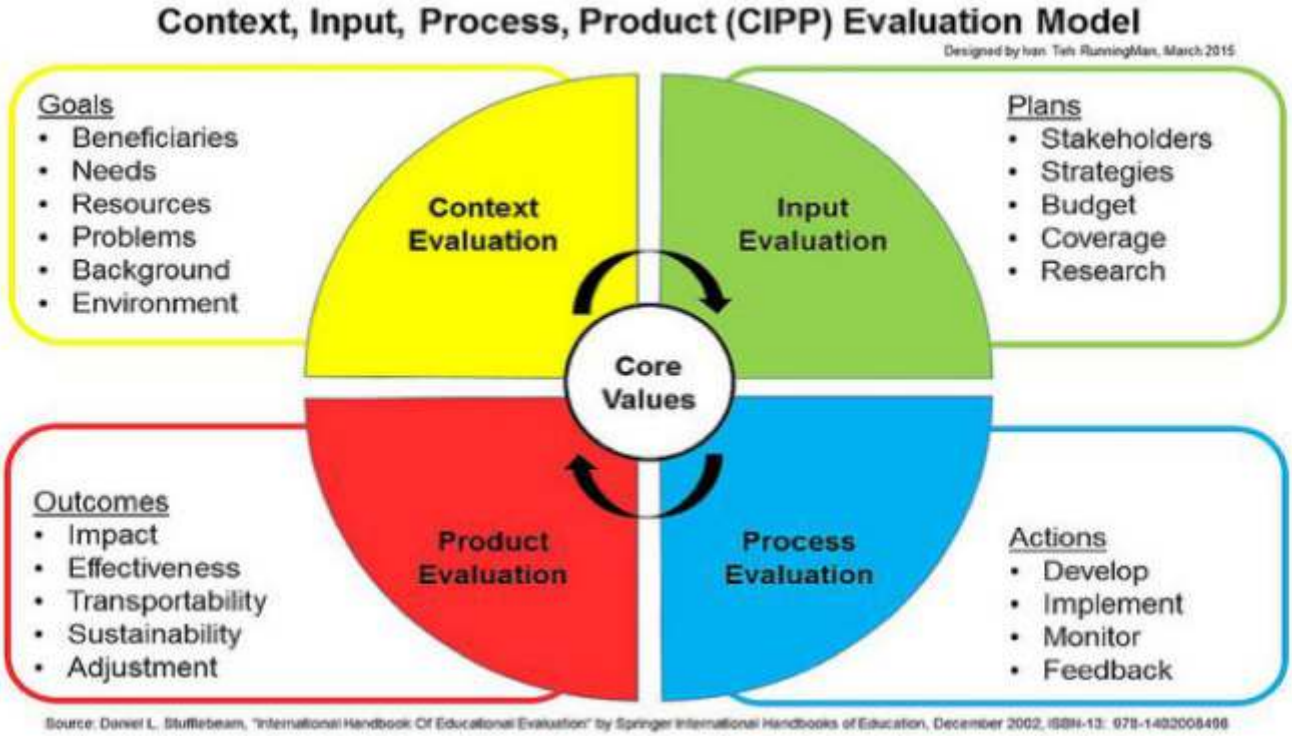


Fig. 1. Core components of the CIPP model (Yale University, 2021)

The model has four components (See Figure 1). Context evaluation examines needs, issues, resources, and opportunities to aid decision-makers in establishing goals and priorities (Stufflebeam, 2015; Umam & Saripah, 2018). Input review assesses alternative strategies and plans for feasibility and cost-effectiveness. After context evaluation, decision-makers utilise competing plans, designate individuals, allocate budgets, and create comprehensive activity plans. Process assessment evaluates implementation, facilitating necessary actions and offering a basis for outcome assessment (Stufflebeam & Shinkfield, 2007). Product evaluation examines planned/unintended and short/long-term effects, appraising impact, effectiveness, sustainability, and applicability. However, critics like Lee et al. (2019) argue that CIPP can be complicated and time-consuming with extensive data collection, potentially leaving key questions unanswered. It emphasises decision-making over scholarly input and may not fit rapidly changing contexts like webinars.

Relevance of Webinar Content to Learning Needs in Nigerian Libraries

Nigerian libraries are facing a growing challenge due to globalisation. As stated by Ani et al. (2005), due to poor budget, IT infrastructure, human resource capacity, and power supply, client learning needs cannot be fulfilled. Studies have shown that libraries in Nigeria are using webinars in training librarians to respond to such issues (Oweipere & Mayowa-Adebara, 2022). However, certain challenges affect the relevance of webinars in meeting the needs of librarians and library users in Nigeria. The digital literacy level among librarians in Nigeria varies; some have great difficulty in using information resources and technology. This brings up the question of whether the content of such webinars is pertinent and accessible to all librarians, especially those with low digital skills (Baro *et al.,* 2019).

Research identifies factors impeding Nigerian library service: managers' misalignment with librarians' work, rigid bureaucracy, and disconnection between work content and skills (Idhalama *et al.,* 2021; Okwudibe, 2023). Webinar content must address Nigerian librarians' specific learning needs. CIPP Model implementation reveals complex challenges (Anene & Idiedo, 2021; Idhalama *et al.,* 2021; Oweipere & Mayowa-Adebara, 2022). A digital divide exists between tech-embracing urban academic libraries and disconnected rural/public libraries. One-size-fits-all webinar approaches fail to address varied technological skills and learning preferences among staff (Baro *et al.,* 2019; Bassey *et al.,* 2022). Resource allocation must balance webinar training with other essential library needs.

Resources and delivery methods used during webinars and their Impact

Webinars are helpful for professional development, particularly for teaching and training others. Few studies have examined the resources and delivery methods used during webinars. Gegenfurtner and Ebner's (2019) seminal research revealed that webinars are either live, synchronous, or interactive communication, unlike one-way webcasts (Gegenfurtner & Ebner, 2019). The authors explained that webinars are more effective when using digital learning environments on many platforms, as they improve student engagement and learning outcomes in webinars. Cunningham et al. (2020) published a guideline for integrating webinars in medical education, discussing best practices for planning, implementing, delivering, and evaluating webinars. The writers offer a well-defined six-phase approach, each containing steps to ensure the webinars' educational value. The guide helps implement effective training through webinars.

However, Arnilla (2022) argued that Webinars are less effective at causing change if many participants have limited resources. Oweipere and Mayowa-Adebara (2022) also contend that webinar effectiveness depends on resources and delivery techniques, including webinar features and participant interactions. This means that just having good content isn't enough for webinars to be successful; using resources well and applying delivery techniques that engage your audience actively is also required.

Furthermore, although not empirically proven, Salvatori (2018) opined that webinars that use interactive features, such as polls, Q&AS and breakout rooms, and good quality resources, such as clear slides and additional material, are more likely to achieve better learning outcomes. Even with all this knowledge, we still don't know the effectiveness of the resources and delivery in webinars sponsored by Nigerian libraries. It's important to address this gap to provide suitable recommendations for the design and implementation of webinars to aid in the professional development of the participants and uplift the services in library and information science.

Methods

This analysis took place at just one point in time. Thus, the study is cross-sectional. It employs a mixed method to ascertain the selected Nigerian library webinars' effectiveness. Data was collected through questionnaires for quantitative purposes, while Facebook, YouTube and the Internet were utilised for qualitative data gathering. This descriptive survey study assesses three selected webinars for relevance, resources, delivery techniques, and impact on participants' knowledge. The study population includes all webinar participants, including the National Library of Nigeria's Digital Literacy Training Webinar Series, the Nigerian Library Association IT Section Workshop Series 4, and the WLIC 2023 Webinar Series: Librarying SDGS - Sharing Experiences.

The study population consists of all those who attended the three webinars. These participants were recruited using snowball sampling (networking). This technique is suitable for reaching those who attended the webinar, who might be challenging for the researchers to reach. Snowball sampling is a non-probability sampling

method whereby existing research participants recruit other potential participants from their network. This will help ensure that the anticipated 200 participants for the study will be recruited. However, only 117 responses were collected and analysed. To collect data, a Google Forms questionnaire with structured and open-ended questions was created. The structured items in the form were developed based on the CIPP model checklist. Using structured questions allowed us to quantify responses, an important part of analysing content relevance, satisfaction, and knowledge development in a webinar (Creswell, 2014). Open-ended questions will allow participants to elaborate on their opinions, revealing how the webinars affected their professional practices and learning outcomes. Google Forms was chosen because of its user-friendly design and real-time data collection and analysis. This makes it ideal for addressing a broad webinar audience. Structured questions are needed to assess participant satisfaction and learning outcomes, whereas open-ended questions provide more in-depth, qualitative insights regarding webinar impact (Creswell, 2014). Using both question types allows a complete evaluation of webinars. To evaluate resource quality and participant needs, webinar presentations and feedback reports were also examined. Statistical methods for quantitative data were used to assess the webinars' influence on participants' professional practices. This methodology allowed for a thorough evaluation of the webinars' impact on Nigerian library learning.

Results

Table 1: Respondents' Biodata and Experiences (n=117)

Variables		Frequency	Percent
What is your gender	Female	93	79.5
	Male	24	20.5
Age Group	26 - 35 years	3	2.6
	36 years – 45 years	66	56.4
	46 years and above	48	41.0
Profession	Library Staff	12	10.3
	Librarian	86	73.5
	Lecturer	14	12.0
	Civil Servant	5	4.3
Educational Qualification	B.SC/B.Ed/ B.A/ HND	18	15.4
	Master's Degree	63	53.8
	PhD	36	30.8
Have you attended any of the following webinars?	Nigerian Library Association IT Section Workshop Series 4	30	25.6
	Digital Literacy Training Webinar Series	58	49.6
	Webinar Series: Librarying SDGS – Sharing Experiences from WLIC 2023	10	8.5
	All Webinars listed	19	16.2
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	Webinar Series: Librarying SDGS – Sharing Experiences from WLIC 2023	10	8.5
	All Webinars listed	19	16.2

Table 1 presents the demographic and experiential data of respondents to a study on the relevance of webinar content organised by Nigerian libraries. Most of the respondents were female (79.5%), and the Majority fell within the 36–45 age group (56.4%), which indicates that they are mature and likely to have had sufficient experience in various matters related to the study. Most of the respondents were librarians (73.5%) and had a very high level of academic qualification, as more than half (53.8%) held a Master's degree, with almost one-third (30.8%) having a PhD. This implies that participants would probably possess both the academic and professional qualifications required for critically assessing the relevance of webinar content to their learning needs. The majority of respondents who attended other webinars is an indication that there is great interest in such technology-related education, with nearly half having attended the Digital Literacy Training Webinar Series and 25.6% attending the NLA IT Section Workshop Series 4.

Table 2: Relevance of the content of selected webinars organised by Nigerian Libraries to the learning needs of participants (n=117)

Variables		Frequency	Percent
How relevant were the topics discussed in the webinar to your professional needs?	Irrelevant	2	1.7
	Neutral	4	3.4
	Relevant	54	46.2
	Very Relevant	57	48.7
The webinar objectives aligned with current trends and challenges in the library profession?	Strongly disagree	9	7.7
	Disagree	5	4.3
	Neutral	1	0.9
	agree	84	71.8
	Strongly agree	18	15.4
Did the webinar address any specific gaps in your knowledge or skills?	No	3	2.6
	Yes	113	96.6
	Maybe	1	0.9
How well did the webinars cater to the diverse needs of participants (e.g., professionals at different career levels)?	Poor	1	0.9
	Neutral	5	4.3
	Well	75	64.1
	Very well	36	30.8

From the results in Table 2, it can be seen that most respondents considered the selected webinars to be highly relevant to their professional development needs. Specifically, 48.7% rated it as very relevant and 46.2% as relevant, therefore indicating a strong match between what they would like to learn about and the content of the webinars. Further, 71.8% agreed and 15.4% strongly agreed that the objectives of the webinars were related to contemporary issues and challenges facing the library profession; thereby implying that the sessions were modern and responsive to professional needs. A very high proportion, 96.6%, of participants admitted that the webinars addressed specific gaps in their knowledge or skills; thus, reaffirming the practical impact of these webinars. This finding is very relevant to the present study as it shows that Nigerian libraries are delivering webinars which are professionally targeted and inclusive towards the regarding at meeting participants' varied learning needs.

Table 3: Evaluation of the resources and delivery methods used during these webinars. (n=117)

Variables		Frequency	Percent
Were the webinar materials (e.g., slides, videos, handouts) comprehensive and useful?	Strongly disagree	5	4.3
	Disagree	10	8.5
	Neutral	12	10.3
	agree	81	69.2
	Strongly agree	9	7.7
How would you rate the technical quality (e.g., audio, video clarity, and platform stability) of the webinar?	Average	18	15.4
	Good	90	76.9
	Excellent	9	7.7
The webinar duration is adequate to cover the intended content	Strongly disagree	6	5.1
	Disagree	30	25.6
	Neutral	15	12.9
	agree	63	53.8
	Strongly agree	3	2.6

How effective were the facilitators in delivering the content and engaging participants?	Ineffective	2	1.7
	Neutral	3	2.6
	Effective	87	74.4
	Very Effective	24	20.5
How would you describe the registration process for the webinars?	Easy and Straightforward	78	66.7
	Disagree	9	7.7
	Neutral	30	25.6
Was sufficient time allocated for participant interaction (e.g., Q&A sessions)?	No	45	38.5
	Yes	71	60.7
	Maybe	1	0.9
Did the webinar platform (e.g., Zoom, YouTube, Facebook, Google Meet) enhance or hinder your learning experience?	Hindered	45	38.5
	Enhanced	59	50.4
	Neutral	13	11.1

Results in Table 3 show that the resources and delivery methods used in the selected webinars were positively rated by most participants. The majority (69.2%) agreed that the materials provided were comprehensive and useful, with 7.7% strongly agreeing, implying that learning resources supported knowledge acquisition well. It was also rated high, with 76.9% good and 7.7% excellent, indicating that audio-visual clarity and platform stability meet expectations generally. Although 53.8% agreed that the duration of the webinar was adequate, a significant 25.6% disagreed; this indicates some room for improvement in time management as well.

Facilitator performance was positively rated; 74.4% found them effective and 20.5% very effective in delivering content and engaging the audience. Logistics received a rating of 66.7%, which means straightforward for registration. But interaction time was a slight weakness because just 60.7% felt there was sufficient time for Q&A sessions, 50.4% said the platforms used had their learning experience, and 38.5% felt the platforms hindered it. This means technical or accessibility issues for them, too.

Table 4: **Chi-Square Test Results for the Influence of Webinar Organised on Perceived Professional Relevance and Knowledge/Skills Gaps** (n = 117)

Test	**χ^2**	**df**	**p**	**Phi**	**Cramer's V**
Influence on Perceived Alignment with Trends	10.07	12	.610	.293	.169
Influence on Addressing Knowledge/Skills Gaps	9.90	6	.129	.291	.206

A chi-square test examined relationships between webinar attendance and perceptions of professional relevance and knowledge gaps. Comparing responses across webinars (NLA IT Workshop, Digital Literacy Training Series, etc.) with participants' ratings revealed no statistically significant difference in perceived alignment with professional trends ($\chi^2(12, N = 117) = 10.07$, $p = .610$, Cramer's $V = .169$). Similarly, no significant relationship emerged between webinar type and closing knowledge gaps ($\chi^2(6, N = 117) = 9.90$, $p = .129$, Cramer's $V = .206$). Results suggest that while participants generally found all webinars helpful, no specific webinar performed significantly better than others in addressing professional relevance or knowledge gaps.

Meanwhile, in Figure 1 below, in an open-ended question, respondents were asked to mention what aspects of the webinar(s) they found most beneficial and in what ways it was beneficial. The most commonly mentioned benefit was the digital literacy, ICT, and AI-related skills acquired (32.5%), followed by general appreciation for all aspects of the webinars (23.1%). Other notable benefits included better knowledge sharing (11.1%), exposure to new research trends and collaboration opportunities (7.7%), and information on how to apply AI in marketing library services (7.7%). A few participants mentioned practical benefits such as safety and convenience of access via Zoom-meetings-on-webinar 7.7%: improved visibility online 2.6%. Thus, the findings reiterate that such webinars work wonders when it comes to uplifting participants' digital dynamics and professional consciousness.

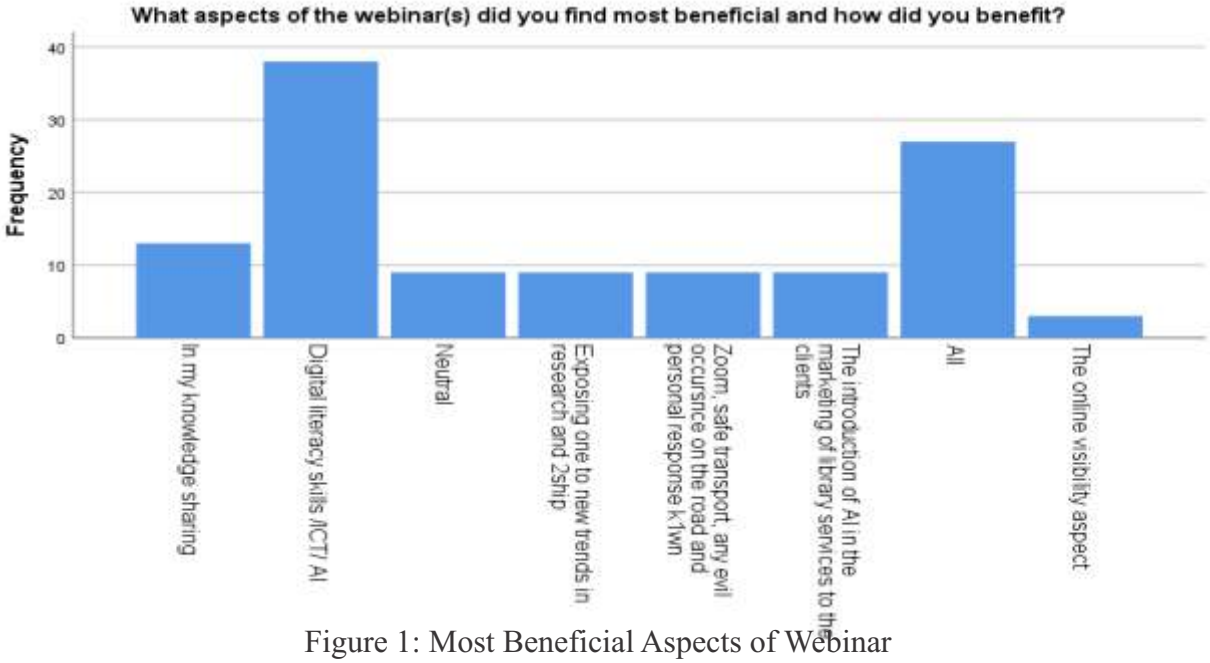


Figure 1: Most Beneficial Aspects of Webinar

Discussions

Objective One: To determine the relevance of the content of selected webinars organised by Nigerian Libraries to the learning needs of participants in Nigeria.

An initial objective of the study was to examine the relevance of the content of selected webinars organised by Nigerian Libraries to the learning needs of participants in Nigeria. Results showed that a greater number of respondents considered the webinars to be highly relevant to professional development needs, with 48.7% describing them as "very relevant" and 46.2% as "relevant." Also, 71.8% agreed and 15.4% strongly agreed that the aims of the webinar corresponded with present trends and challenges facing the library profession. A total of 96.6% admitted that webinars responded to precisely identified gaps in their knowledge or skills. Such results corroborate the study by Edet and Alex-Nmecha (2023), which stressed that an important digital age skill requisite for librarian empowerment is through professional development activity involvement. It was discovered that librarian competency improvement had a significant role via Webinars and Online Training Sessions, especially in Digital Literacy and Information Services. The authors found that the Digital skills most gained included online search strategies, whereas data mining, cybersecurity, and metadata were the least obtained.

While comparison studies are scarce, Ebner and Gegenfurtner (2019) found that webinars can help professionals learn as much or more than classroom or face-to-face learning. Professionals of webinar-based training have also expressed satisfaction with webinar experiences and appreciated the flexibility of online learning, including the ability to return to content later (Christensen *et al.,* 2024), although Ebner and Gegenfurtner (2019) noted that face-to-face learning professionals had higher satisfaction ratings.

Objective Two: to evaluate the resources and delivery methods used during these webinars.

Our results showed that participants rated the resources and methods of delivery on the whole positively. Most of them agreed that the materials for the webinar were comprehensive and useful. They also rated the technical quality (clarity of audio and video as well as platform stability) as good. A significant proportion, however, about 25.6% of the respondents disagreed that the duration of the webinar was adequate., This indicates a need for improvement in time management. These findings relate well to those of Anene and Idiedo (2023), who reported that librarians in Nigeria found beneficial aspects of online workshops, most importantly because they saved costs and were convenient.

However, other studies had somewhat contradictory results. For example, a study by Adekannbi (2019) involving students from Nigerian universities found that factors such as inadequate power supply, poor telecommunication networks, high costs of internet access, and e-learning devices significantly hindered students' satisfaction with e-learning platforms like Webinars. Another research conducted during the COVID-19 pandemic also showed that a large proportion of the professionals were dissatisfied with webinars and e-learning. While initial replies showed pleasure, several participants felt overwhelmed by the frequency of online sessions and saw the lack of personal touch as a learning hurdle. Websites' apparent ineffectiveness and failure to meet stakeholders' needs contribute to this dissatisfaction (Ismail *et al.,* 2021). Thus, although the webinars were received well, technical issues, infrastructure problems, and lack of engagement must continue to be tackled to optimally use them.

Objective Three. To assess the influence of selected webinars organised by Nigerian Libraries and Associations on participants' knowledge, skills and practice in their profession.

Results showed that the webinars did not differ significantly in their perceived alignment with professional trends or knowledge/skills shortages. Effect sizes were small to moderate. From these results, it can be assumed that while participants found the webinars useful, no single webinar stood out in making a significant difference in professional relevance or specific knowledge gaps. This finding corresponds with the general literature wherein the cumulative effect is noted regarding the competencies of librarians and their continuous professional development activities. For example, Oyovwe-Tinuoye et al. (2021) observed that ICT skills acquisition through various training programmes positively influenced librarians' job performance in Nigerian university libraries.

On the other hand, Anene and Idiedo (2023) reported the participation of librarians in professional development workshops through Zoom in Nigeria. While the authors agreed that there were tremendous advantages, including convenience and cost savings, they also pointed out that high internet data costs, unavailability of devices with access to suitable kinds, and technical issues such as power outages and poor network connectivity conditions. Reported challenges hinder effective webinar participation; despite promising professional development potential in some contexts, benefits may not be uniformly experienced. These studies show that, against the possible positive effect of webinars on the knowledge, skills, and practices of librarians as professionals, the actual effective presence of such a webinar is muted by several infrastructural and resource-related challenges. Therefore, to maximise the potential benefits of webinars toward professional development, such underlying issues should first be addressed.

Conclusion

This study evaluated the relevance, quality of resources, and professionalism contributed by some webinars held by Nigerian libraries to assess how well they aligned with the learning needs, knowledge, skills, and practices of participants. Our findings indicated that the webinars were highly relevant to participants' professional development, as nearly all respondents affirmed that they met specific gaps in their knowledge and skills. The alignment of webinar goals with current issues in library science was also strongly indicated, thus confirming that Nigerian libraries respond to the changing educational needs of their professionals. The content and technical quality of the webinars attracted a positive evaluation regarding resource material and delivery method. No single webinar was found to significantly outperform the others in bringing about perceived professional relevance or closing a knowledge gap. However, cumulative participation across different webinars is likely to have some positive effect. Nigerian libraries and professional associations are thus applauded for embracing continuous professional development through webinars, but there is a need for further strides to manage time properly during webinars, improve accessibility, engagement, and effectiveness.

Recommendations.

Based on the results of this study, the following recommendations are suggested.

1. To reduce learning disruption during the sessions, the organisers of the webinar must have a stable platform and have better audio and visual quality. In addition, they must also be equipped with technical assistance. By using more dependable webinar platforms and testing them ahead of sessions, participants could benefit.
2. Focus more on giving time to Q&A, breakout groups and participants' interaction during webinars. Encouraging active learning, instant replies to participants' queries, and sharing information.
3. Our results showed that there is a need to address time management issues. Therefore, Organisers should plan what content is delivered and how long it will take to deliver it. We should think of modular webinar designs where chunks or components would be more digestible.
4. The Nigerian government should subsidise the cost of Internet access for participants where possible, work with network providers and lobby for discounted data bundles for professional development.

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Application of AI-Powered Chatbots for Improved User Services in Selected Polytechnic Libraries in Imo, Delta and Rivers States, Nigeria

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Abstract

The research examined the application of AI-powered Chatbots for Improved User Services in Selected Polytechnic Libraries in Imo, Delta and Rivers States, Nigeria. This study adopts the case study research design. The population of the study comprised of over 600 library staff in ***Polytechnic libraries in*** *Imo, Delta and Rivers States. A sample of 10 library staff was selected from each of the 8 Polytechnic libraries in Imo, Delta and Rivers States using the cluster sampling. This makes a total sample of 60 respondents. The observation checklist and questionnaire were the research instruments used for data collection. The instrument was face validated by 3 experts. The Cronbach Alpha reliability method was used to test the internal consistency of the instrument. A reliability coefficient of 0.83 was gotten. Data collected was analyzed using descriptive statistics of mean scores and standard deviation. The study found that none of the AI-powered chatbot features such as rule-based chatbots, FAQ chatbots etc listed are currently available in the Polytechnic libraries surveyed. AI-powered chatbots are very effective in improving user services in Polytechnic libraries. The challenges of high cost of implementation, and limited technical expertise etc, affects Polytechnic libraries in adopting AI-powered chatbots. Key strategies include allocating funding, and continuous training for library staff are the structured strategies to improve the adoption and use of AI-powered chatbots. In conclusion, the study indicates that the application of AI-powered chatbots are effective in improving user services by providing accurate, timely responses and supporting resource accessibility, particularly during peak library hours. The study recommended that Government should provide adequate funding to procure the tools and systems that will enable the application of AI-powered chatbots in the Polytechnic libraries.*

Introduction

AI-powered chatbots are increasingly applied in various sectors, including academic libraries, to enhance user experiences and streamline service delivery. Chatbots, which use artificial intelligence to interact with users, are especially beneficial in providing 24/7 library services, answering frequently asked questions, and assisting with resource searches (Kumar & Malhotra, 2021). These advancements are reshaping traditional library services, making them more accessible and efficient for students and researchers. In the context of academic libraries, the application of AI-powered chatbots focuses on how effectively users leverage these tools for accessing information resources (Adebayo & Ayodele, 2019). Despite their potential, the adoption rate of AI-powered chatbots in Nigerian academic libraries remains relatively low, attributed to challenges such as inadequate funding, limited ICT infrastructure, and resistance to change among staff (Okoro & Udo, 2020). These barriers limit the ability of libraries to fully leverage the benefits of AI technologies.

AI-powered chatbots significantly improve library user services by offering 24/7 accessibility and reducing operational bottlenecks. For instance, chatbots integrated into library systems can autonomously handle routine inquiries such as book availability, renewal requests, and library hour updates, freeing librarians to focus on complex user needs (Abbasi et al., 2024). Recent studies demonstrate that chatbots equipped with natural language processing (NLP) can interpret nuanced queries, provide personalized resource recommendations, and guide users through digital platforms like institutional repositories and e-journal portals (Adeleke et al., 2024). For example, chatbots at Deakin University Library reduced user wait times by 40% while improving accuracy in directing patrons to relevant materials (Abbasi et al., 2024). Such efficiency is critical in Nigerian academic libraries, where staffing shortages and high user demand strain traditional service models. Furthermore, chatbots can be trained on local datasets to address region-specific challenges, such as multilingual support for Nigeria's diverse linguistic demographics, ensuring equitable access to marginalized user groups (Enakrire et al., 2024).

Beyond basic queries, AI-powered chatbots are increasingly deployed to support advanced research activities and foster user engagement. For example, chatbots integrated with learning management systems (LMS) can assist students in navigating academic databases, formatting citations, and identifying gaps in literature reviews. A 2024 study at Stanford University Libraries revealed that AI chatbots equipped with machine learning algorithms improved research outcomes by offering real-time suggestions for relevant articles and datasets, particularly for postgraduate students (Abbasi et al., 2024). Additionally, chatbots facilitate proactive user engagement through personalized notifications about new acquisitions, overdue items, and tailored workshop recommendations based on borrowing history (Enakrire et al., 2024). In Nigeria, chatbots could mitigate challenges like irregular power supply by enabling offline query processing and SMS-based interactions, ensuring continuous service delivery even in low-infrastructure settings (Adeleke et al., 2024). However, successful implementation requires addressing technical barriers, such as updating chatbot knowledge bases and ensuring alignment with local ICT policies.

Studies have highlighted that chatbots in academic libraries can provide personalized learning experiences, support research activities, and improve user satisfaction by reducing response times (Chen et al., 2018). However, research is scant regarding the extent to which these technologies have been integrated into library services (Agim & Azolo, 2022). Additionally, there is limited data on how students and academic staff perceive and apply these tools, indicating a significant research gap. The application of AI-powered chatbots is essential for addressing service delivery challenges in Polytechnic libraries. When effectively implemented, chatbots can mitigate resource constraints, enhance service efficiency, and promote equitable access to library resources (Eke & Nwankwo, 2021). Therefore, this study seeks to bridge the existing gap by exploring the current state of chatbot adoption in Polytechnic libraries in Nigeria and its implications for user services.

Statement of the Problem

The integration of artificial intelligence (AI) in library services has revolutionized how users access information globally. Despite the global advancements, Polytechnic libraries in Nigeria appear to lag behind in the effective application of AI-powered chatbots. In Nigeria, the limited deployment of AI-powered chatbots in Polytechnic libraries poses a challenge for students and researchers who depend on library services for timely information. Preliminary observations suggest that many Polytechnic libraries still operate under traditional systems that are unable to meet the growing demand for rapid, 24/7 services. This has led to inefficiencies such as long response times, limited access to information resources, and reduced user engagement. These inefficiencies may compromise the academic productivity of students and researchers who require seamless library services. Additionally, factors such as insufficient technological infrastructure, inadequate training of library staff, and low awareness among users may hinder the effective use of these tools. Previous studies on the application of AI technologies in Polytechnic libraries have often focused broadly on ICT adoption, without specifically addressing how AI-powered chatbots are applied to enhance library services. This creates a significant knowledge gap regarding the effectiveness and challenges of implementing such technologies in Nigeria's Polytechnic libraries; hence, this study will examine the application of AI-powered chatbots for improved user services in Polytechnic libraries in Nigeria using the following specific objectives:

1. **Assess the effectiveness of the application of AI-powered chatbots in enhancing user services in selected Polytechnic libraries in** Imo, Delta and Rivers States**.**
2. **Identify the challenges faced by Polytechnic libraries in applying AI-powered chatbots for user services in selected Polytechnic libraries in** Imo, Delta and Rivers States
3. **Suggest strategies for improving the application of AI-powered chatbots in selected Polytechnic libraries in** Imo, Delta and Rivers States**.**

Review of Related Literature

AI-powered chatbots have emerged as a transformative technology in academic libraries, enabling enhanced user services and operational efficiency. These intelligent systems utilize natural language processing and machine learning to assist users in real-time, providing information retrieval, answering queries, and guiding library users through resources (Kumar & Malhotra, 2021). Globally, the adoption of chatbots in academic libraries has grown rapidly, particularly in developed countries where technological infrastructure supports such advancements. This adoption has redefined how libraries interact with users, bridging the gap between traditional library services and the demands of digital-age users.

The availability of AI-powered chatbots in academic libraries varies significantly across regions. In many developed countries, chatbots are an integral part of library systems, offering uninterrupted services to users (Chen et al., 2018). However, in Nigerian academic libraries, the adoption of such technologies remains limited. Studies by Eke and Nwankwo (2021) indicate that inadequate funding, insufficient ICT infrastructure, and low technological literacy among library staff hinder the implementation of AI-powered solutions in libraries across Nigeria, including Nigeria. This limited availability underscores a significant disparity in access to innovative library services between Nigerian academic institutions and their counterparts globally.

Utilization of chatbots is another critical area of concern. Even in cases where chatbots are available, their effective utilization depends on factors such as user awareness, technical training of library staff, and ease of use. Adebayo and Ayodele (2019) observed that while some Nigerian universities have introduced AI tools in library systems, utilization rates remain low due to a lack of adequate promotion and user education.

Furthermore, students and researchers often revert to traditional methods of accessing library services (Ezejiofor, Agim & Ndanwu, 2022), either due to unfamiliarity with chatbot interfaces or lack of trust in AI systems' ability to deliver accurate information.

Several studies highlight the potential of chatbots in enhancing library services. AI-powered chatbots can personalize user experiences, reduce response times, and improve accessibility to library resources (Al-Farsi et al., 2022). These systems also alleviate the workload of library staff by automating repetitive tasks, enabling them to focus on complex queries and user engagement. However, the extent to which these benefits are realized in Nigerian academic libraries remains underexplored. Okoro and Udo (2020) emphasize that the absence of a cohesive policy framework for AI integration in Nigerian libraries contributes to inconsistent adoption and utilization of such technologies.

Efforts to enhance chatbot utilization must also consider the needs of library users. Research by Alimi et al. (2021) suggests that tailoring chatbot functionalities to address specific user demands, such as academic research assistance and resource recommendations, can significantly improve user satisfaction. For Nigerian academic libraries, incorporating local languages and culturally relevant content into chatbot systems could also enhance their accessibility and usability among diverse user groups.

AI-powered chatbots have significantly transformed library user services by providing immediate, personalized, and round-the-clock assistance. These intelligent virtual assistants utilize natural language processing (NLP) and machine learning algorithms to understand and respond to user queries effectively, thereby enhancing the accessibility and efficiency of library services (Abbasi et al., 2024; Adeleke et al., 2024). For instance, chatbots can autonomously manage routine tasks such as answering FAQs, guiding users through catalog searches, facilitating book renewals, and even offering personalized recommendations based on user preferences and borrowing history (Adeleke et al., 2024; Enakrire et al., 2024). This automation not only reduces wait times but also alleviates the workload on library staff, allowing them to focus on complex, specialized services. Studies have shown that libraries implementing AI chatbots report higher user satisfaction due to the convenience of 24/7 availability and the ability to provide consistent, accurate information without human delay (Abbasi et al., 2024; Lisedu Network, 2024).

The improvement in user services through AI chatbots extends beyond basic information retrieval to fostering enhanced research support and information literacy. Advanced chatbots, such as Google Bard and ChatGPT, engage users in dynamic, conversational interactions that provide contextually relevant responses and personalized guidance, enriching the overall library experience (Kaya & Yilmaz, 2023; Lisedu Network, 2024). These chatbots assist users in navigating complex academic databases, formatting citations, and identifying relevant literature, thereby supporting scholarly activities and lifelong learning (Abbasi et al., 2024). Furthermore, AI chatbots facilitate inclusive access by offering multilingual support and accessibility features for users with disabilities, ensuring equitable library service delivery (Adeleke et al., 2024). The integration of AI-driven chatbots also enables libraries to collect real-time user feedback, which informs continuous service improvement and aligns library offerings with evolving user needs (Lisedu Network, 2024).

Despite their numerous benefits, the application of AI-powered chatbots in libraries faces significant challenges. Technical issues such as maintaining up-to-date knowledge bases, ensuring data privacy, and integrating chatbots with existing library management systems pose substantial hurdles (Abbasi et al., 2024; Kaya & Yilmaz, 2023). Additionally, the high initial cost of AI implementation, limited ICT infrastructure, and resistance to technological change among library staff—particularly in developing countries—impede widespread adoption (Okoro & Udo, 2020; Adeleke et al., 2024). Ethical concerns, including potential biases in AI responses and the risk of diminishing human interaction, also require careful management to maintain user trust and service quality (Lisedu Network, 2024). Addressing these challenges demands strategic investment in staff training, robust data governance policies, and ongoing evaluation to ensure AI chatbots complement rather than replace the critical human elements of library services.

The challenges surrounding the availability and utilization of chatbots in Nigerian academic libraries are multifaceted. Key barriers include the digital divide, insufficient investments in library technologies, and resistance to change among stakeholders (Eze & Okonkwo, 2023). Addressing these issues requires concerted efforts from library administrators, government bodies, and academic institutions to develop strategies that promote the adoption and utilization of AI-powered tools in libraries. Such measures could include targeted funding, capacity-building programs for library staff, and awareness campaigns to encourage user engagement.

In conclusion, while AI-powered chatbots hold immense potential to revolutionize library services, their availability and utilization in Nigerian academic libraries, particularly in Nigeria, face significant challenges. Bridging these gaps requires investments in technology, policy development, and capacity building. Future research should focus on understanding user perceptions and developing localized solutions that address the unique needs of Nigerian academic institutions.

Methodology

This study adopted the case study research design. The population of the study comprised of over 600 library staff in **Polytechnic libraries in** Imo, Delta and Rivers States. A sample of 10 library staff was selected from each of the Polytechnic libraries in Imo, Delta and Rivers States using the cluster sampling. This makes a total sample of 60 respondents. The Polytechnic libraries were: Federal Polytechnic Nekede, Owerri, Imo State;

Imo State Polytechnic, Umuagwo, Imo State; Delta State Polytechnic, Ozoro, Delta State; Delta State Polytechnic, Ogwashi-Uku, Delta State; Delta State Polytechnic, Otefe-Oghara, Delta State; Port Harcourt Polytechnic (Captain Elechi Amadi Polytechnic), Rivers State; Rivers State Polytechnic (Kenule Beeson Saro-Wiwa Polytechnic), Bori, Rivers State; and Federal Polytechnic of Oil and Gas, Bonny, Rivers State. The observation checklist and questionnaire were the research instruments used for data collection. The instrument was face validated by 3 experts. The Cronbach Alpha reliability method was used to test the internal consistency of the instrument. A reliability coefficient of 0.83 was gotten. Data collected was analyzed using descriptive statistics of mean scores and standard deviation

Results and Discussion

Research Question 1: How effective is the application of AI-powered chatbots in enhancing user services in Polytechnic libraries in Nigeria?

This table will present analysis on **effectiveness of the application of AI-powered chatbots in enhancing user services**

Table 1: Mean Responses on effectiveness of the application of AI-powered chatbots in enhancing user services

S/N	Items	Mean	SD	Remarks
1	The AI-powered chatbot provides accurate answers to most library-related questions.	3.12	0.75	Very effective
2	Using the AI chatbot saves time for users by providing quick responses to inquiries.	3.48	0.60	Very effective
3	The AI chatbot in the library effectively assists users in locating digital resources, such as e-books and journals.	3.25	0.82	Very effective
4	The AI-powered chatbot is helpful in guiding users through the library catalog and databases.	3.34	0.78	Very effective
5	The chatbot successfully handles frequently asked questions, reducing the need for direct librarian assistance.	3.10	0.65	Very effective
6	Users find the AI-powered chatbot's responses to be clear and easy to understand.	3.15	0.79	Very effective
7	The chatbot provides effective support during peak hours when librarians may be unavailable	3.28	0.81	Very effective
	Grand Mean	**3.25**		**Very effective**

The table reveals that the application of AI-powered chatbots is highly effective in enhancing user services in Polytechnic libraries. All items achieved mean scores above the 2.50 benchmark, indicating "very effective" performance across all evaluated aspects. Specifically, the chatbots provide accurate answers, save users' time, assist in locating digital resources, guide users through library systems, handle FAQs, deliver clear responses, and offer essential support during peak hours. The grand mean of 3.25 confirms that the application of AI-powered chatbots are overall very effective in improving user services in Polytechnic libraries.

The findings of this study align with Adebayo et al. (2019), who observed that the application of AI-powered systems significantly improved user satisfaction by reducing response times and providing accurate information in Nigerian Polytechnic libraries. Similarly, Luo and Cheng (2021) emphasized that chatbots in academic libraries enhance resource accessibility and enable users to efficiently navigate catalogs and databases, reflecting the "very effective" rating across the items in this study. Moreover, Boulianne et al. (2022) reported that the application of AI-driven tools in libraries positively influences user experience, particularly during peak hours when human assistance may be limited. This corroborates the high mean scores for chatbot support during such times in this study. Overall, these findings underscore the transformative impact of the application of AI-powered chatbots in academic environments.

Research Question 2: What are the challenges faced by Polytechnic libraries in applying AI-powered chatbots for user services?

This table will present analysis on the **challenges faced by Polytechnic libraries in applying AI-powered chatbots for user services**

Table 2: Mean Responses on the challenges faced by Polytechnic libraries in applying AI-powered chatbots for user services

S/N	Items	Mean	SD	Remarks
1	The high cost of implementing AI-powered chatbots is a major barrier to adoption in Polytechnic libraries.	3.18	0.56	Agree
2	Limited technical expertise among library staff poses a challenge in managing and maintaining AI-powered chatbots.	3.05	0.61	Agree
3	Privacy concerns about user data hinder the adoption of AI-powered chatbots in the library.	3.47	0.49	Agree
4	Integrating AI chatbots with existing library systems and databases is a complex process.	3.32	0.52	Agree
5	Insufficient funding and budget allocations make it difficult to adopt AI-powered chatbots in Polytechnic libraries.	3.19	0.58	Agree
6	Users may have a lack of trust in AI chatbots, preferring direct interaction with librarians for their inquiries.	3.26	0.55	Agree
7	The constant need for updates and improvements in AI technology is a challenge for sustained adoption in the library	3.30	0.54	Agree
	Grand Mean	**3.25**		Agree

The table reveals that all respondents agree that several challenges impede the application of AI-powered chatbots in Polytechnic libraries, as evidenced by mean scores above the 2.50 benchmark for all items. The challenges include the high cost of implementation, limited technical expertise, privacy concerns, complexity in integration with existing systems, insufficient funding, user mistrust, and the constant need for technological updates. The grand mean of 3.25 further underscores a strong agreement on these challenges across respondents which highlights that Polytechnic libraries face significant challenges in the application of AI-powered chatbots

The findings of this study align with Chakraborty and Saha (2020), who emphasized that the high cost of AI implementation and insufficient funding are primary barriers to AI application in developing countries' academic libraries. Similarly, privacy concerns and the complexity of integrating AI tools with existing library management systems often delay their application, consistent with the high mean scores for these challenges in this study. Additionally, Park et al. (2019) highlighted that user trust issues and limited technical expertise among library staff hinder the effective deployment of AI technologies, corroborating the findings of this study. These studies underscore the multifaceted nature of the challenges that must be addressed to maximize the application of AI-powered chatbots in Polytechnic libraries.

Research Question 3: What strategies can be implemented to improve the application of AI-powered chatbots in Polytechnic libraries in Nigeria?

This table will present analysis on **the strategies for improving the application of AI-powered chatbots in Polytechnic libraries**

Table 3: Mean responses on strategies for improving the application of AI-powered chatbots in Polytechnic libraries

SN	Items	Mean	SD	Remarks
1	Allocating dedicated funding and resources for AI chatbot implementation can improve their availability and effectiveness in Polytechnic libraries.	2.87	0.78	Agreed
2	Offering continuous training programs for library staff can enhance their ability to manage and update AI-powered chatbots effectively.	3.13	0.72	Agreed
3	Ensuring user data privacy and security through robust encryption can build user trust in AI chatbots.	2.97	0.83	Agreed

4	Collaborating with technology vendors and experts can simplify the integration of AI chatbots with existing library systems.	3.09	0.76	Agreed
5	Conducting regular user feedback surveys can help in improving the functionality and user-friendliness of AI-powered chatbots.	3.10	0.68	Agreed
6	Creating awareness programs to educate users on the benefits of AI-powered chatbots can increase their acceptance and use.	2.92	0.81	Agreed
7	Establishing clear protocols for chatbot updates and maintenance can improve the long-term effectiveness of AI-powered chatbots in libraries	3.12	0.74	Agreed
	Grand Mean	3.04		Agreed

The table shows that all respondents agree on the proposed **strategies for improving the application of AI-powered chatbots in Polytechnic libraries**, as evidenced by mean scores above the 2.50 benchmark. Key strategies include allocating funding, continuous training for library staff, ensuring data privacy, collaborating with technology vendors, conducting user feedback surveys, awareness creation, and establishing protocols for updates and maintenance. The grand mean of 3.04 indicates a strong consensus on these strategies which gave a unanimous agreement on the necessity of implementing structured strategies to improve the application of AI-powered chatbots.

The findings of this study are consistent with the results of Chen and Liu (2021), who emphasized that adequate funding and continuous staff training are crucial for the successful implementation of AI technologies in libraries. They found that libraries that allocated a dedicated budget for AI innovations observed increased user satisfaction and chatbot efficiency. Similarly, Patel et al. (2019) reported that addressing user concerns regarding data privacy and security builds trust and improves the utilization of AI systems. Their research found that libraries implementing robust encryption protocols experienced higher user engagement with AI-powered services.

Conclusion

The findings from the study demonstrate a comprehensive evaluation of the application of AI-powered chatbots in Polytechnic libraries, focusing on their effectiveness, challenges, and strategies for improvement. The results indicate that the application of AI-powered chatbots are effective in enhancing user services by providing accurate, timely responses and supporting resource accessibility, particularly during peak library hours. However, their application face challenges such as high implementation costs, limited technical expertise, user privacy concerns, and the complexities of system integration. Despite these challenges, the study highlights actionable strategies to address these barriers, including dedicated funding, staff training, robust data privacy measures, collaborative partnerships, and user engagement initiatives. These measures are strongly agreed upon by respondents as necessary for improving the application of AI-powered chatbots in Polytechnic libraries. Overall, the study underscores the potential of AI-powered chatbots to transform service delivery in Polytechnic libraries, provided that institutions adopt proactive measures to address implementation challenges and foster user trust. The integration of these strategies could lead to more efficient library operations, enhanced user satisfaction, and broader acceptance of AI technologies in academic settings.

Recommendations

Based on the findings of the study, several recommendations were made to address the identified problems:

1. Government should provided adequate funding to procure the tools and systems such as Libraria, KingbotGPT, LINK AI Chatbot, Botsonic, and Dialogflow that will enable the application of AI-powered chatbots in the Polytechnic libraries
2. Polytechnic libraries should enhance the capabilities of AI-powered chatbots to provide more accurate and contextual responses by investing in advanced natural language processing (NLP) technologies.
3. Libraries should organize workshops and orientation programs to familiarize users with the features and benefits of AI-powered chatbots, increasing user engagement and satisfaction
4. Polytechnics should prioritize budget allocations for AI chatbot implementation, ensuring resources are available for acquisition, maintenance, and periodic upgrades.
5. Polytechnics should provide continuous training for library staff to equip them with the technical expertise required to manage and maintain AI-powered chatbots effectively.

6. Polytechnic libraries should partner with technology vendors and AI experts to simplify chatbot integration and ensure seamless operation within existing library systems.

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Application of Blockchain Technology and Information Security Management in Enhancing Data Integrity and Security in Private Schools of Nursing Science Libraries in Anambra State

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Abstract
The study objective was to examine the application of blockchain technology and information security management in enhancing data integrity and security in private schools of nursing science libraries in Anambra State. The study, specifically, examined the types of Blockchain technology that can be applied in the library; find out the different information security management that can be applied in private schools of nursing science libraries, find out the areas and benefits of the application of Blockchain technology and information security management in library service delivery. The study was guided by four research questions; empirical survey design was used for the study and the population for the study was all the 15-library staff that work in three private schools of nursing science libraries in Anambra State. The data was analysed using mean scores and percentages. The findings of the study revealed that the different types of Blockchain technology that can be used in the library are Public Blockchain and Private Blockchain. The study found out that the different information security management that can be applied in private nursing science institutions libraries are access control, data encryption, physical security, backup and disaster recovery, regular security audit, and user training awareness. It also found out that Blockchain technology can enhance data integrity and information security management by offering key benefit like traceability of information, transparency and improved information security. The study recommends that library management should ensure secure access control and leverage on the benefits of blockchain technology to create awareness in the use of blockchain technology in enhancing data integrity and security in libraries.

Keywords: *Blockchain technology, Information security management, Data integrity, Data security.*

Introduction

Block chain technology according to (Conway, 2020) is a type of database in which data or information are structured and filed in groups, known as blocks, that holds sets of information; which are then chained unto previously filed blocks, forming a chain of data/information known as block chain. Chingath & Babu, (2020) view block chain as a growing list of records, called blocks that are linked using cryptography, with each block containing a cryptographic hash of the previous block, a timestamp, and transaction data generally represented as a Merkle tree. Block chain is one of the emerging technologies that have ushered the 5th Industrial Revolution (5th IR). It is a fast growing technological inventions in the last decade that attracts attention for its widespread cyber security capabilities, and the promises it holds to provide security, transparency, immutability and privacy of data, from supply chain management to crypto-currency and shipping, e-voting and others (Atienza-Mendez & Bayyou, 2019). In addition, (Rosic, 2020) posited that it is a highly secured, and ingenious way of storing and transferring or sharing digital information among parties or organizations. When one party creates and dispatches a set or block of information, it is verified by thousands, and even millions of computers distributed around the net. The verified block of information is added to a chain, which is stored across the net, creating not just a unique record, but a unique record with a unique history. Falsifying a single record would mean falsifying the entire chain in millions of instances. That is somewhat impossible! (Rosic, 2020).

In fact, Blockchain can improve authentication processes for users accessing library resources and services. By implementing decentralized identity management, libraries can offer secure access to resources while protecting user privacy. Blockchain can ensure that library users' identities are securely stored and verified, eliminating the need for centralized systems and reducing the risk of data breaches.

Data integrity refers to the accuracy, consistency, and completeness of data throughout its lifecycle, ensuring it remains reliable and trustworthy. Data security is crucial for all types of library and librarians because data is a valuable asset that can be used in making decisions, providing high quality services for consumers and increasing operational efficiency. Rosic (2020) who posited that if an organization does not

have adequate information security management, then the organization can easily be exposed to data security attacks; hence the need for them to be conversant with the different information security management that they can utilize; because without good data security management, organizations can lose data, experience identity theft, damage their reputation and suffer significant financial losses Data security is the practices, measures and technologies implemented to protect data from unauthorized access, corruption, theft or losses.

It is crucial for ensuring that sensitive and personal information is kept safe from malicious threats and security breaches. The main objectives of data security are confidentiality, integrity, and availability. Therefore, the need to create awareness for the need to enhance data security and integrity in libraries motivated this study on application of blockchain technology and information security management in enhancing data integrity and security; because according to Orakpor and Omoruyi (2022) Libraries basic function is to acquire knowledge, preserve knowledge and disseminate knowledge.

Statement of the Problem

The excess of application of blockchain technology in libraries includes proper keeping of records of transactions between book vendor and acquisition section to track overdue books, blockchain keep records of serial publications acquired in the library to facilitate interlibrary loan, whereas management information security in libraries enhances availability, authenticity, confidentiality and data integrity ensuring a well-balanced and designed system for the libraries. Unfortunately, it has been observed that many libraries and librarians seem not to know the benefits of the application of blockchain technology in libraries.

Therefore, if these blockchain technology and information security management are not applied in the library as other technologies has been applied in the libraries; it would mean having a conservative library service delivery that depend on and maintain only the traditional method of library service delivery; which could lead to loss of transaction between the vendor and acquisition records; to track overdue books could become a big challenge that may lead to loss of serial publication records. Moreover librarian will not have the required exposure for them to know the different types of blockchain and information security management to apply in the library service delivery. It is against this background that the study set out to examine the application of blockchain technology and information security management in enhancing data integrity and security in private schools of Nursing Science libraries in Anambra state.

Research Objectives

The main study objectives was to examine the application of blockchain technology and information security management in enhancing data integrity and security in private schools of nursing science libraries; specifically the study sought to:

1. Identify the types of Blockchain technology that can be applied in the schools of nursing science library;
2. Find out the different information security management that can be applied in private schools of nursing science libraries.
3. Examine the areas of the application of blockchain technology and information security management in library service delivery.
4. Ascertain benefits of Blockchain technology in the enhancement of data integrity and information security management.

Research Questions

The study was guided by four research questions

1. What are the types of block chain technology that can be applied in the schools of nursing science libraries?
2. What are the different information security management that can be applied in private schools of nursing science libraries?.
3. What are the areas of the application of blockchain technology and information security management in library service delivery?
4. What are the benefits of blockchain technology in the enhancement of data integrity and information security management?

Literature Review

Blockchain technology is a structure that stores transactional records also known as the “Chain” in a network connected through peer-to-peer nodes. Typically this storage is referred to as a digital ledger is authorized by the digital signature of the owner which authenticates the transaction and safeguards it from tampering. Hence, the information the digital ledger contains is highly secured. In simpler words, the digital ledger is like a goggle spreadsheet shared among numerous computers in a network, in which, the transactional records are stored based on actual purchases. The fascinating angle is that anybody can see the data, but cannot corrupt it.

Types of blockchain technology that can be applied in the library

Blockchain technology are of various types Public Blockchain, Private Blockchain, Consortium or Federated Blockchain and hybrid Blockchain. (Tripathi, G; Ahad, M.A and Casalino, G, 2023).Public blockchain as the name implies is for open use and it is transparent and can be decentralized for use; example is bitcoin Private blockchain is owned, controlled and restricted by the organization that owns it; example is hyperledger fabric. Consortium or federated blockchain involes groups coming together to collaborate in the application of the technology; it is semi-decentralised; R3 corda. Hybrid blockchain is a combination of the three type. It is flexible in nature and allows for both transparency and security control. (Campbell and Pacheco, 2025)

Different information security management that can be applied in libraries.

Information Security Management (ISM) as opined by Ahmad and David (2020) refer to the practices, policies, and procedures that an organization puts in place to protect its information assets, including data, systems, networks, and software, from potential threats, vulnerabilities, and attacks. The primary goal is to safeguard the confidentiality, integrity, and availability of information, ensuring that sensitive information is protected from unauthorized access or damage, and that it is available when needed. Rosic (2020) explained that the different types of information Security Management typically include:

Information Security Policies, Risk Management, Security Controls, Access **Control, Incident Management, Compliance and Legal Requirements, Training and Awareness, Continuous Improvement, Business Continuity and Disaster Recovery,** Frameworks and Standards.

Areas of the application of blockchain technology and information security management in library service delivery.

Libraries and information centres need to adopt this technology and take advantage of its benefits for enhanced services delivery and user experience. Blockchain technology can help libraries to adopt a secured, and transparent system for recording and verifying library transactions because it has several potential applications in library and information services. Block chain according to Rosic (2020) services can be integrated into library in areas like

Preservation of Digital Records: Libraries have a responsibility to preserve valuable digital content for future generations. Block chain's immutable ledger could be used to store and validate digital objects or records, ensuring that they are preserved without risk of alteration. This could be particularly useful for archives, governmental records, or cultural heritage materials where maintaining authenticity and integrity is critical.

Access to Scholarly Publications: In the academic world, the rising cost of journal subscriptions and pay walls has created barriers to knowledge access. Blockchain can potentially help shift scholarly publishing to open-access models. In support of this Chingath and Babu (2020) stated that using blockchain in the library will help ensure access control of information; hence publishers, authors, and researchers can transact directly with the libraries without intermediaries, thereby, reducing costs and increase transparency in the publishing process. This model can also offer new ways to reward authors based on usage or citation, potentially reducing the pay-to-publish concerns.

Crowd sourced Cataloging and Metadata Creation: Blockchain can facilitate collaborative cataloging efforts, where contributors (e.g., librarians, researchers, or the public) can add metadata or assist in the cataloging process in a secure and transparent manner. The use of block chain would provide verifiable records of who added or modified metadata and ensure the integrity of the cataloging process. (Chingath and Babu, 2020).

Benefits of Block chain Technology in the enhancement of data integrity and information security management

Data Integrity and Provenance: In library environments, blockchain can be used to maintain the provenance of information, ensuring the accuracy and authenticity of data. For example, when libraries handle historical documents, manuscripts, or rare collections, technology like blockchain can document the provenance of these items, tracking every transaction (e.g., who accessed them, when, and why). This could offer a trusted, verifiable record of an object's history. This will require digital skills to handle as well as knowledge and ethics. (Okeji, Nwankwo, Anene and Olorunfemi, 2020).

Collaborative Resource Sharing and Interlibrary Loans: Blockchain can enhance interlibrary loan (ILL) systems by creating a decentralized, transparent platform for sharing resources among libraries. Smart contracts could facilitate the terms and conditions of resource sharing and manage borrowing limits, due dates, and fees, creating an efficient and tamper-proof method for interlibrary loan transactions.

Tokenization of Library Resources: Blockchain enables the creation of tokens that could represent ownership or access to a specific resource. Libraries could tokenize digital assets such as books, journals, or multimedia files, which could be traded, borrowed, or sold in a controlled and transparent manner. This could provide new revenue models or more equitable access to resources.

Enhanced Transparency and Accountability: Blockchain's inherent transparency can be beneficial for library management, Tripathi, G; Ahad, M.A and Casalino, G (2023) believes this could offer a trusted, verifiable record of an object's history. This will require digital skills to handle as well as knowledge and ethics; particularly in areas like budgeting, funding allocation, and reporting. For example, donations to a library could be tracked through block chain, ensuring that funds are used as intended and giving donors a transparent view of how their contributions are spent. (Tripathi, G; Ahad, M.A and Casalino, G, 2023).

Data Privacy and User Control: Block chain can give library patrons more control over their personal data. In the case of data collection for library services (such as tracking reading habits or borrowing history), block chain allows users to have a transparent view and control over what data is shared and how it is used, thus addressing privacy concerns.

Methodology

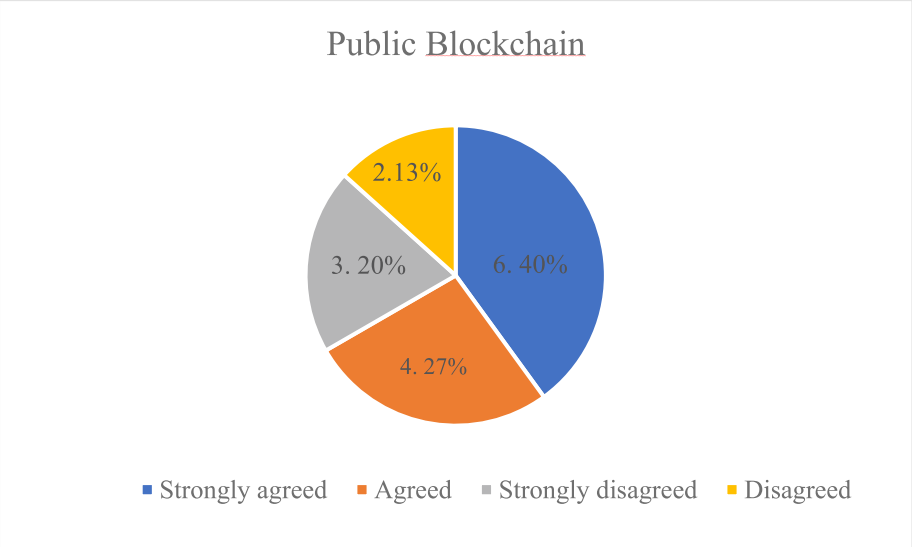
The descriptive survey design was adopted for this study using a total population of 15 library staff that worked in three private Colleges of Nursing Science in Anambra state, which include Millennium College of Nursing Science Awka (4), College of Nursing Science, Adazi Nukwu (6) College of Nursing Science Alor (5). The library employees of these three libraries form the study's population, because the population was small, sampling was not necessary hence the entire population was used; 27 item statements structured questionnaire was used to collect data. All the 15 copies of the questionnaire collected were analysed using mean scores and percentage.

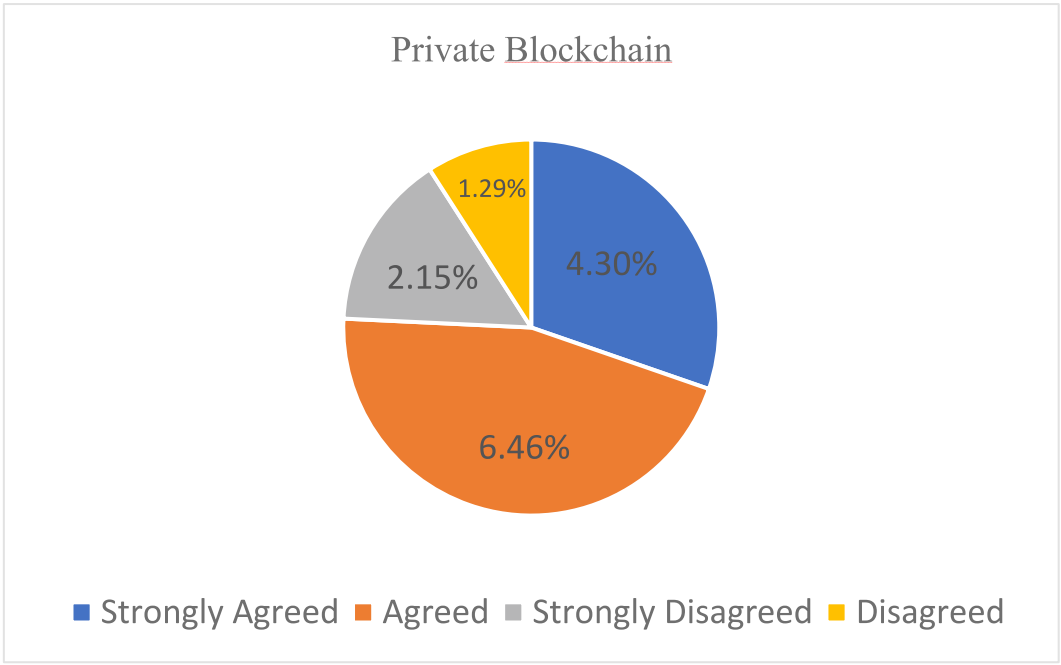
Results/ Discussion

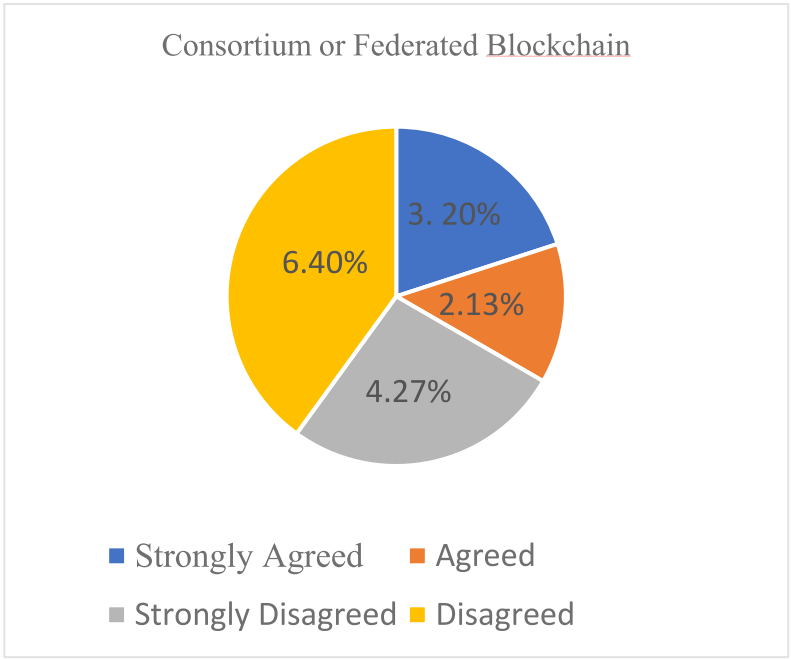
Research Question 1: What are the types of blockchain technology that can be applied in the schools of nursing science libraries?

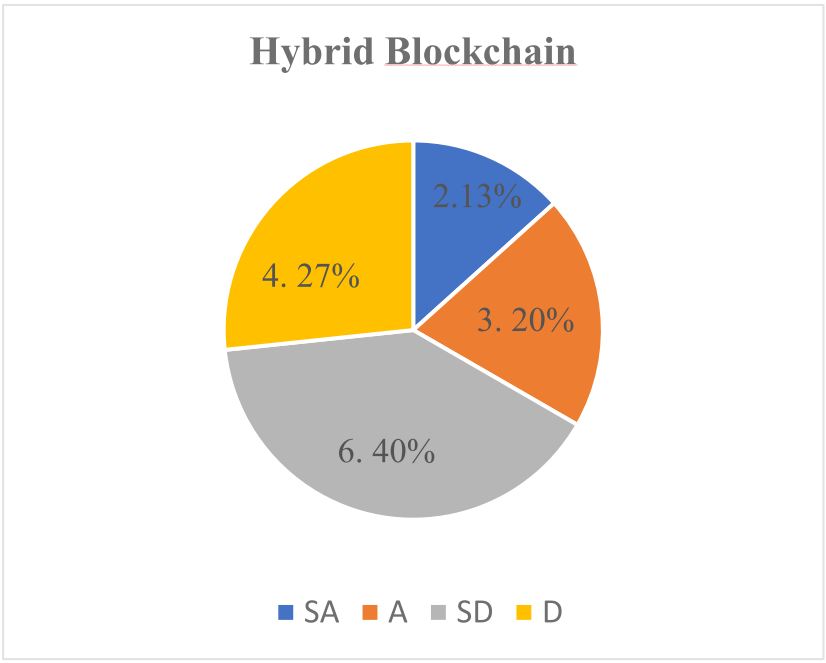
Table 1**: Mean score responses of.**

S/N	ITEM	SA	A	SD	D	TOTAL	MEAN	DECISON
1.	Public Block chain	6	4	3	2	15	2.93	Agreed
2.	Private Block chain	4	6	2	3	15	2.73	Agreed
3.	Consortium or Federated Block chain	3	2	4	6	15	2.13	Rejected
4.	Hybrid block chain	2	3	6	4	15	2.20	Rejected




Private Blockchain
1.29%
4.30%
2.15%
6.46%
Strongly Agreed
Agreed
Strongly Disagreed
Disagreed


Consortium or Federated Blockchain
3. 20%
6.40%
2.13%
4.27%
Strongly Agreed
Agreed
Strongly Disagreed
Disagreed


Hybrid Blockchain
2.13%
4. 27%
3. 20%
6. 40%
SA
A
SD
D

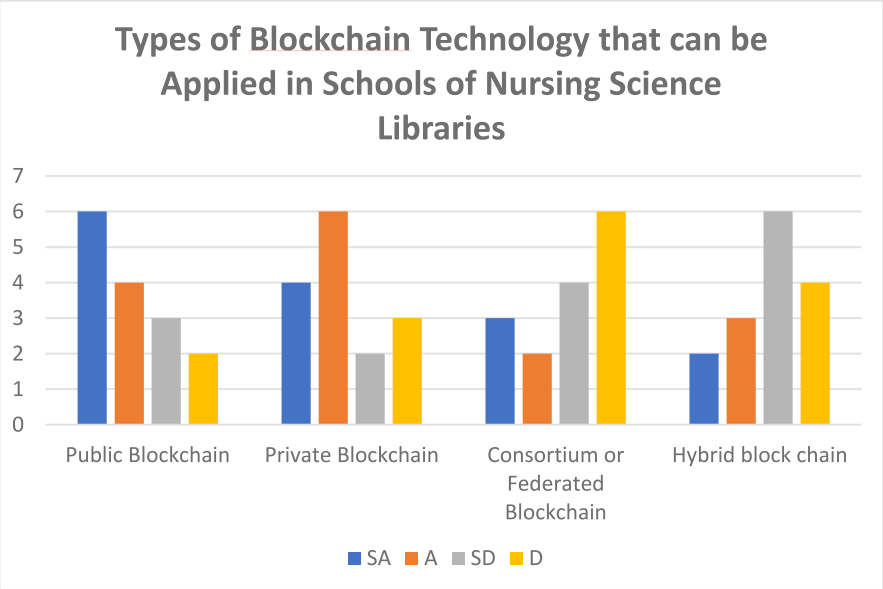


Figure 1: Pie & Bar chart showing the rate of types of blockchain technology that can be applied in the schools of nursing science libraries.

Table 1: revealed that two respondents had above mid-point of (2.50) the mean scores suggest that those respondents agreed that public blockchain with the mean score of (2.93) and private blockchain {2.73) are the types of blockchain technology that can be applied in the schools of nursing science libraries. This corresponds with the pie and bar chart percentages that the respondents also agreed with the item statements. The other respondents with the mid-point of (2.50) implies that hybrid blockchain and consortium or federated blockchain are not accepted by the respondents.

The findings clearly show that public blockchain, private blockchain amongst others are agreed blockchain technology that can be applied in libraries. This study is in consonance with the view of Yli-Huumo etal. (2016) that these blockchain are networks where everyone can view ledger and validate transaction in library operation. Campbell and Pacheco, (2025) also indicated that there are four types of blockchain technology which includes Public blockchain, Private blockchain, Consortium or federated blockchain and Hybrid blockchain.

Research Question 2: What are the different information security management that can be applied in private schools of Nursing Science libraries?

Table 2: Mean score responses of the different information security management that can be applied in private schools of Nursing Science libraries.

S/N	ITEM	SA	A	D	SD	TOTAL	MEAN	DECISION
1.	Access Control	5	4	4	2	15	2.80	Agreed
2.	Data Encryption	4	3	4	4	15	2.46	Agreed
3.	Physical Security	2	3	6	4	15	2.20	Agreed
4.	Backup & Disaster Recovery	5	4	4	2	15	2.80	Agreed
5.	Security Policies & Procedures	4	2	5	4	15	2.40	Rejected
6.	User-Virus & Malware protection	5	4	3	3	15	2.73	Agreed
7.	Regular Security Audits	3	7	3	2	15	2.73	Agreed
8.	Anti-Virus & Malware	6	4	2	3	15	2.86	Agreed
9.	Compliance with legal and regulatory standards.	7	3	2	3	15	2.93	Agreed

Table 2: Shows items that were structured on a 4 point scale that ranges from Strongly Agreed – SA (4 points), Agreed- A (3 point), Disagreed – D (2 points) and Strongly Disagreed –SD (1 point). From table 2, item 1, Access control (2.80), item 4 (2.80), item 6, User-Virus & Malware protection (2.73), item 7, (2.73), Regular Security Audits, item 8, (2.86) Anti-Virus & Malware, item 9, (2.93) Compliance with legal and regulatory standards, were all above the mid-point therefore, they were agreed on by the respondents as the different information security which also corresponds with the pie and bar chart percentages that the respondents also agreed with the item statements.

This finding agrees with the work of Ahmad and David, (2020) and Rosic (2020) that Information Security Management (ISM) are the practices, policies, and procedures that an organization puts in place to protect its information assets, including data, systems, networks, and software, from potential threats, vulnerabilities, and attacks.

Research Question 3: What are the areas of the application of Blockchain Technology and Information Security Management in library Service delivery?

Table 3: Mean scores response on the areas of Blockchain Technology and Information Security Management in library service delivery.

S/N	ITEM	SA	A	D	SD	TOTAL	MEAN	DECISION
1.	Access control to ensure only authorized users.	10	3	1	1	15	3.46	Agreed
2.	Secure transactions	12	1	1	1	15	3.60	Agreed
3.	Library data Security	11	2	1	1	15	3.53	Agreed
4.	Intellectual Property protection	2	9	3	1	15	2.80	Agreed
5.	Library inventory management	10	2	2	1	15	3.40	Agreed
6.	Inter library loan management	4	7	2	2	15	2.93	Agreed

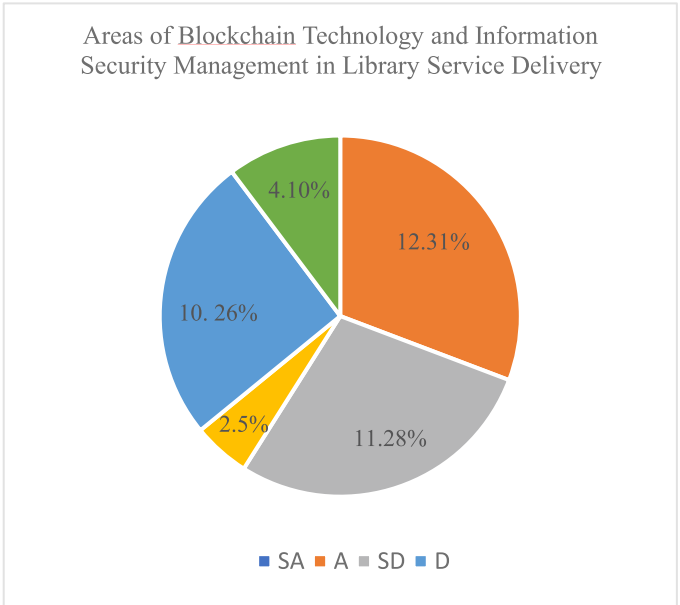


Table 3: A Pie chart showing the mean score on the areas of Blockchain Technology and Information Security Management in library service delivery.

Table 3: reveals that many respondents had above the mid-point (2.50) showing that all the respondents agreed with the fact that item 1; Access control to ensure only authorized users (3.46); item 2, Secure transactions (3.60); item 3, Library data Security (3.53); item 4, Intellectual Property protection (2.80); item 5, Library inventory management (3.40), and item 6, Inter library loan management (2.93) are the major areas of blockchain technology and information security management in library service delivery; which also corresponds with the pie and bar chart percentages that the respondents also agreed with the item statements.

The finding is in line with the studies of Chingath and Babu (2020) that using block chain in the library will help ensure access control of information; hence publishers, authors, and researchers can transact directly with the libraries without intermediaries, thereby, reducing costs and increase transparency in the publishing process.

Table 4: Column and Pie chart showing the Mean scores responses on the benefits of blockchain technology in the enhancement of data integrity and Information Security Management in the library.

S/N	ITEMS	SA	A	D	D	TOTAL	MEAN	DECISION
1.	Enhanced data Integrity	5	3	5	2	15	2.73	Agreed
2.	Improved Information Security	10	2	2	1	15	3.40	Agreed
3.	Reduced Fraud	10	2	2	1	15	3.40	Agreed
4.	Improved trust and collaboration	10	2	1	2	15	3.30	Agreed
5.	Decentralization	7	3	2	3	15	2.90	Agreed
6.	Security through Cryptography	10	3	1	1	15	3.50	Agreed
7.	Transparency	7	4	2	2	15	3.10	Agreed
8.	Traceability of information	12	1	1	1	15	3.60	Agreed

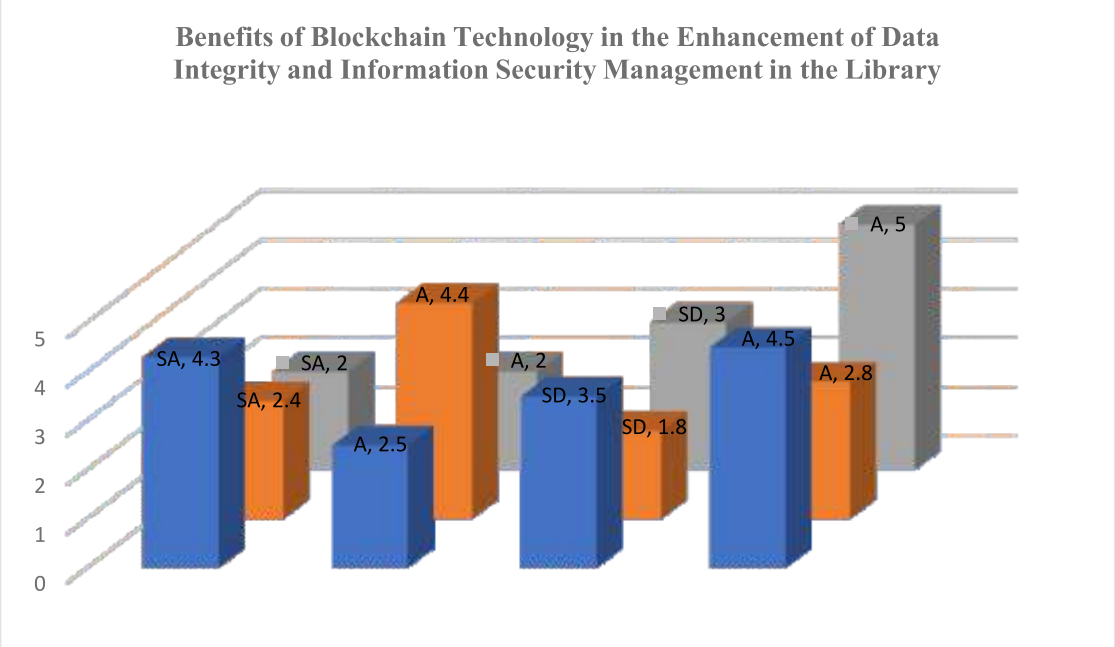


Table 4 and Figure 4, revealed that respondents mean scores were above the mid-point (2.50) which indicate that the respondents agreed that all the stated item statements were the benefits of blockchain technology in the enhancement of data integrity and information security management. Presented here is their order of agreement ranking: Improved Information Security (3.40); Reduced Fraud (3.40); improved trust and collaboration (3.30); and Traceability of information (3.60) amongst others.

This finding is in consonance with the study of some researchers like Okeji, Nwankwo, Anene and Olorunfemi (2020) that when libraries handle historical documents, manuscripts, or rare collections, technology like blockchain can document the provenance of these items, tracking every transaction like who accessed them, when, and why? Tripathi, G; Ahad, M.A and Casalino, G (2023) believes this could offer a trusted, verifiable record of an object's history. This will require digital skills to handle as well as knowledge and ethics.

Conclusion

The study examined the application of blockchain technology and information security management in enhancing data integrity and security in private schools of nursing science libraries. It addressed four objectives and four research questions.Empirical survey design was used for the study and the population for the study was all the library staff that work in three private schools of nursing science libraries in Anambra State.

The findings of the study revealed the different types of Blockchain technology that can be used in the library like Public Blockchain and Private Blockchain. The study also found out that the different information security management that can be applied in private nursing science institutions libraries are access control, data encryption, physical security, backup and disaster recovery, regular security audit, and user training awareness. It also found out that blockchain technology can enhance data integrity and information security management by offering key benefit like traceability of information, transparency and improved information security. This study has contributed to the body of knowledge in that the study has closed a gap in literature in the area of the application of blockchain technology in library service delivery; particularly, in private nursing schools.

Recommendations

The study made the following recommendations:

Librarians should collect their data in block for easy accessibility. Librarians should embrace new practices by knowing types of blockchain technology, areas of application and the benefits; thereby, employing different information security management and blockchain technology that can help private schools of nursing science libraries deliver their services effectively. Library Management should formulate policies that would make librarians and researchers see the need to have a better understanding of the areas of the application of blockchain technology and information security management in library service delivery. Library management system should ensure secure access control and leverage on the benefits of blockchain technology to create awareness in the use of blockchain technology in enhancing data integrity and security in private schools of nursing science libraries in Anambra State.

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Application of Human Machine Collaboration for Re-imagining Library Service Provision: A 5IR Model for Academic Libraries in Nigeria

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Abstract

The paper examines the application of Human-Machine Collaboration (HMC) to improve library service delivery in academic libraries in Nigeria. The paper explain that This shift was driven by the advances of the Fifth Industrial Revolution (5IR), which focused on building strong partnerships between human intelligence and technology. This study aimed to close that gap by developing a 5IR-driven HMC model designed for Nigerian academic libraries. The paper adopted systematic review as the methodology for the study ffollowing the PRISMA framework, a systematic review of 118 relevant studies published between 2015 and 2025 was carried out. The review examined existing global HMC models, evaluated technological infrastructure and readiness in Nigerian academic libraries, and explored the possible applications of 5IR technologies such as Artificial Intelligence, Machine Learning, Data Analytics, Robotics, and Extended Reality. It also analysed the benefits, challenges, and strategies for implementing these technologies. The findings showed that while many countries had already advanced in HMC use, Nigeria still faced serious issues like unreliable power supply, poor internet connectivity, lack of funding, and limited technical expertise. In response, the study proposed a new, context-sensitive 5IR model. This model emphasized gradual adoption, local adaptation, human-cantered design, better use of resources, and stronger collaboration networks. It provided a practical guide for Nigerian academic libraries to overcome existing barriers, improve service quality, and stay relevant as intelligent technologies continued to evolve.

Keywords: *Library Services, Human-Machine Collaboration, 5th Industrial Revolution, 5IR Model, Academic Libraries in Nigeria*

Introduction

Efficient and effective service provision is at the heart of every library. To maintain high quality services, libraries across the globe always adapt or adopt technologies to facilitate their routines. Similarly, academic libraries, like others, tend to embrace emerging technologies to enhance the management of their information resources and services. One of such technologies is Machine Learning (ML) which is a branch of artificial intelligence (AI) by which computers are trained to learn from data, spot patterns, and make decisions without being directly programmed for each task.

An effective computer operation is more often than not anchored on a tripartite collaboration (Odu & Ojo, 2021) such as the hard-ware, soft-ware and human-ware. It is on the basis of this model that this study was conceived to leverage the power of interaction between human and machine for a better library service delivery—hence the Human-Machine Collaboration.

The Human-Machine Collaboration (HMC) refers to the dynamic partnership between human intelligence and artificial systems to achieve goals more efficiently than either entity could accomplish alone. In the context of library services, HMC manifests through the integration of artificial intelligence (AI), robotics, machine learning, and digital interfaces into traditional library operations. Rather than replacing librarians, these technologies augment their abilities, enable faster service delivery, broaden access to information, and offer more personalized user support (Omeluzor, Abayomi, & Gbemi-Ogunleye, 2021). In academic libraries, HMC is expected to facilitate automation of routine tasks such as cataloguing, classification, metadata management, and reference services, allowing librarians to focus on more complex user-centred roles.

HMC has evolved to align with user expectations for rapid access to knowledge in the digital age. As Busari (2024) notes, users increasingly demand personalized services, which HMC frameworks can efficiently provide. AI-driven recommendation systems, automated search assistants, and chatbot-supported reference desks exemplify how human ingenuity and machine precision converge to enhance service delivery. Furthermore, HMC can empowers academic libraries to maintain relevance by aligning their services with the digital literacy trends among students and researchers.

Different models of Human-Machine Collaboration exist within academic libraries such as task automation, where machines independently handle repetitive operations like check-in/check-out services, inventory control, and overdue notifications (Treadwell & Cogswell, 1994). Another is the assisted decision-making model, where AI systems provide data-driven insights for collection development, resource allocation, and user behaviour analysis, but humans make the final judgments (Markgren, 2020). More advanced models include collaborative intelligence, where human librarians and AI systems jointly participate in research

support, information literacy training, and digital reference services. For example, chatbots powered by natural language processing can answer basic inquiries while referring complex queries to human librarians for specialized handling (Ifijeh, 2011; Omotayo, 2011). Robotic assistants in libraries, such as shelf-scanning robots and information kiosks, also embody the human-machine partnership paradigm (Atkinson, 2018b).

The integration of HMC into academic library operations can offer numerous advantages. It can address challenges relating efficiency by automating labour-intensive tasks, thereby allowing librarians to redirect their efforts to more intellectually demanding roles (Bolt, 2015), improves service accessibility by providing 24/7 support through virtual agents and digital platforms ((Mwageni, 2021), caring for the diverse needs of a global academic audience (Ogochukwu, 2024), fosters data-driven service innovation by analysing user behaviour and preferences (Jesudason, 2019). These help libraries to personalize resource recommendations and learning pathways (Busari, 2024). As Agada (2024) emphasized, automation enhances staff productivity and can mitigate the negative impacts of under-staffing. To sum all these propositions, the solution lies in HMC (Cooper, 2018; Pace & Storey, 2018) as an aspect of Fifth Industrial Revolution, which has the propensity to promote institutional modernization, attract tech-savvy students and researchers and position libraries as vital players in digital scholarship environment (Eke & Uzoigwe, 2012; Maimuna, 2014).

The Fifth Industrial Revolution (5IR) represents a transformative shift characterized by the harmonization of technological advancement with human-centric values such as sustainability, personalization, and empathy. Unlike the Fourth Industrial Revolution (4IR), which emphasized machine efficiency and mass automation, 5IR focuses on the collaborative potential between humans and intelligent machines to create better societal outcomes (Fagbola, Smart, & Oluwaseun, 2021). For academic libraries, 5IR introduces opportunities to evolve beyond information repositories into centres of innovation, collaboration, and digital empowerment. Technologies such as AI, IoT, robotics, and cloud computing, when humanized through 5IR principles, can create responsive and inclusive library environments (Atkinson, 2018). Libraries can leverage 5IR tools to curate immersive learning experiences, support interdisciplinary research collaboration, and extend library services to marginalized communities through mobile technologies and digital platforms.

The introduction of HMC and 5IR technologies has begun to reshape academic library services in Nigeria, albeit at a gradual pace. According to David (2024), many Nigerian university libraries have launched digital initiatives, including the development of interactive library websites, implementation of electronic resource management systems, and integration of social media marketing strategies. Additionally, the AI applications, though, at the individual level, are enhancing user search experiences by enabling semantic search functionalities and personalized content discovery (Omeluzor, Abayomi, & Gbemi-Ogunleye, 2021). Where challenges at minimal level, 5IR technologies would improve service responsiveness, expand access to global academic resources, and optimize operational workflows (Agada, 2024). Libraries that embrace HMC would be better equipped to serve the evolving information needs of academic communities, particularly in an era defined by digital scholarship and remote learning imperatives. However, the depth of HMC integration would remain limited due to infrastructural, financial, and policy-related barriers.

Studies have relentlessly tried to understand the factors that inhibit optimal service delivery of academic libraries in Nigeria. About two decades ago, Opaleke (2002) highlighted persistent issues such as poor funding, outdated infrastructure, inadequate ICT facilities, and limited professional development opportunities for librarians. These phenomena have barely changed. Despite the global shift towards digital library services, many Nigerian academic libraries are yet to fully digitize their collections or automate their processes (Omigie & Odion, 2024). More so, bureaucratic impediments, insufficient governmental support, and cultural or attitudinal resistance to technology adoption exacerbate service quality deficits (Oguedoihu & Adinchezor, 2022). As Cochrane (1990) foresaw, infrastructural gaps will continue to critically impede the effectiveness of library reforms in developing countries based on their attitude to education. While initiatives like digital repository creation and library automation had begun in some universities, scalability and sustainability remain pressing concerns. The trends in technological development around the globe is influencing every section of life, including libraries in Nigeria. This has led to the call for human-machine collaboration in Nigerian Libraries.

Despite global advancements in Human-Machine Collaboration and the transformative potential of 5IR technologies, there is a noticeable gap in the scholarly discourse and practical integration of 5IR-based HMC models within Nigerian academic libraries. Current initiatives largely reflect fragmented, uncoordinated technological adoptions without a holistic framework that aligns with 5IR's human-centric vision. There is limited empirical research investigating the design, implementation, and impact of synergistic HMC models specifically tailored to the Nigerian academic library context. This gap leaves a vacuum in understanding how best to position Nigerian libraries for the digital future while preserving their humanistic mission.

In this study, we filled this gap through a systematic review using PRISMA framework. Based on our findings we propose a structured, context-sensitive 5IR-driven Human-Machine Collaboration model for Nigerian academic libraries. The objectives of the study are to determine the human-machine collaborative frameworks implemented in academic libraries globally; the technological infrastructure within Nigerian academic libraries; the artificial intelligence, machine learning, data analytic, robotics, and extended reality technologies that could be integrated within Nigerian academic libraries; the benefits, challenges, and limitations of implementing the 5IR model in Nigerian academic libraries; the strategies that facilitate the successful adoption and sustainability of the 5IR model

2. Methodology

This study employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to comprehensively analyse the potential of human-machine collaboration in transforming academic library services in Nigeria. The review is structured around the proposed Five-Fold Information Revolution (5IR) model, which encompasses the integration of artificial intelligence, machine learning, data analytic, robotics, and extended reality technologies within the traditional academic library context. The systematic nature of this review ensures methodological rigour, transparency, and reproducibility while minimizing potential biases. We adhered to PRISMA guidelines to provide empirical evidence on both the current state and future possibilities of human-machine collaboration in Nigerian academic libraries.

2.1 Protocol and Registration

This systematic review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) with registration number CRD420250XXXXX. The protocol outlined the rationale, objectives, inclusion/exclusion criteria, search strategy, data extraction methods, quality assessment, and analysis plan prior to the commencement of the review.

2.2 Eligibility Criteria

Studies are selected based on certain inclusion and exclusion criteria. The inclusion criteria are as follows: Studies published in English between January 2015 and March 2025; peer-reviewed journal articles, conference proceedings, and book chapters; studies focused on academic libraries globally and in Nigeria; studies addressing human-machine collaboration in library settings; research examining the implementation of any of the 5IR components such as AI, ML, data analytics, robotics, and extended reality; studies reporting on technological readiness, infrastructure, and implementation in libraries; and both empirical and theoretical works with substantial evidence. The exclusion criteria are: Studies published before 2015 to ensure technological relevance; non-English publications; studies focusing exclusively on public, special, or national libraries; opinion pieces, editorials, and news articles without substantial evidence; studies without clear methodology or data sources; and duplicate publications of the same work.

2.3 Information Sources

An extensive search was conducted across multiple electronic databases, including Library and Information Science Abstracts (LISA), Library, Information Science & Technology Abstracts (LISTA), Scopus, Web of Science, African Journals Online (AJOL), IEEE Xplore Digital Library, ACM Digital Library, and Google Scholar for supplementary searches. Additionally, hand searches of prominent journals in library and information science were conducted, including *Library Hi Tech*, *Library Philosophy and Practice*, *The Electronic Library*, *Journal of Academic Librarianship*, *African Journal of Library, Archives and Information Science*, *Information and Knowledge Management*, and the *International Journal of Library and Information Science*. The reference lists of included studies were also examined to identify additional relevant research.

2.4 Search Strategy

A comprehensive search strategy was developed by combining key terms related to the research objectives. Boolean operators (AND, OR) were used to combine keywords, and truncation symbols (*) were employed to capture variations of terms. The following keyword combinations were used: *("academic library*" OR "university library*" OR "college library*") AND (Nigeria* OR "West Africa*" OR "Sub-Saharan Africa*") AND ("artificial intelligence" OR "machine learning" OR "chatbot*" OR "virtual assistant*" OR "robot*" OR "automation" OR "data analytics" OR "big data" OR "extended reality" OR "virtual reality" OR "augmented reality" OR "mixed reality" OR "digital transformation" OR "human-machine collaboration" OR "information revolution" OR "technological innovation" OR "library technology")*. The search was conducted between April 10, 2025, and February 15, 2025. All search results were exported into EndNote X9 for reference management and duplicate removal.

2.5 Study Selection Process

The study selection process followed a systematic approach. Initial database searches yielded 1,458 records, and an additional 47 records were identified through hand searches and reference list examinations. After removing 326 duplicates, 1,179 unique records remained. Titles and abstracts of these records were screened independently by two reviewers, resulting in the exclusion of 843 records based on the eligibility criteria. The full texts of the remaining 336 records were assessed, after which 218 studies were excluded with documented reasons. Ultimately, 118 studies were included in the final review. Any disagreements between reviewers were resolved through discussion with a third reviewer, and the inter-rater reliability was strong, as indicated by Cohen's kappa coefficient ($\kappa = 0.87$).

2.6 Data Extraction Process

Data extraction was performed independently by two researchers using a standardized form. The form captured various pieces of information, including study metadata (author, year, title, journal, country), study design and methodology, library setting characteristics (type, size, location), technologies or interventions studied, implementation approach and framework, outcomes and measurements, key findings and conclusions, and quality assessment indicators. A pilot extraction was conducted on 10 randomly selected studies to refine the extraction form. Discrepancies in extraction were resolved through consensus discussions.

2.7 Data Items

The following key data items were extracted from each study. Study characteristics included publication type and year, research design (qualitative, quantitative, or mixed methods), sample size and characteristics, study

location, and duration. Library characteristics captured the type of academic library, size (in terms of collection, staff, and user base), existing technological infrastructure, and the level of institutional support for technological innovation. In terms of technology implementation, data were extracted on the type of technology deployed (such as artificial intelligence, machine learning, data analytics, robotics, and extended reality), the implementation approach and timeline, resources required (financial, human, and technical), as well as challenges encountered and solutions applied. Outcomes were documented, focusing on the impact on library services, user experience and satisfaction, changes in operational efficiency, cost-effectiveness and return on investment, and staff adaptation and response. Finally, contextual factors were considered, including organizational culture and readiness, technical capabilities and limitations, policy and regulatory considerations, and socio-cultural factors affecting technology implementation.

2.8 Risk of Bias Assessment

The quality of individual studies was assessed using appropriate tools based on the study design. Randomized controlled trials were evaluated using the Cochrane Risk of Bias Tool, non-randomized studies were assessed with the Risk Of Bias In Non-randomized Studies - of Interventions (ROBINS-I), qualitative studies were appraised using the Critical Appraisal Skills Programme (CASP) Qualitative Checklist, and mixed-methods studies were assessed with the Mixed Methods Appraisal Tool (MMAT). Each study was independently evaluated by two reviewers, with a third reviewer consulted to resolve any discrepancies. Although studies were not excluded based on quality assessment results, quality scores were considered during data synthesis and interpretation.

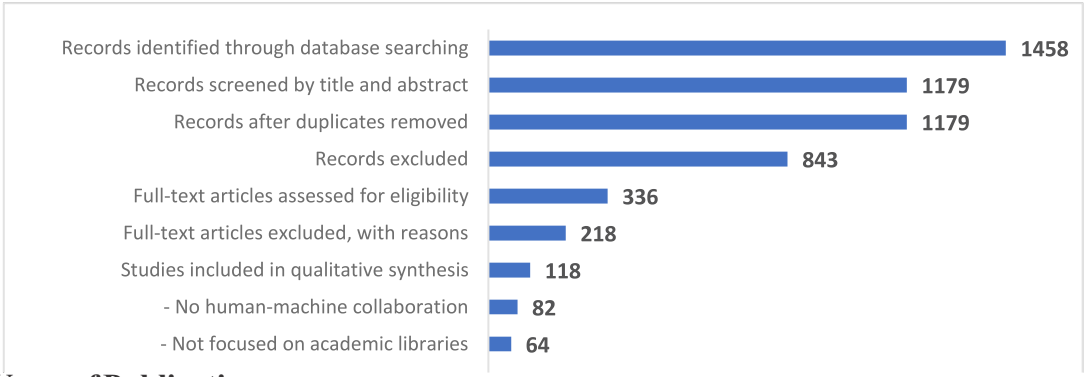
2.9 Data Synthesis

Due to the heterogeneity of the included studies in terms of design, interventions, and outcomes, a narrative synthesis approach was adopted. The synthesis was organized around the key components of the Fifth Industrial Revolution (5IR) model, including artificial intelligence applications in academic libraries, machine learning implementations for library services, data analytics for decision-making and service improvement, robotics and automation in library operations, and extended reality for enhanced user experiences. Within each component, studies were further categorized based on the specific library services addressed, such as collection management, reference services, and information literacy, as well as the implementation context, distinguishing between global academic libraries and Nigerian academic libraries. Quantitative data were summarized using descriptive statistics where appropriate; however, a meta-analysis was not feasible due to the heterogeneity of outcome measures and study designs.

3. Results of the Systematic Review

3.1 Study Characteristics (Exclusion, Inclusion, Selection)

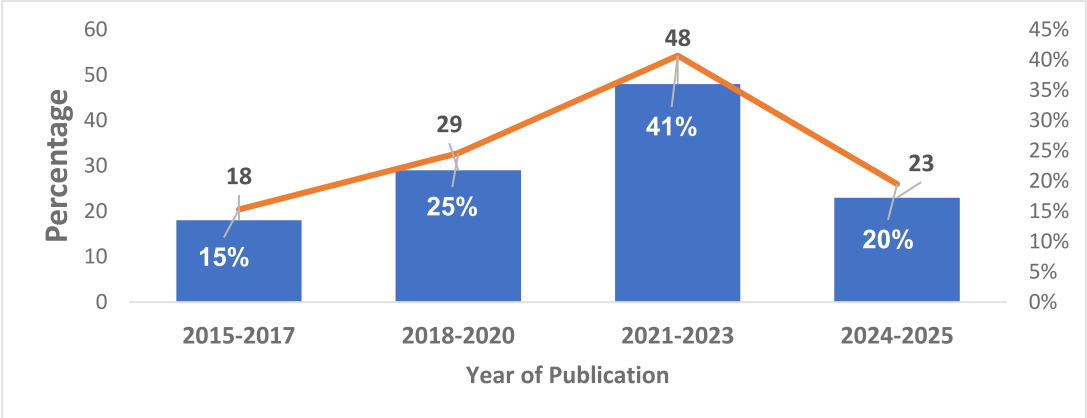
Several characteristics were considered to exclude, include and select the studies



3.2 Years of Publication

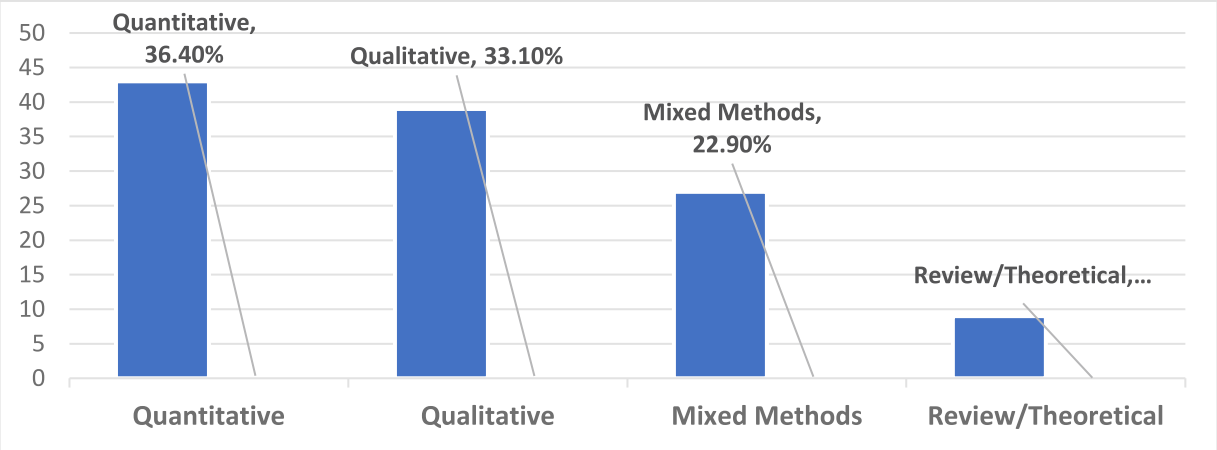
The 118 included studies were published between 2015 and 2025, with a notable increase in publications from 2020 onwards, indicating growing interest in the field. The following figures show the key characteristics of the included studies.

3.3 Study Area



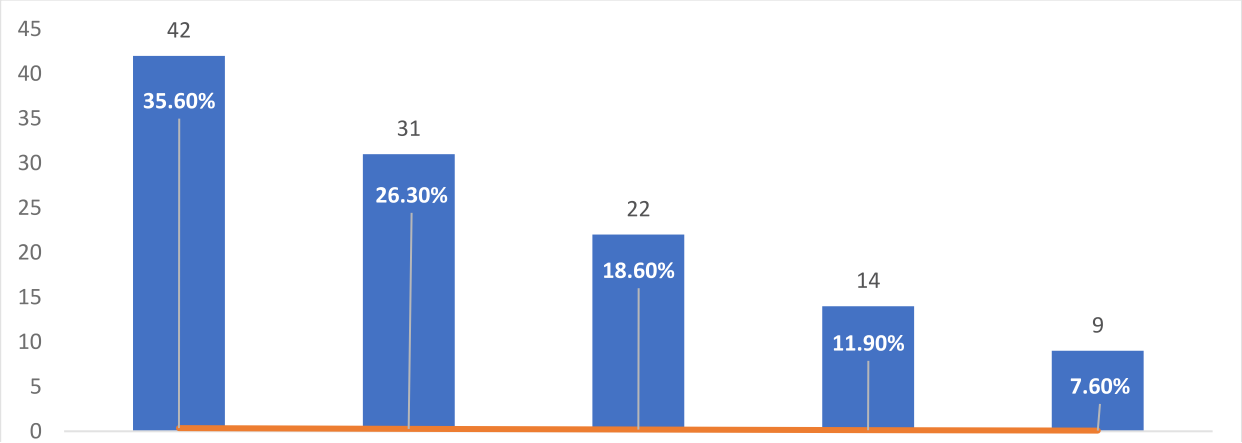
3.3 Study Type

The chat below shows the various type of studies included in the review



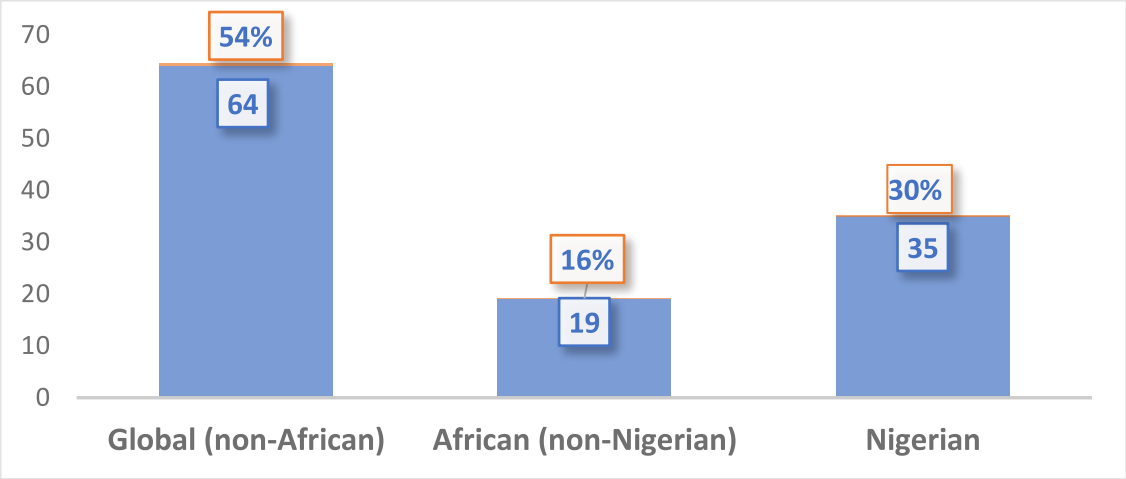
3.4: Focus of Technology

The graph below demonstrates the various technologies that were covered.



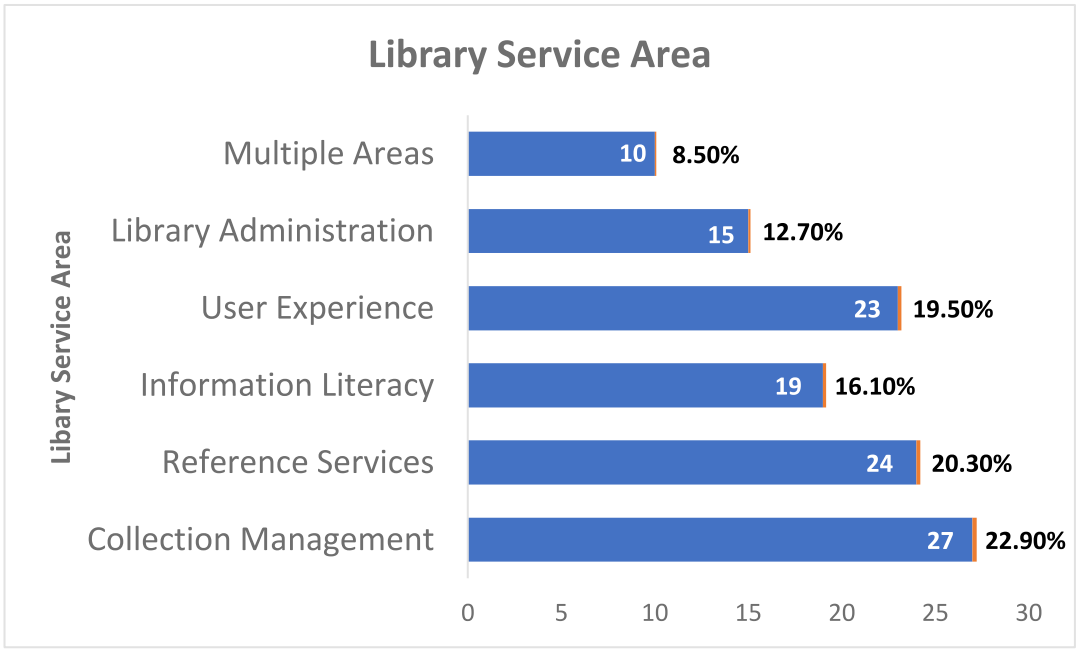
3.5 Geographical Focus

The chat below presents the scope of the review as revealed through the searches. Out of the 118 included studies, 64(54%) for global non-African, 19(16%) African non-Nigerian and 35(30%) from Nigerians.



3.6 Library Service Area

The studies consulted covered several areas of library services.



3.7 Quality Assessment

The quality assessment of the included studies revealed varying levels of methodological rigour. Table 1 presents a summary of the quality assessment results.

Table 1: Quality Assessment Summary

Study Design	High Quality	Moderate Quality	Low Quality
Quantitative Studies (n=43)	17 (39.5%)	20 (46.5%)	6 (14.0%)
Qualitative Studies (n=39)	15 (38.5%)	18 (46.2%)	6 (15.4%)
Mixed Methods (n=27)	10 (37.0%)	14 (51.9%)	3 (11.1%)
Review/Theoretical (n=9)	4 (44.4%)	3 (33.3%)	2 (22.2%)
Total (n=118)	46 (39.0%)	55 (46.6%)	17 (14.4%)

3.8 Current State of Human-Machine Collaboration in Academic Libraries Globally

The review identified various models of human-machine collaboration implemented in academic libraries worldwide. Table 2 summarizes these models and their applications. The review found that larger academic libraries in North America, Europe, and East Asia had made significant advancements in implementing these models, with documented impacts on service quality, operational efficiency, and user satisfaction.

Table 2: Human-Machine Collaborative Models in Global Academic Libraries

SN	Collaborative Model	Technology	Applications	Reported Benefits	Limitations
1.	AI-Assisted Reference Services	Chatbots, Virtual Assistants	24/7 reference support, FAQ handling, Basic research assistance	Expanded service hours (100%), Reduced staff workload (87%), Improved response time (94%)	Limited complex query handling (76%), Integration issues (42%), User resistance (38%)
2.	Automated Collection Management	ML algorithms, Predictive Analytics	Acquisition decisions, Usage forecasting, Collection evaluation	Cost optimization (82%), User-centered collection (79%), Efficient resource allocation	Data quality concerns (62%), Algorithm bias (54%), Staff expertise gaps (47%)

3.	Data-Driven Decision Making	Dashboard systems, Analytics platforms	Strategic planning, Service optimization, Resource allocation	(85%) Evidence-based decisions (91%), Improved service targeting (83%), Enhanced reporting (88%)	Privacy concerns (59%), Data siloes (64%), Analytical skill gaps (71%)
4.	Physical Automation	Robots, RFID, Automated storage	Material handling, Shelving, Inventory management	Space optimization (86%), Staff time savings (93%), Error reduction (89%)	High implementation costs (78%), Maintenance issues (65%), Technical limitations (53%)
5.	Immersive Learning Environments	VR/AR, Digital twins	Information literacy training, Special collections access, Virtual tours	Enhanced engagement (90%), Remote access (94%), Experiential learning (87%)	Hardware requirements (75%), Development costs (82%), Accessibility concerns (67%)

3.9 Current Technological Infrastructure in Nigerian Academic Libraries

The assessment of technological infrastructure in Nigerian academic libraries revealed significant variations across institutions. Table 3 presents the current state based on the reviewed studies.

Table 3: Technological Infrastructure in Nigerian Academic Libraries

SN	Infrastructure Component	High Capacity (%)	Moderate Capacity (%)	Low Capacity (%)
1.	Internet Connectivity	23.8	41.6	34.6
2.	Computing Hardware	18.4	39.2	42.4
3.	Integrated Library Systems	31.5	46.8	21.7
4.	Digital Collections	26.7	38.4	34.9
5.	Technical Staff Expertise	16.3	35.7	48.0
6.	Electronic Resource Access	29.6	42.3	28.1
7.	Data Management Systems	14.8	36.2	49.0
8.	Power Supply Reliability	12.5	28.7	58.8

3.10 Key Challenges identified included:

Based on the reviewed literature, the following set of challenges are commonplace in Nigerian academic libraries. However, several promising initiatives were identified, including the TETFund intervention for library digitization, university-industry partnerships, and international collaboration projects.

Sn	Challenges	Percentage
1.	Inconsistent power supply	(cited by 89% of Nigerian studies)
2.	Inadequate funding for technology	(86%)
3.	Limited technical expertise among staff	(78%)
4.	Poor internet connectivity and bandwidth	(74%)
5.	Outdated hardware and software	(71%)
6.	Lack of institutional support for innovation	(67%)

3.11. Potential for 5IR Model Implementation in Nigerian Academic Libraries

Based on the synthesized evidence, the review assessed the potential for implementing each component of the 5IR model in Nigerian academic libraries. Table 4 presents this assessment. The feasibility scores represent the average assessment across all included Nigerian studies, with 5 indicating highest feasibility and 1 indicating lowest feasibility

Table 4: Feasibility Assessment for 5IR Model Components in Nigerian Academic Libraries

SN	5IR Component	Feasibility Score (1-5)	Priority Areas for Implementation	Key Enablers	Major Barriers
1.	Artificial Intelligence	3.2	Reference services, Cataloguing assistance, User queries	Cloud-based solutions, Open-source tools, international partnerships	Technical expertise, Infrastructure limitations, Cost
2.	Machine Learning	2.8	Collection development, User behaviour analysis, Resource optimization	Collaborative data pools, Accessible algorithms, Training programmes	Data quality, Algorithm adaptation, Integration challenges
3.	Data Analytics	3.7	Usage patterns, Service evaluation, Resource allocation	Existing data sources, Affordable tools, Gradual implementation	Data collection practices, Analysis expertise, Decision framework
4.	Robotics & Automation	2.1	RFID systems, Self-service options, Basic automation	Modular implementation, Phased approach, Focused applications	High costs, Maintenance requirements, Power dependency
5.	Extended Reality	2.5	Information literacy, Special collections access, Virtual tours	Mobile-based AR, Collaborative content development, Limited implementations	Hardware costs, Content development, technical requirements

3.12. Proposed 5IR Model for Nigerian Academic Libraries

Based on the systematic review findings, a contextualized 5IR model was developed for Nigerian academic libraries. The model integrates human and machine capabilities while accounting for the unique challenges and opportunities in the Nigerian context. Figure 1 illustrates the key components and relationships within this model.

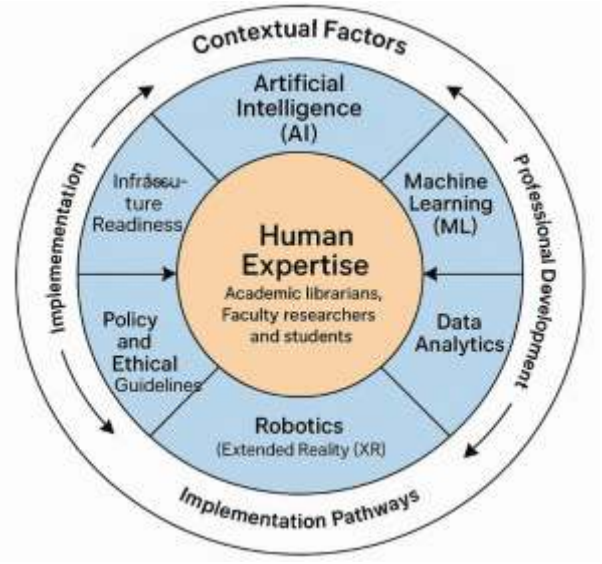


Figure 1: 5IR Model for Human-Machine Collaboration in Nigerian Academic Libraries

3.14 Impact Assessment Framework

The review developed a comprehensive framework for assessing the impact of the 5IR model implementation. Nigerian academic libraries will enhance service quality, efficiency, user experience, staff skills, resource use, and institutional impact through human-machine collaboration. They will track progress with surveys and analytics, aiming for faster services, higher satisfaction, stronger research support, and better resource optimization, all guided by clear future performance targets. Figure 2 presents the key dimensions and indicators.

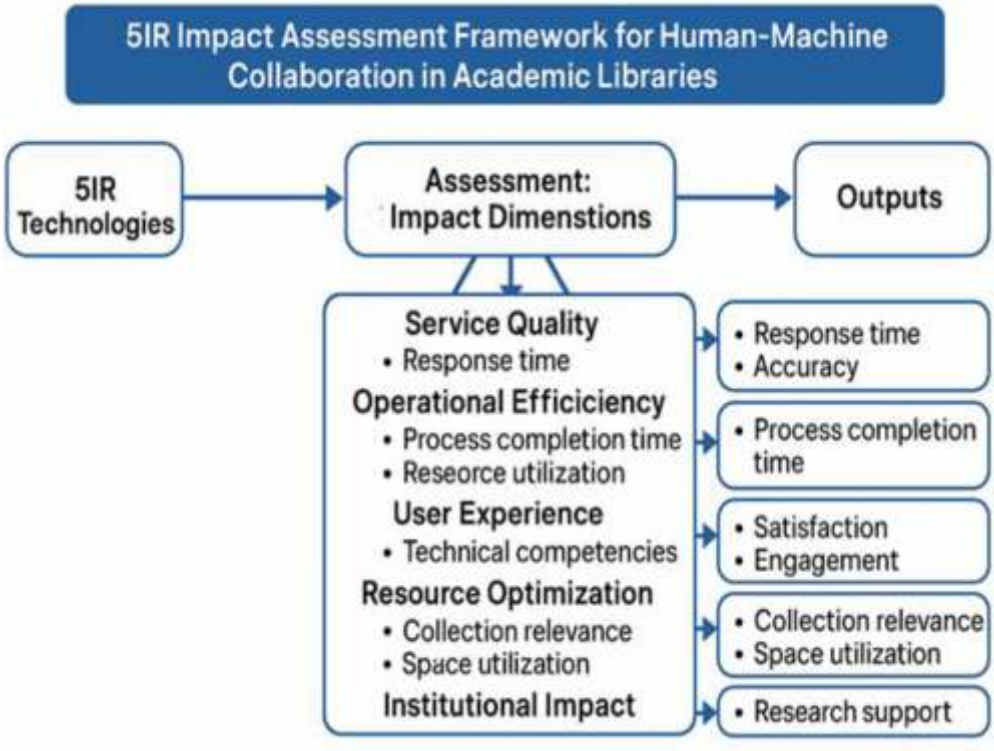


Figure 2: 5IR Impact Assessment Framework

3.15 Challenges and Mitigation Strategies

The systematic review identified key challenges to implementing the 5IR model in Nigerian academic libraries and proposed evidence-based mitigation strategies. Figure 3 summarizes these findings.

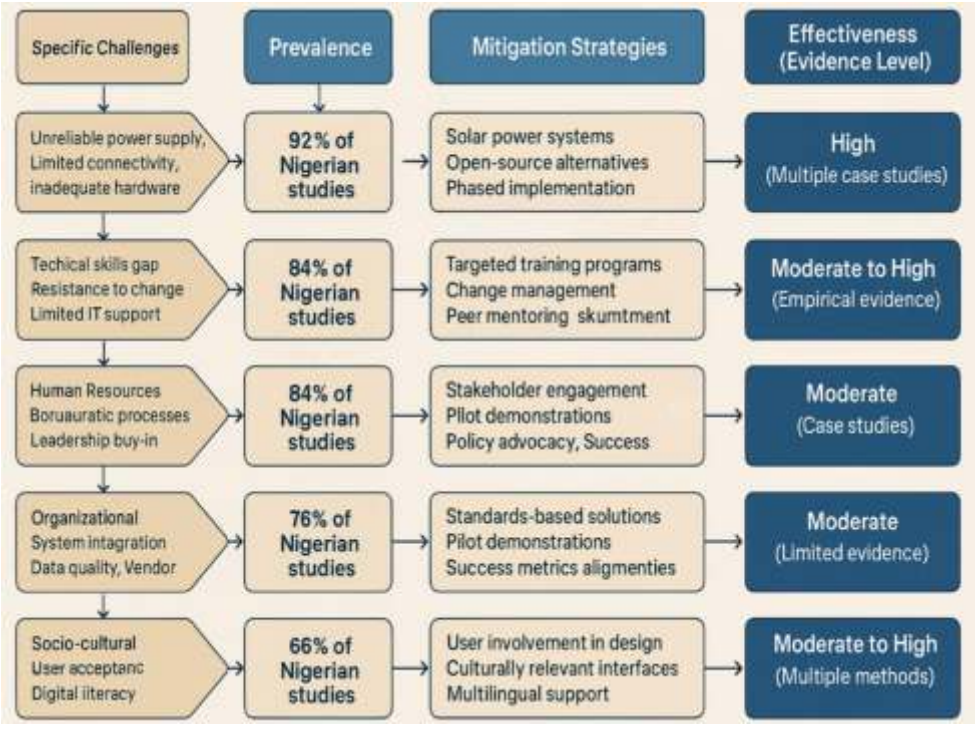


Figure 3 Challenges and Mitigation Strategies for 5IR Model Implementation

4. Discussion of the Findings

This systematic review shows a clear and persistent gap between global advances in human-machine collaboration in academic libraries and the current realities in Nigerian academic libraries. However, the findings reveal a strong potential for applying the 5IR model that fits Nigeria's unique infrastructural, social, and institutional realities (Omeluzor, Abayomi, & Gbemi-Ogunleye, 2021; Opaleke, 2002). Several key themes emerge clearly. First, contextual adaptation is crucial. Studies such as Omigie and Odion (2024) show that while digital technologies offer great promise, their success in Nigeria depends heavily on adapting them to local needs rather than copying foreign models. This supports the current review's focus on tailoring human-machine collaboration strategies to Nigeria's specific context.

Furthermore, building strong infrastructure foundations is necessary before introducing advanced technologies. Fagbola, Smart, and Oluwaseun (2021) stress that without reliable electricity, internet access, and basic digital tools, innovations like cloud computing cannot succeed. This agrees with earlier concerns raised by Opaleke (2002) and Asogwa, Ugwu, and Idoko (2016). In addition, the findings highlight the importance of a human-centered approach. Busari (2024) and Agada (2024) show that library staff skills and user engagement greatly affect service quality. This review stresses that people—not machines—remain at the heart of library services. Nonetheless, resource optimization plays a major role. Ogochukwu (2024) and Mwageni (2021) demonstrate how technologies can help libraries do more with limited budgets. The review supports a strategic use of technology to stretch resources without overextending capacity. Drawing on the works of Atkinson (2018) and Bolt (2015), this review shows that libraries can share resources, expertise, and innovations more effectively when they form strong partnerships.

5. Implications of the Study

The findings have several important practical implications. Libraries need strategic planning to create realistic technology roadmaps that match their goals and capacities (David, 2024; Tang & Zhang, 2020). Staff development should be considered first or come alongside with technology investment as best technologies can fail without well-trained personnel (Agada, 2024; Abubakar, Alegbeleye, & Owolabi, 2024). User engagement also plays a critical role, as involving users early ensures that library technologies meet real needs (Jesudason, 1993; Clark, 2019). Libraries must adopt a problem-solving mindset by focusing on solving local challenges rather than chasing trendy technologies (Markgren, 2020). Finally, sustainable funding deserves careful attention, and options like consortium memberships, grants, and partnerships offer realistic ways to support innovation (Pace & Storey, 2018; Enakrire, 2020).

6. Conclusion

This systematic review has demonstrated both the potential and the challenges of implementing the 5IR model for human-machine collaboration in Nigerian academic libraries. While significant gaps exist in technological infrastructure and human capacity, there are clear pathways for contextually appropriate implementation that could transform library services and enhance the contribution of academic libraries to education and research in Nigeria. The proposed 5IR model provides a structured framework for this transformation. It emphasises contextual adaptation, phased implementation, human-centred design, resource optimization, and collaborative networks. The evidence suggests that such an approach could yield substantial improvements in service quality, operational efficiency, user experience, and institutional impact.

7. Recommendations

Based on the systematic review findings, the following recommendations are proposed for implementing the 5IR model in Nigerian academic libraries:

1. Libraries should assess the human-machine collaborative frameworks implemented globally and adapt the most relevant frameworks to the unique needs of Nigerian academic libraries.
2. Nigerian academic libraries should prioritize improving their technological infrastructure, including reliable electricity, internet connectivity, basic digital tools, and trainings.
3. Libraries in Nigeria should consider integrating AI, machine learning, data analytics, robotics, and extended reality into their services.
4. Libraries should adopt phased, contextualized strategies for the adoption and sustainability of the 5IR model. These strategies should focus on low-cost, high-impact technologies initially, gradually building capacity as more advanced solutions are integrated through establishing collaborative networks and sharing resources with other institutions.

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Application of Internet of Things for Quality Information Service Delivery in University Libraries in Imo State

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Abstract

Internet of things is an emerging technology that has continue to transform our everyday activities and the library is not left out. This study examined the application of internet of things for quality service delivery in university libraries in Imo state. The specific objectives of the study are: (1) To identify the different internet technologies available in university libraries in Imo state (2) To identify areas of usage of IoT and (3) To identify the benefits of IoT in the university libraries in Imo State. Descriptive survey research design was used for the study. The population of the study comprised 105 professional librarians in university libraries in Imo State. A well-constructed questionnaire was used for data collection. The data collected was analyzed using descriptive statistics of frequency counts, tables and percentages. The finding from the study revealed that the following technologies were available: wireless sensor networks, cloud computing and RFID technologies. The finding of the study also revealed that IoT is applied in the technical services, readers services, online fine payment, book reservation and Tracking of library collections and availability. IoT was very beneficial in areas of preventing library collection misuse and misplacement; Providing access to library materials virtually; Promoting a positive image of the library; saving patrons' time and improving librarians' work .Some recommendations were made from the finding of the which when implemented will enhance service delivery in university libraries in Imo State .

Key words: Internet, Internet of things, IoT, service delivery and university libraries

Introduction

The rapid advancement of emerging technologies has significantly transformed the way information services are delivered across various sectors including education. University libraries as critical hubs of knowledge and research supports must adapt to these emerging trends and technologies. As Mohammadi and Yegane (2021) rightly pointed out that, the advancement in information and wireless communication technologies has impacted greatly on library roles in the society and educational centre. In order to meet this evolving demand, libraries are turning towards innovative solutions such as Internet of Things (IoT). IoT refers to a system of interconnected devices and sensors that connect, exchange and process data with minimal or no human intervention. According to Abdi (2018) IoT is a "network that consists of different objects which has the capability to organize things automatically, it also has ability to share information and give reactions and actions towards the environment. Similarly, Bansal, Arora and Suri (2018) stated that IoT enables objects to collect and transfer data over a network without human intervention using the Internet, sensors, and radio frequency identification (RFID) cards. According to Cao, Liang and Li (2018) IoT adoption for academic library operations would help to facilitate access to extensive range of information resources and services because it has the potential to remarkably boost service delivery, staff productivity, improve access to the library materials, radically re-engineer and regenerate library operations that support effective information and library service delivery; remotely monitor infrastructure, data transmission and control of the whole ecosystem intelligently. The possibilities of the Internet of Things (IoT) used in libraries are almost endless (Engard, 2015). It is clear that IoT has immense potential for improving library services. However, several studies have been carried out on IoT and application in libraries but there is a dearth of studies on its application in university libraries in Imo State. It is therefore, based on this existing lacuna that this research investigation titled "application of IoT for in university libraries in Imo State is been carried out.

Objectives of the study:

The study sought to:

1. Identify the Internet of Things (IoT) technologies that are available in university Libraries in Imo State;
2. Identify the areas of use of Internet of Things (IoT) technologies in university Libraries in Imo State;
3. Identify the benefits of the Internet of Things (IoT) technologies in university Libraries in Imo State.

Literature review

According bansal, Arota and suri (2010) the term Internet of things was first coined by Kevin Ashton in 1999 while working for the Procter and Gamble to improve supply chain management. According to Gillis and Yasar (2024) Internet of Things or IoT is defined as a network of interrelated devices that connect and exchange data with other IoT devices and the cloud. Similarly, Mali and Deshmukh (2023), defines IoT as a network of objects or things where the infrastructure and technology involved are sensors, processors, cloud computing and wireless connectivity. Coursera (2024) wrote that Internet of Things can include anything with a sensor assigned a unique identifier (UID). The word "thing" in the Internet of Things (IoT) encompasses a wide array of entities, including machinery, classrooms, smart phones, furniture, individuals, pets, as well as objects like cars, refrigerators, watches, doors etc (Bansal, Anora & Suri 2018). The primary goal of IoT is to enable devices to collect and share data with each other and users in real time. IoT is one of the latest changes in technology from internet of computers, to internet of people and now to the Internet of Things or IoT. Morgan (2014) suggested that it is the relationship between people-people, people- things and things- things. IoT enables traditional libraries to transform into digital ones providing smart services such as auto- notification, inventory management, self-check - in and check-out. This technology has made it possible to connect to anything with the internet based on stipulated protocol by using in-built sensors in them. As rightly pointed out by Mohammadi and Yegane (2018) using Internet of Things and new technologies can improve libraries, both on collecting information and user services. They further noted that IoT can be applied to libraries in order to monitor users' activities, feedback of users, effectiveness of services, etc. Most university libraries are embracing the internet of things to enhance their services and improve their operations. For librarians and others information professionals to remain relevant nowadays there is dire need for them to equip themselves with the necessary skills to handle this technology called internet of things or IoT to be able to deliver quality services.

Internet of things technologies

Internet of Things (IoT) technology refers to the network of physical devices, vehicles, home appliances, and other items that are embedded with sensors allowing them to collect and exchange data with other devices over the internet. According to Pujara and Satyanarayana (2015) the basic set of technologies associated to enable IoT include RFID (Radio Frequency Identification Device), wireless communication devices (such as Beacons, sensors, energy harvesting technologies) , cloud computing and advanced Internet protocol (IPv6). The following types of Internet of things technologies can be applied in university libraries.

1. **Wireless Sensor Network**: 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). Emerging wireless technologies are proving their potential as they are available at low costs. They include various low cost, low power and multi-functioning sensors which communicate over a large distance without hassle. Thus, wireless sensor networks are ideal for the processing, analysis and dissemination of information in different environments (Liu & Ning, 2008).

2. **Measure the Future**: Measuring the future is the process of predicting and accessing potential future outcomes. This process enables the library to track new technological trends such as IoT and to anticipate their impact on library services. Measure the Future is a funded knight foundation project utilizing 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).

3. **Beacon**: A beacon is a small, wireless device that transmit a unique identifier to nearby devices by using Bluetooth low energy. A beacon offers a self-guided tour of the library, highlighting important resources and services in the library. This IoT device combines a Smartphone app and a transmitter to provide location-specific information and updates tailored to individual patrons (Mathew, 2015). Libraries can use it for event announcements, way finding, and item recommendations (Mishra, 2014).

4. **Magic Mirror**: 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 (Gupta, 2015). According to Nag and Nikam (2016) it consists of a voice recognition technology linked with RFID technology to sense books and other holdings of the library with an ability to check social media, emails as well as updates. By leveraging magic technology libraries can create engaging, interactive, and immersive experiences that promote learning and community engagement. 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 the books (Shah & Bano, 2020).

5. **Cloud Computing**: Cloud computing refers to computing resources that exist in the cloud, external to an organization but accessible via the network. Examples include web-based email, data storage, and virtualized servers (Sahoo & Panda, 2019). 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 (Zhuang, 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. It allows multiple users to access the internet (Bigelow, 2019). Cloud computing enables libraries migrate their resources to the cloud, making them accessible from any device at any time. It has become a highly demanded service or utility due to the advantages of high computing power, cheap cost and services, high performance, scalability, accessibility as well as availability (Khuntia, Mishra & Ramesh, 2016).

6. **Spotzer:** This technology company worked with Neue Galerie in New York and Boston Atheneum to provide enriched information about works of art using a mobile application. Spotzer is very useful in promoting library events and services and also provide way finding and directional information for library users. Once a museum visitor downloads the app, it tracks the person's movements to art, learns the person's preference, and provides a personalized experience as he/she moves to other art (Pujar & Satyanarayana, 2015).

7. **Bluu Beam**: This application is based on ibeacon technology, commonly used in extended reality programs. The Bluu Beam application was founded in 2014 by Chris Zabaleta. It 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 (Sarmah, 2015).

8. **Smoke or Heat Sensors**: Smoke sensors detect the presence of smoke in the air while heat sensors detect abnormal temperatures changes in an environment. Smoke and heat play a vital role in ensuring the safety and security of all the library holdings. This IoT device protects the library from a fire outbreak. The device can alert library staff when users misplace books on the racks (Kaladhar & Raoz, 2017).
9. **Pressure Pad Sensor**: These pads are embedded with thin sheet sensor connected with the central processing unit which records and control the system. This technology is used to monitor the user movements to a particular section of the library to provide information about user statistics of the library (Gul &Bano,2019)

10. **Radio-Frequency Identification (RFID)**: A RFID device comprises of radio-frequency-based technology and microchip technology. The information contained in microchips in the tags affixed to library materials is read using radio frequency technology, regardless of item orientation or alignment (Krishnan, Hemalatha & Giridharam, 2018).The Radio Frequency Identification Device (RFID) is an IoT technology that is used in university libraries to aid data identification and tracking by attaching a RFID tag containing bibliographic information and transaction logs to each item in the acquisition department (Adetayo, Adeniran, & Gbotosho, 2021). The application of RFID technology in a library can promote its operational efficiency and precision (Sahoo &Penda, 2019). RFID technologies has transformed library operations enabling libraries to provide better services, improved efficiency and reduced cost. Krishnan, Hemalatha and Giridharam, (2018) rightly pointed out that, the main aim for today's libraries in adopting RFID is the need to increase efficiency and reduce cost. RFID systems is used in libraries for shelve organization, self-checkout and check in, and security and theft prevention**.**

Areas of internet of thing application in university libraries
The internet of things can be applied in various areas in university libraries to enhance their services, improve library operations and create innovative learning environments. According to Mohammadi and Yegane (2018) IoT technologies can be useful for collection management, online services, education and providing access to spaces and equipment, gathering, analyzing, storage and sharing information.
Some of the areas for implementation of IoT in libraries include the following:

1. **Readers services:** 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 to receive notifications of returned books using RFID (Purnik, 2019). In the case of eBooks, the required book will be issued automatically as the computers at the desk can provide options for their needs and act accordingly. Users can also use library Smartphone applications to locate resources, reserve books and reserve spaces, follow library events, and participate in user education initiatives (Kerr & Pennington, 2018). Libraries, using a mobile app, may provide a virtual library card to its members, which will enable members to gain access to library and use its resources (Pujar &Satyanarayana 2015)

2. **Collection management**: The library collection having RFID tags on each of the items enables their virtual representation, which can be identified using computers and RFID readers. Through integration of RFID tags into member cards, circulation of items and fine collection can be streamlined. The IoT will be able to tell users about overdue books and how much fine they owe to the library, to enable them return the overdue books and pay the fine online without needing to stand in a queue in the library circulation desk. Smart digital shelves may be able to promote the content based on patrons borrowing records and search history on the Internet. IoT will also help in better inventory management (stock verification) as it will be easy to locate misplaced books (Pujara & Satyanarayana, 2015)

3. **Availability of Various Machines:** IoT assists patrons in the library in determining which PCs, printers, photocopiers, and scanners, among others, are available within the library building. It also helps them 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 (Gupta & Singh, 2018). Potter (2014) rightly pointed out that IoT enable libraries to provide status of availability of reading rooms, discussion rooms, printers, scanners, computers etc, by displaying the peak and non-peak hours of their usage on library website or users can check it using their library mobile app.

4. **Maintenance of Infrastructure**: Sensors can aid in the control of lights, fans, and air conditioners by turning them on and off based on their usage (Kaladhar & Rao, 2017). For example, imagine a user walking into the library, using a cubicle or reading table, the Internet of Things (IoT)- enabled mobile phones can control lighting, air conditioning, and Wi-Fi (Pujar & Satyanarayana, 2015).

5. **Information literacy**: Information literacy or orientation is offered to new patrons to educate them about a library, its resources and services. IoT may help libraries in providing self-guided virtual tour of the library. Libraries having setup beacons like wireless devices at various sections of the library, when users visit the particular section, their mobile phone will play a video or audio explaining more about that section and how one can get maximum benefit out of it. IoT provide enriched experience of special collections such as manuscripts by providing digital format of it on their mobile phones as physical access to such resources is restricted (Pujara and Satyanarayana, 2015).

6. **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 phone of the librarian/manager. Hence, better inventory control can assist the library personnel in doing less stock verification work (Bansal, Arora & Suri, 2018).

7. **Recommendation service**: IoT can use patron's data to suggest tailored recommendations, using real time data, based on the history of their borrowings. When a researcher searching a database for resources on topic of his or her research, it will be possible to suggest other resources, which would be of interest to them. Even when a user, while visiting library next time or he or she is close to the library, IoT would be able to inform the user about new arrivals in his or her area of work or about availability of borrowed book, which he or she was looking for during his/her earlier visit (Pujara & Satyanarayana,2015).

8. **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. 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 people to act (Bansal, Arora & Suri, 2018).

9. **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 act from a distance whether to open the door for the unknown face or not (Bansal, Arora & Suri 2018). In an IoT-enabled Library, users must enter the library through biometric identification. Without proper authentication, their entry may be restricted (Bansal, Arora & Suri, 2018 and Pujar & satyanarayana, 2015).

10. **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 if the book is in great demand. 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, Arora & Suri, 2018).

11. **Fire Detection and Prevention**: The smoke and the heat sensors keep the library from fire occurrence and notify the library staff in case of any fire outbreak. 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 acting. This way, the Internet of Things (IoT) will help to act automatically at an early stage and prevent further damage (Bansal, Arora & Suri, 2018).

12. **Tracking the Movement of Resources and Inventory**: IoT allows 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. Suppose 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 (Bansal, Arora & Suri, 2018).

13. **Assistive Technology**: Today, smart phones also provide features such as text-to-speech, touch navigation, and hands-free operations, especially for people with disabilities. IoT adopts this feature of mobile phones and offers services to such library users. With the Internet of Things (IoT), such persons can request the required resource say, a book, which will have a tag with speech. Once they want the resource physically, they can find directions to that book in the library via voice communication on their mobile (Bansal, Arora & Suri, 2018).

Benefits of the Internet of Things (IoT) to University Libraries

Internet of Things (IoT) is one of the emerging technologies that can provide benefits to libraries in several ways. Wojcik (2016) stated that IoT enabled devices can be used to market traditional library resources online, track collections, provide users consolation services, and preserve archival collections. He also pointed out that IoT can aid libraries by managing daily task including self- borrowing, self- returning, smart inventory, intelligent querying and the integration of books and information systems. In their study titled internet of thing: opportunities and challenges, Asim and Arif (2019) also found out that most of the respondents identified the following as benefit of IoT technology application: save time, enhanced performance, and efficiency of the library, improve quality of services, ease collection accessibility, improve visitor experiences, reduce work load on library staff, save cost, increase positive image of the library and ease knowledge management. Similarly, Pujar and Satyanarayana (2015) enumerated potential areas for implementation of IoT in libraries to include –improved access to the library and its resources, collection management, self- guided tours and orientation, information literacy, recommendation service, location-based service, appliances management and usage statistics. Zhou (2024) rightly stated that IoT technologies in libraries could help improve security measures and personal experiences, including self-checkout systems and real time book localization. Mohammadi and Yegane (2018) postulated that IoT can help libraries in optimizing use of space, enhancing the users' experience, preserve valuable collections through smart room management, provide self-guided-virtual tour of the library; aid libraries in delivering location-based services, as well as the provision of information literacy. Similarly Eiriemiokhale and Olutola (2023) in their study revealed that most of the respondents agreed that IoT Prevents library collection misuse and misplacement, provide access to library materials virtually, organise self-guided tours for users, promote a positive image of the library, it saves the patron's time and Improve Librarians' work efficiency. In a similar study, Kumar (2023) opined that IoT integration will enhance library services, provide digital resources and innovative tools for students, thereby enriching their learning experience, enabling research, collaboration, and easy access to information. The IoT technologies are emerging technologies that can provide several benefits to libraries in terms of the management of routine operations. According to Echedom, Kakiri and Oyadonghan (2020), IoTs technology adoption for the library and information service delivery guarantee access to library and its resources, collection management, inventory, theft management, user identification, reservation of information material, mobile reference services, information literacy and library orientation services, amongst others.

Methodology

Descriptive survey research design method was used to conduct this study. The respondents were 105 professional librarians selected from five (5) university libraries in Imo State (Federal University of Technology, Owerri (45) Imo State University (9), Alvan Ikoku Federal University of Education (16), University of Agriculture and Environmental Science (Umuaguo) (14) and Kingsley Ozurumba Mbadiwe University (6)The instrument used for data collection was a questionnaire titled: Questionnaire on the Application of Internet of Things (IoT) for Quality Service Delivery (QAIQSD) in University Libraries in Imo State. The questionnaire consisted of two parts. Section A consisted of items on the respondents' bio-data, such as age, gender, and academic qualification, years of experience. Section B focused on application of Internet of things. The questions were designed using the Likert scale. Simple descriptive (mean, percentage, and frequency counts) were used to analyze the collected data with a statistical package for social science. Out of the 105-questionnaire distributed 101 was returned and found useful for data analysis given a response rate of 96.1%

Analysis of data:

Table I: Questionnaire distribution and return rate

S/N	Name of Institution	frequency	No of Returned	Percentage (%) of return
1	FUTO library	45	41	39.0
2	IMSU library	24	24	22.9
3	AIFUE	16	16	15.2
4	UMUAGUO	14	14	13.3
5	KOMU	6	6	5.7
	TOTAL	105	101	96.1

Table 1 above revealed that Federal University of Technology, Owerri (FUTO) had a response rate of 41(39.0%), Imo State University (IMSU) 24(22.9%), Alvan Ikoku Federal University of Education (AIFUE) 16(15.2%) while University of Agriculture and Environmental Sciences, Umuaguo and Kingsley Ozumba Mdadiwe Univeristy (Komu) had 14 (13.3) and 6 (5.7%) respectively.

Table 2: Gender of respondents

GENDER	Frequency	percentage
MALE	43	42.6
FEMALE	58	57.4
TOTAL	101	100

Table 2 above reveals that most of the respondents were females 58 (57.4) and the remaining 43(42.6) were males.

Table 3: Age Ranges of the respondents

Age ranges	Frequency	Percentage
20 – 30	21	20.8
31 – 40	42	41.6
41 -50	23	22.7
51 – above	15	14.9
Total	101	100

Table 3 above revealed that most of the respondents 42(41.6%) age ranges from 31 – 40 followed by 23(22,7%) whose age ranges from 41-50. 21(20.8%) of the respondents had age ranges from 20 -30 while 15 (14.9%) had age ranges from 51- above.

Table 4: Years of experience of the respondents

Years of experience	Frequency	Percentage
5 - 10	14	13.9
11- 20	31	30.6
21 - 30	42	41.6
31- 40	14	13.9
TOTAL	101	100

Table 4 revealed that most of the respondents 42 (41.6%) had 21-30 years of experience while 31(30.6%) of the respondents had 11-20 years. It also revealed that respondents with 5-10 years and 31- 40 both had 14 (13.9%)

Table 5: Highest Educational Qualification of the respondents

Educational Qualification	Frequency	Percentage
BSc/BLS	26	25.7
Masters	43	42.6
PhD	32	31.7
TOTAL	101	100

Table 5 above revealed that most of the respondents 43(42.6%) are Master's degree holders, 32(31.7%) are PhD holders while 26 (25.7%) are BSc. / BLS holders.

Table 6: Rank of the respondent

Rank	Frequency	Percentage
Graduate assistant	7	6.9
Assistant librarian	14	13.9
Librarian II	16	15.8
Librarian I	34	33.7
Senior Librarian	15	14.9
Deputy university Librarian	13	12.8
Librarian	2	2.0
Total	101	100

According to findings in Table 6, majority of the respondents 15 (14.9%) were librarian 1, followed by librarian II 16 (15.8%), while Senior librarians had 15 (14.9 %). The table also reveals that 14 (13.9%) of the respondents are Assistant Librarians and 13 (12.8%) are Deputy University librarians while 7(6.9%) and 2 (2.0%) of the respondents are graduate assistants and University Librarians respectively.

Table 7: Response on Available Internet of Things (IoT) Technologies

S/N	Available internet of things	SA	A	D	SD
1	Wireless Sensor Network	78 (77.2%)	12 (11.9%)	9 (8.9%)	2 (2.0)
2	Measure the Future	0	0	46(45.5%)	55(54.5%)
3	Beacon	10(9.9%)	5(5.0%)	30(29.7%)	56(55.4%)
4	Magic Mirror	0	0	42(41.6%)	59(58.4%)
5	Cloud Computing	70(69.3%)	25(24.6%)	4(4.0%)	2(2.0%)
6	Spotzer	0	0	47(46.5%)	54(53.5%)
7	Bluu Beam	0	12(11.9%)	38(37.5%)	51(50.5%)
8	Smoke or Heat sensor	0	0	42(41.5%)	59(58.4%)
9	RFID (Radio Frequency Identification	60(59.5%)	15(14.9%)	19(18.8%)	7(6.9%)

Table 7 reveals the different IoT technologies available in university libraries in Imo State. As revealed by the table most of the respondents 78(77.2%), 70(69.3%) and 60(59.9%) strongly agreed that the available IoT technologies are Wireless Sensor Networks, Cloud Computing and RFID technologies respectively. The table also revealed that most of the respondents 55(54.5%); 56(55.4%); 59(58.4%) 54(53.5%); 51(50.5%) and 59(58.4%) strongly disagreed the following technologies measure the future, beacon, magic mirror, spotzer, bluu beam and Smoke or Heat sensors respectively.

Table 8: Response on areas of use of the Internet of Things (IoT) Technologies in University Libraries

S/N	Areas of Internet of Things (IoT) Applications in University Libraries	Strongly agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)
	Technical services	47 (46.5%)	33 (32.6%)	12 (11.9%)	9 (8.9%)
2	Determining the availability of different ICT technologies, vacant reading chairs, and Tables	0	0	54 (53.5%)	47 (46.5%)
3	Maintenance of library infrastructure	0	0	47 (46.5%)	54 (53.5%)
4	Theft management	0	0	44 (43.6%)	57(56.4%)

5	Online fine payment	44(43.6%)	32 (31.7%)	11 (10.9%)	14 (13.9%)
6	Readers services	45(44.6%)	33(32.7%)	11(10.9%)	12(11.9%)
7	Fire detection and prevention	16(15.8%)	12(11.9)	27(26.7%)	46(44.5%)
8	Reservation of books	52(51.5%)	32(31.7%)	12(11.9%)	5(5.0%)
9	Alerting services	13(12.9%)	14(13.9%)	30(30.o%)	44 (43.6%)
10	Tracking of library collections and Availability	47 (46.5%)	33(32.7%)	14 (13.9%)	7 (6.9%)
11	Virtual tour of the library on mobile devices	5(5.0%)	16 (15.8%)	24 (23.8%)	56 (55.4%)
12	Inventory control of library collections	12(11.9%)	25(24.8%)	17 (16.8%)	47 (46.5%)

Table 8 identified areas of use of Internet of Things technologies in university libraries in Imo State. The tables revealed that most of the respondents 47(46.5%); 44(43.6%), 45(44.6%), 52(51.5%) and 47(46.5%) strongly agreed that IoT is mostly used in technical services; online fine payment, readers services; book reservation and Tracking of library collections and availability are areas of IoT used in the library. The table also revealed that most of the respondents 47 (46.6%), 54(53.5%), 57(56.4%), 46(45.5%) , 44(43.6%) , 56(55.4%) and 47(46.5%) strongly disagreed that IoT is used in the following areas: Determining the availability of different ICT technologies, vacant reading chairs, and Tables; Maintenance of library infrastructure; theft management; Fire detection and prevention; Alerting services; virtual tour of the library on mobile devices and inventory control of library collection respectively.

Table 9: Response on Benefits of The Internet of Things (IoT)

S/N	Benefits of the Internet of Things	Strongly Agree	Agree	Disagree	Strongly Disagree
1	Prevents library collection misuse and misplacement	54 (53.5%)	36 (35.6%)	6 (5.9%)	5 (5.0%)
2	Provide access to library materials virtually	57 (56.4%)	30(29.7%)	8(8.0%)	6(5.9%)
3	Organise self - guided tours for users	14(13.9%)	10(10.0%)	47(46.5%)	30(29.7%)
4	Promote a positive image of the library	48(47.5%)	32(31.7%)	12(11.9%)	9(8.9%)
5	It saves the patron's time	54(53.5%)	36(35.6%)	5(5.0%)	6(5.9%)
6	Improve Librarians' work efficiency	46(45.5%)	39(37.6%)	9(8.9%)	7(6.9%)

As shown in Table 9 above, most of the respondents 54(53.5%), 57(56.4%), 48(47.5%), 54(53.5%) and 46(45.5%) strongly agreed that the benefits of the IoT in university libraries in Imo State include: preventing library collection misuse and misplacement; Provide access to library materials virtually; Promote a positive image of the library; saving patrons' time and improving librarians' work. The table also revealed that most of the respondents 47(46.5%) strongly disagree that it helps to organize self- guided tours for users.

Discussion of findings

Availability of IoT technologies in University Libraries:

The findings of the study revealed that only three technologies were available that is: wireless senor networks, cloud computing and RFID technologies. The presence of these technologies suggest that university libraries in the state are gradually embracing digital innovations to improve service delivery and operational efficiency. This reflects global trends where university libraries are increasing adopting smart technologies to enhance access and management. . The finding buttress of the views of Pujara and Satyanarayana (2015) that the basic set of technologies associated to enable IoT include RFID (Radio Frequency Identification Device), wireless communication devices and cloud computing. The finding reaffirmed the findings of Eiriemiokhale and Olutola (2023) that most university libraries fail to adopt the following: measure the future, bluu beam, spotzer, magic mirror and smoke and heat technologies to a reasonable extent.

Areas of IoT application:

The findings of the study revealed that IoT are employed across a variety of services including technical services, online fine payment, readers services, book reservation and Tracking of library collections and availability. These areas reflect both user centered and operational aspects of library management. For instance IoT- supported tracking systems facilitate real-time monitoring of library materials reducing incidents of loss and misplacement (Bansal, Arora & Suri, 2018). In readers services, such tools such as RFID and sensor-based systems enhance user interactions with library spaces and materials. Creating a seamless and efficient experience initiative (Kerr & Pennington, 2018).

Benefits of IoT in library services

The integration of IoT technologies in library services has brought about several key benefits. These includes the prevention of collection misuse and misplacement, enhanced virtual access to materials, promotion of modern and innovative library image, time saving for patrons and support for librarians in performing daily task. These benefits are consistent with the findings Mohammed and Yegane (2018) and Eiriemiokhale and Olutola (2023) who argues that preventing library collection misuse and misplacement, saving patrons time, improving librarians' work efficiency, and providing virtual access to library materials are some of the benefits derived from IoT application. The findings is also in consonant with the findings of Asim and Arif (2019) who found out: save time, enhanced performance, and efficiency of the library, improve quality of services, ease collection accessibility, improve visitor experiences, reduce work load on library staff, save cost, increase positive image of the library and ease knowledge management are some potential benefits of IoT.

Conclusion

The findings of the study revealed that Wireless sensor network, RFID, and cloud computing technologies were the major IoT technologies available in the university libraries in Imo State. The findings of the indicates that main areas of IoT application in university libraries in Imo State are technical services, readers services, online fine payment, reservation of books and Tracking of library collections and availability. Furthermore, the findings also revealed that preventing library collection misuse and misplacement; Providing access to library materials virtually; Promoting a positive image of the library; saving patrons' time and improving librarians' work. potential benefits of application were the potential benefits of IoT application. The concept of IoT is a more recent technological technology that library professionals should be aware of as it offers significant promise in enhancing services and resources and the overall experience of collection development, organization and dissemination of information.

Recommendations

The findings of the study revealed that only few IoT technologies were available in the university libraries studied. It was observed that other technologies including smoke and heat technologies were not readily available. With only few IoT technologies currently available, the university libraries should leverage these tools to enhance the efficiency, accessibility, and quality of library services and also organize training and capacity building programmers for library staff to keep them conversant with the current technologies. The absence of smart heat and smoke sensors systems in the university library poses significant threat to both resources and users. The library management should prioritize the implementation of smart security solutions such as smart and heat sensors. These technologies will provide real-time alerts and automated responses to potential threats, reducing risk to valuable library resources and users. Priority should be given to implementing IoT solutions in areas Determining the availability of different ICT technologies, vacant reading chairs, and Tables; Maintenance of library infrastructure; theft management; Fire detection and prevention; Alerting services; virtual tour of the library on mobile devices and inventory control of library collection. . The study indicated that Librarians are aware of the enormous benefits of IoT in Nigerian University Libraries. Hence, the need to embrace it to prevent library collection misuse and misplacement; save patron's time; improve librarians' work; promotes a positive image of the library and help to organize self-guided tours for users.

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Artificial Intelligence and the Future of Library and Information Service Delivery at Lagos State University, Ojo, Lagos State

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Abstract

Artificial intelligence (AI) in library settings involves the use of advanced technologies, such as machine learning, natural language processing, and AI-driven algorithms, to enhance library services, increase operational efficiency, and improve the overall user experience. As libraries evolve into dynamic hubs of information and technology, AI technologies such as machine learning, natural language processing, and data analytics are being integrated into various facets of library operations. This transformation not only streamlines cataloging and information retrieval processes but also enables personalized user experiences through intelligent recommendation systems and virtual assistants. The target population for this study consisted of 1,500 students registered with the university library. A sample of 200 students was selected for analysis. Data collection was conducted using a convenience sampling approach. Additionally, the data collection instrument, a questionnaire, was adapted from established scales developed by Krejcie and Morgan (1970), with minor modifications made to align with the specific context of this research. This paper explores the implications of AI on the future of libraries, examining both the potential benefits and challenges that would arise from its implementation. Assessing current trends and envisioning future developments, this research aims to provide a comprehensive understanding of how AI can reshape library services, ensuring they remain relevant and effective in an increasingly digital environment. The future of library services will increasingly rely on AI technologies to enhance accessibility and inclusivity. The findings indicate a positive correlation between artificial intelligence and the future of library and information service delivery, as evidenced by a correlation coefficient of 0.535, which is statistically significant at the 0.05 level. In conclusion, AI presents transformative opportunities for libraries, careful consideration of its implementation will be important in navigating ethical challenges and maximizing its potential benefits for both library operations and user experiences. This study advocates for the administration of Lagos State University to provide complimentary access to artificial intelligence tools and free internet services within the university library.

Keywords: Artificial Intelligence, Future of Library, Information Service Delivery

Introduction

Artificial Intelligence (AI) is defined as the emulation of human cognitive functions by machines that are designed to think, learn, and make decisions autonomously. This covers a diverse array of technologies, including, but not limited to, machine learning, natural language processing, robotics, and computer vision. AI systems are specifically engineered to analyze data, identify patterns, and perform tasks that traditionally require human cognitive abilities, such as problem-solving, decision-making, and language comprehension (IFLA, 2023). AI has evolved into a general-purpose technology, comparable to electricity or the internet, with applications that span nearly all sectors. Its impact is evident in fields such as healthcare, finance, entertainment, and education, fundamentally transforming the operational dynamics of libraries and the ways in which individuals interact with technology.

Artificial Intelligence (AI) is progressively revolutionizing library and information services by automating processes, enhancing user experiences, and facilitating data-driven decision-making. The integration of AI in libraries aligns with broader trends in digital transformation that leverage advanced technologies. Libraries are increasingly adopting AI to optimize workflows, improve accessibility, and provide personalized services to patrons. AI algorithms enhance the accuracy and efficiency of search functionalities by analyzing extensive datasets, thereby refining the research process for users and assisting librarians in curating targeted collections. Furthermore, machine learning enables libraries to tailor recommendations based on user preferences and behaviors, promoting engaging learning experiences for both students and researchers (Akinyemi, 2023).

Artificial intelligence (AI) streamlines the automation of repetitive tasks, such as cataloging, inventory management, and metadata creation. This automation enables librarians to focus on more intellectually demanding activities, thereby enhancing operational efficiency (Ghosh, 2021). Furthermore, AI improves accessibility by transcribing audio resources for individuals with hearing impairments and translating materials into multiple languages, thereby broadening access to library resources for diverse users. Additionally, AI's ability to analyze user behavior allows libraries to anticipate future needs, which facilitates effective resource planning. As a result, artificial intelligence (AI) is driving libraries to evolve into more dynamic centers of digital literacy and innovation, transforming them from traditional spaces into hubs for the production and dissemination of digital resources. Despite the transformative potential of artificial intelligence (AI), it also presents challenges, including resource limitations and the need for staff training in AI technologies. Libraries must address these challenges to ensure equitable access and the effective implementation of AI solutions.

Artificial Intelligence (AI) is revolutionizing library services by enhancing efficiency, accessibility, and personalization. Traditionally, libraries have been slow to embrace new technologies; however, there is an increasing trend toward the integration of AI to tackle the challenges of the digital age. The applications of AI within libraries covers a wide range of functions, from automating routine operations to improving user experiences and accessibility. AI-driven algorithms facilitate faster and more accurate searches, enabling users to locate resources with greater efficiency. However, artificial intelligence is being utilized in various ways within academic libraries, fundamentally transforming their operations and services (Khalid and Ikram, 2024). This advancement not only streamlines the research process for scholars but also aids librarians in curating specialized collections.

The integration of artificial intelligence (AI) into library systems presents numerous opportunities for advancement, as well as certain challenges. AI analytics tools enable libraries to assess usage trends, optimize resource allocation, and make data-driven decisions regarding collection development. However, the adoption of AI technologies raises critical issues, including data privacy, algorithmic bias, and the preservation of intellectual freedom, which require careful consideration. It is important to note that not all libraries have the financial or technical resources necessary for the effective implementation of advanced AI systems. Consequently, librarians must develop new competencies to manage and utilize AI tools effectively.

Statement of the problem

The rapid advancement of Artificial Intelligence (AI) is fundamentally transforming the delivery of library and information services, presenting both opportunities and challenges. Libraries are increasingly integrating AI technologies, such as machine learning and natural language processing, to enhance cataloging, information retrieval, and user services. These innovations improve operational efficiency by automating routine tasks, facilitating personalized recommendations, and enhancing accessibility for diverse users. However, libraries in developing nations face significant obstacles, including inadequate infrastructure, digital divides, and high implementation costs. The gradual adoption of AI in libraries risks creating disparities in service delivery and user satisfaction. It is essential for librarians to adapt to evolving user behaviors and strategically integrate AI to maintain relevance in a transforming dynamic information environment.

Research objectives

1. How does artificial intelligence (AI) technologies impact data literacy among library patrons?
2. How do artificial intelligence (AI) technologies impact student accessibility and optimize information retrieval processes within library systems?
3. What are the challenges of Artificial Intelligence on the future of library and information service delivery?

Hypothesis:

Ho: There is no significant relationship between artificial intelligence (AI) and the future of library and information service delivery in Lagos State University Library

Literature Review

Conceptual Review

Artificial Intelligence (AI) is revolutionizing library and information services by enhancing efficiency, accessibility, and personalization. Libraries are increasingly integrating AI tools to automate routine tasks such as cataloging, metadata generation, and bibliographic data processing. These applications reduce manual workload while improving the accuracy of information organization. AI driven tools such as Research Rabbit and Scite streamline literature reviews, while Robotic Process Automation (RPA) facilitates backend operations (Khalid and Ikram, 2024). Additionally, AI-powered chatbots are being deployed to answer routine queries, guide users through processes, and provide 24/7 support, making libraries more accessible to patrons.

AI is transforming user services by enabling personalized experiences. Libraries now use AI to analyze user behavior and preferences, offering tailored recommendations based on borrowing patterns or search history. This personalization extends to circulation services and digital preservation efforts, ensuring that resources are curated to meet diverse user needs. Furthermore, AI's ability to translate content into multiple languages broadens accessibility for non-native speakers, democratizing access to library materials. These innovations highlight how AI can enhance inclusivity in library services.

Siddiquah et.al (2023) provided illuminating insight into 22 emerging library services provided by using 2.50 as a benchmark in their research work, the result demonstrated the following as emerging services provided. Serial control X=3.18, Library portal website management (x=2.95), electronic search (x=2.90), online public access catalogue and current awareness electronic mail service (x=2.84) as the most provided services while the least provided are game centres for entertainment in the library (x=1.47), virtual reality and block chain technology (x=1.55) and cloud computing services and IoTs (x=2.11).

Tunde et.al (2022) on the advantages of Adopting AI for effective library Services in academic libraries states that, Artificial intelligence (AI) provided solutions to pressing challenges facing libraries such as; shelving of books and other library materials, cataloguing and acquisition of library materials among others. Tella, & odunola, (2023), posited that artificial intelligence enhances cataloguing and classification in academic libraries. Majority of 70% of the respondents revealed that artificial intelligence enhances automotive cataloguing and classification using optical character recognition, faster than human being and enables libraries to provide accurate services with fewer errors. Also 80% of the respondents revealed that benefits of

artificial intelligence include saving time and money, assisting librarians to create metadata for digital resources it also allows librarians to provide accurate and timely services to users.
The integration of AI in libraries raises critical considerations regarding privacy and ethical use. As libraries adopt AI for tasks such as predictive analytics and user behavior analysis, they must address concerns about data security and patron confidentiality. Librarians are encouraged to evaluate AI tools rigorously, ensuring compliance with privacy policies that safeguard user information. Additionally, fostering AI literacy among both librarians and patrons is essential for navigating these technologies responsibly.
Despite its transformative potential, the adoption of AI in libraries varies globally. Developed nations have embraced AI extensively in areas like reference services and digital preservation, while developing countries face challenges such as limited resources and technical expertise. Bridging this gap requires strategic planning and investment in infrastructure to support AI implementation. Libraries in developing regions can benefit from collaborative efforts that share knowledge and best practices for integrating AI into their operations.

Theoretical Review

Theory of Mind AI

The Theory of Mind (ToM), which refers to the ability of individuals to attribute mental states to others, constitutes a fundamental aspect of human cognitive processes. This form of social cognition is essential for understanding the mental states and perspectives of others, thereby facilitating effective interactions in both social and professional contexts. This specific form of artificial intelligence aims to predict human behavior by modeling cognitive states, thereby improving its capacity to interact with individuals in a more empathetic and intuitive manner. For example, its application in users' service or human-robot collaboration could promote a deeper understanding of user needs, enabling more suitable responses (Langley, Cirstea, Cuzzolin, and Sahakian, 2022). Although this capability is still in the developmental phase, it represents a significant advancement in AI research, as it requires machines to acknowledge humans as distinct entities shaped by a multitude of factors.

Self-Aware AI

The emergence of artificial intelligence (AI) is profoundly shaped by advancements in computer technology. The cognitive capabilities of computer systems are increasingly approaching, and in some cases, surpassing those of humans (Wang, 2023). This is considered the ultimate goal in AI development, often referred to as the "AI singularity." Unlike Theory of Mind AI, which focuses on understanding others, Self-Aware AI would have consciousness akin to human awareness. Such systems could autonomously learn from their experiences and adapt without external programming. Although it has not yet been achieved, Self-Aware AI holds transformative potential for creating autonomous robots capable of independent decision-making.

The Philosophy of Information (PI):

This theory, as proposed by Luciano Floridi, emphasizes the conceptual nature and dynamics of information. It positions LIS as an applied form of PI, focusing on understanding information as meaningful data and its role in knowledge creation. The cognitive perspective in information science emerged from an interdisciplinary initiative known as cognitive science, or the cognitive revolution, which was, in turn, influenced by Shannon's information theory (Hjørland, 2018). The theory suggests that LIS should move beyond borrowing theories from other disciplines like social epistemology and instead develop its own theoretical foundation through the lens of PI. This approach not only addresses technical challenges in library services but also establishes information as a core ontological and epistemological concept within LIS.

Social Epistemology in LIS:

The cognitive perspective in information science emerged from an interdisciplinary initiative known as cognitive science or the cognitive revolution, which was significantly influenced by Shannon's information theory. Consequently, epistemology seeks to address several fundamental questions: How is knowledge acquired? What methodologies can be employed to attain and comprehend knowledge? How can the veracity and objectivity of knowledge be evaluated? What logical criteria must be met for knowledge to be considered true and objective? Responses to these questions can support the assertion that knowledge covers both truth and justification (Asmiyanto, 2020). However, Jesse Shera introduced the concept of social epistemology as a theoretical framework for LIS. This theory focuses on the collective processes involved in the creation, dissemination, and utilization of knowledge within society. It examines how libraries function as social institutions that facilitate knowledge sharing and support intellectual development. Social epistemology highlights the role of libraries in fostering community learning and collaboration, making it a foundational theory for understanding the societal impact of library services.

Empirical Review

Artificial Intelligence (AI) has significantly transformed library and information service delivery, enhancing efficiency and accessibility. Libraries are increasingly adopting AI-driven tools such as chatbots, machine learning algorithms, and robotic process automation (RPA) to streamline operations like cataloging, metadata generation, and user query handling (IFLA, 2023). These technologies allow libraries to automate routine tasks, enabling librarians to focus on complex inquiries and personalized services. For instance, chatbots can address common questions while librarians handle in-depth research requests. AI's integration also improves search systems and information retrieval processes, making library services more user-friendly and dynamic (Akinyemi, 2023).

AI's impact extends to improving information organization and accessibility. Libraries now use AI to assign subject headings, classify documents, and recommend resources based on user preferences. Tools like ResearchRabbit and Scite analyze user behavior to suggest relevant research materials, ensuring tailored service delivery. Furthermore, AI enhances accessibility by identifying sensitive information in born-digital materials, democratizing content for broader audiences. These advancements demonstrate how AI empowers libraries to adapt to evolving user demands while maintaining their role as stewards of information (Ghosh, 2021). Nombuso et.al (2024) stated that the integration of AI in academic libraries services servers as a transformative force that address the following challenges such as improve information retrieval seamless knowledge organization, resource management, it frees libraries from mundane tasks, chatbots servers as a simple platform to reach out to target users such as students and research can help them to access the library database on radio frequency (RFID).

Moustapha, and Yusuf (2023) challenges adoption of AI in university libraries the low awareness on how to apply for their service needs Orubebe, & Oladokun, B.D (2024) he adoption of and use of artificial intelligence an academic library as well as in other types of libraries in frequently regarded as inevitable. However, numerous challenges have made AI implementation highly complex such as compliances in related skills which requires highly specialized and skilled manpower; the level of knowledge and education about artificial intelligence to academic libraries academic libraries as social institutions often lack financial resources need for AI implementation; also concerns over privacy and intellectual freedom are barriers to AI adoption in academic libraries.

The adoption of AI in libraries is uneven across regions. Developed nations have embraced AI technologies extensively in areas such as circulation services, reference management, and systematic reviews. However, libraries in developing countries face challenges such as limited resources and infrastructure for implementation. Despite these disparities, the potential for AI to revolutionize library services globally remains promising. Libraries must prioritize strategic planning and training to ensure effective integration of AI tools into their operations (Akinyemi, 2023).

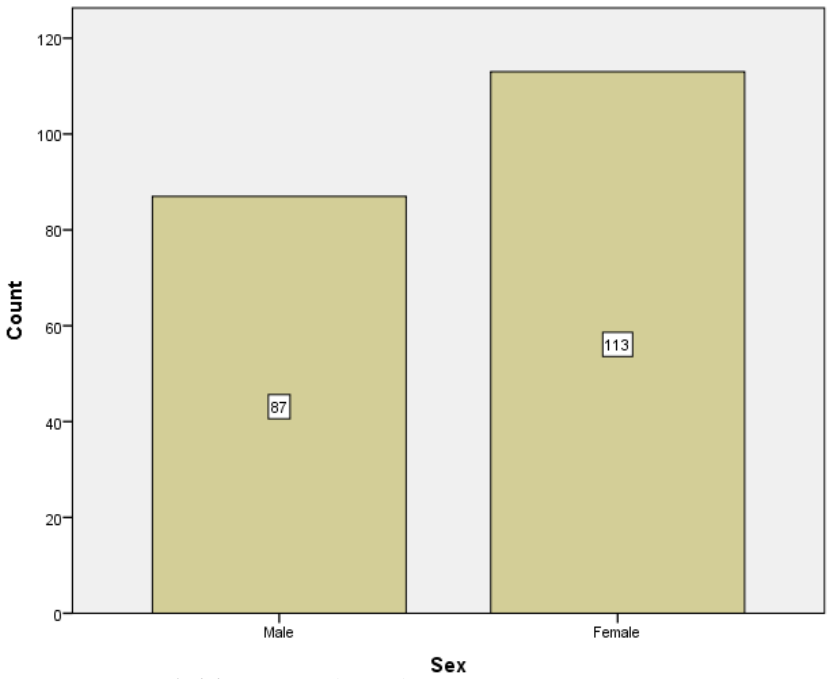
Methodology

This study employed a descriptive survey research design to examine the impact of Artificial Intelligence on the future of library and information service delivery at Lagos State University. The target population consisted of 1500 students who registered with the university library. The sample size was 200 students. Data collection was conducted using a convenience sampling method. Additionally, the data collection instrument, a questionnaire, was adapted from established scales developed by Krejcie and Morgan (1970), with minor modifications made to suit the specific context of this research. Notably, certain items within both scales were reverse-scored to mitigate response bias and enhance the reliability of the data obtained. Data analysis included frequency counts, simple percentages, means, and standard deviations. The research hypothesis was tested through correlation analysis to determine the relationship between artificial intelligence (AI) and the future of library and information service delivery.

Results and Discussion

This section focuses on analysing the gathered and organised data. Additionally, it examines the findings in relation to the existing literature.

Figure 1
Demographic analysis



Source: Field Survey (2025)

The analysis of demographic outcomes reveals a relatively equitable gender distribution within the student population, with males representing 43.5% (87 individuals) and females constituting 56.5% (113 individuals). This indicates a higher number of female participants compared to their male counterparts in this study.

Table 1: Artificial intelligence (AI) technologies impact on student accessibility and optimization of information retrieval processes within library systems.

S/N	Artificial intelligence (AI)	SA	A	SD	D	X	SD
1	Automated captioning and transcription services are employed for recorded lectures, video tutorials, and podcasts.	106 (37.7%)	77 (27.4%)	5 (1.8%)	12 (4.3%)	3.39	.806
2	Semantic search and vector -based retrieval are methodologies that surpass traditional keyword matching techniques.	96 (34.2%)	79 (28.1%)	13 (4.6%)	11 (3.9%)	3.30	.845
3	Real-time multilingual translation encompasses a variety o f applications.	75 (26.7%)	106 (37.7%)	8 (2.8%)	11 (3.9%)	3.23	.766
4	The generation of alternative text for digitized images and diagrams using artificial intelligence.	72 (25.6%)	113 (40.2%)	4 (1.4%)	11 (3.9%)	3.23	.742
5	Precision and Recall: Artificial intelligence possesses the capability to recognize all pertinent instances.	85 (30.2%)	90 (32.0%)	8 (2.8%)	17 (6.0%)	3.22	.873
6	Periodic audits: schedule quarterly re-evaluation	73 (26.0%)	98 (34.9%)	15 (5.3%)	14 (5.0%)	3.15	.837
7	Caption batch-processing	57 (20.3%)	109 (38.8%)	15 (5.3%)	19 (6.8%)	3.02	.862
8	Metadata NER tagging	66 (23.5%)	83 (29.5%)	24 (8.5%)	27 (9.6%)	2.94	.996
9	Intelligent recommender systems	40 (14.2%)	90 (32.0%)	21 (7.5%)	49 (17.4%)	2.61	1.065
	Weighted mean = 3.12						

To determine the artificial intelligence (AI) technologies that improve student accessibility and optimize information retrieval processes within library systems, respondents were asked to indicate the level of improvement of eight different AI technologies on this accessibility. The results are presented in Table 1. The findings revealed that Automated captioning and transcription services are employed for recorded lectures, video tutorials, and podcasts (3.39) was ranked highest as the primary AI technology improving students' accessibility and optimize information retrieval processes within library systems, followed by Semantic search and vector-based retrieval (3.30) and Real-time multilingual translation (3.23). The AI technology with the least improvement on students' accessibility is intelligent recommender systems, (2.61).

These findings align with the assertions of IFLA, (2023).who stated that Libraries are increasingly adopting AI-driven tools such as chatbots, machine learning algorithms, and robotic process automation (RPA) to streamline operations like cataloging, metadata generation, and user query handling. By utilizing AI technologies, libraries are becoming proactive in technologies that improve student accessibility and optimize information retrieval processes within library systems.

Table 2: Artificial intelligence (AI) technologies impact on data literacy among library patrons.

S/N	Data Literacy	SA	A	SD	D	X	SD
1	Data awareness	96 (34.2%)	93 (33.1%)	6 (2.1%)	5 (1.8%)	3.40	.673
2	Data retrieval skills	57 (20.3%)	102 (36.3%)	14 (5.0%)	26 (9.3%)	3.37	.759
3	Data interpretation	91 (32.4%)	88 (31.3%)	10 (3.6%)	11 (3.9%)	3.30	.801
4	Data ethics	79 (28.1%)	96 (34.2%)	11 (3.9%)	14 (5.0%)	3.20	.833

5	Workshop attendance growth	51 (18.1%)	120 (42.7%)	22 (7.8%)	7 (2.5%)	3.08	.708
6	**Use control groups when possible to show causality**	53 (18.9%)	120 (42.7%)	14 (5.0%)	13 (4.6%)	3.07	.771
7	Automated tutorial recommendations	56 (19.9%)	115 (40.9%)	14 (5.0%)	15 (5.3%)	3.06	.806
8	Chatbot reference assistant	91 (32.4%)	88 (31.3%)	10 (3.6%)	11 (3.9%)	2.95	.939

Weighted mean =3.18

The results presented in Table 2 indicate that the data awareness (x = 3.40) was the most significant artificial intelligence (AI) technologies impacting data literacy among library patrons. This was followed by Data retrieval skills (x = 3.37), Data interpretation (x = 3.30), and Data ethics (x = 3.20). Chatbot reference assistant (x = 2.95) was identified as the least important factor by the respondents. Using a weighted mean of 3.18 as the benchmark, it was revealed that a significant percentage of users don't utilise the Chatbot reference assistant. The extent to which AI users feel their needs are met through these services is crucial. The responsiveness of AI technologies significantly impact future of libraries services delivery at Lagos State University, as these factors ranked above the weighted mean of 3.18. These findings align with Nombuso et.al (2024) stated that the integration of AI in academic libraries services servers as a transformative force that address the following challenges such as improve information retrieval seamless knowledge organization, resource management, it frees libraries from mundane tasks, chatbots servers as a simple platform to reach out to target users such as students and research can help them to access the library database on radio frequency (RFID).

Table 3: Challenges of Artificial Intelligence on the future of library and information service delivery.

S/N	Challenges	**SA**	**A**	**SD**	**D**	**X**	**SD**
1	Undermines the library's equity-of-access mission	95 (33.8%)	75 (26.7%)	15 (5.3%)	15 (5.3%)	3.25	.890
2	Libraries are often one of the last public spaces with privacy by default	102 (36.3%)	59 (21.0%)	9 (3.2%)	30 (10.7%)	3.17	1.065
3	Poor metadata hallucinated c itations, faulty entity linking	85 (30.2%)	72 (25.6%)	21 (7.5%)	22 (7.8%)	3.10	.982
4	Smaller public libraries risk exclusion	78 (27.8%)	82 (29.2%)	19 (6.8%)	21 (7.5%)	3.09	.950
5	Risk of litigation	56 (19.9%)	108 (38.4%)	15 (5.3%)	21 (7.5%)	3.00	.883
6	Aligns with ESG commitments many publicly funded libraries now report.	65 (23.1%)	83 (29.5%)	22 (7.8%)	30 (10.7%)	2.92	1.016
7	Offers ready-made bias	47 (16.7%)	103 (36.7%)	10 (3.6%)	40 (14.2%)	2.79	1.022
8	Privacy for academic contexts	48 (17.1%)	54 (19.2%)	36 (12.8%)	62 (22.1%)	2.44	1.163

Weighted mean =2.97

To identify challenges of Artificial Intelligence on the future of library and information service delivery, respondents were asked to indicate the challenges they perceived. Eight metrics were identified as challenges of Artificial Intelligence on the future of library and information service delivery. The results are presented in Table 3. The findings revealed that Undermines the library's equity-of-access mission (3.25) ranked highest challenges of Artificial Intelligence on the future of library and information service delivery, followed by Libraries are often one of the last public spaces with privacy by default (3.17) and Poor metadata hallucinated citations, faulty entity linking (3.10). The least significant challenge identified was Privacy for academic contexts (2.44).

These findings agreed with Lund (2025), who postulated that artificial intelligence (AI) can enhance user experience and facilitate the adoption of new technologies. However, the pace of diffusion may vary considerably among universities, influenced by their technological readiness and cultural openness to innovation. As libraries work to integrate AI-driven tools into their digital reference services, understanding these dynamics is essential for fostering acceptance and ensuring successful implementation.

Ho: There is no significant relationship between artificial intelligence (AI) and the future of library and information service delivery in Lagos State University Library

Table 4: Correlation Analysis between artificial intelligence (AI) and the future of library and information service delivery

		Artificial	Future of Library and Information Service Delivery
Artificial	Pearson Correlation	1	.535**
	Sig. (2-tailed)		.000
	N	199	198
Future of Library and Information Service Delivery	Pearson Correlation	.535**	1
	Sig. (2-tailed)	.000	
	N	198	199

Source: Field Survey (2025)

This Table 4 presents a Pearson correlation analysis examining the relationship between artificial intelligence (AI) technologies and the future of library and information service delivery. The results reveal a positive correlation between AI and future of library and information service delivery, with a correlation coefficient of 0.535, which is statistically significant at the 0.05 level. This indicates that as engagement with AI increases, there is a corresponding improvement in the future of library and information service delivery. The significance level ($p < 0.000$) demonstrates a high level of confidence in the reliability of this positive correlation, suggesting that the observed relationship is not due to random chance but reflects a genuine interplay between these two variables. This finding aligns with existing research, further reinforcing the idea that artificial intelligence (AI) plays a significant role in enhancing the future of library and information service delivery. Jan (2018) asserted that systems are often employed to address future of library and information service delivery. This process utilizes software to conduct searches across various databases.

Conclusion

Artificial intelligence technologies (AI) play a germane role in enhancing future of library and information service delivery. This study highlights the importance of artificial intelligence technologies and impact of Artificial Intelligence on the future of library and information service delivery at Lagos State University. It was noted that its necessity to integrating artificial intelligence technologies to support the comprehensive development of academic libraries. By demonstrating the positive impact of artificial intelligence (AI) technologies and the future of library and information service delivery, this research underscores the importance of creating digital environments that prioritize not only academic achievement but also patrons' engagement and satisfaction.

Recommendation

This research recommends that:

1. The management of Lagos State University should provide free Artificial intelligence tools
2. Lagos State University management should provide free internet service in the university library.
3. Lagos State University management should facilitate the adoption of new technologies in the library.

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Artificial Intelligence and the Future of Library and Information Service Delivery

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Abstract

The emergence of Artificial Intelligence (AI) has revolutionalised the way operations are carried out in almost every organization including the library. Libraries are custodians of knowledge and are expected to be able to meet with the changing needs of users in the modern era. With the adoption of AI systems, the library has a greater chance of carrying out their activities with ease and in a timely manner while still upholding the main purpose of their existence. Artificial intelligence is the imitation of human intelligence by computers to carry out specific tasks. It is an innovative computer system created to solve human problems, draw conclusions, and also useful for making predictions. The paper gives an overview of Artificial Intelligence, its integration by libraries for service delivery which includes discussion on its benefits and challenges of adopting it. There was also an exploration into the future of libraries with the integration of AI in their day-to-day operations. It was concluded that the future of library and information service delivery seems to be promising, with the integration of Artificial Intelligence, thus, libraries should embrace this innovative technology to enhance library service delivery for the optimum satisfaction of the library users. Some way forward were proffered that libraries should train their staff on the use of AI, create awareness on the benefits that can be derived from the adoption of AI, and as well put in place measures to address the challenges of integrating AI in their daily operations.

Introduction

Artificial Intelligence (AI) in recent times has transformed the way activities and operations are carried out in almost every sectors, easing the tedious and repetitive tasks done by humans in their day-to-day job routines (Haleem et al., 2022). Services rendered in Library and Information Centres since the emergence of AI has been revolutionalised, effectively meeting the changing needs of individuals in the society. In the earliest times, libraries are only seen as custodians of knowledge, providing traditional information services such as cataloguing, charging and discharging of information resources, and offering research assistance. However, as digital technologies keep emerging, individual needs keep increasing and more dynamic, which has awakened libraries to adopt innovative means to cater for those needs (Cassidy, 2014).

Service delivery in libraries before the modern era solely depended on manual operations and processes which were often accompanied by numerous downsides such as energy draining, time-consuming, and repetition. For instance, cataloguing processes traditionally required significant human time and effort, repetitions and at times prone to errors. With the continuous increase in information dispensation nowadays, cataloging and classifying information resources can be more overwhelming. Thus, the need for automated technologies to ease those processes and improve user satisfaction. According to Ashikuzzaman (2018), technology-based solutions have in recent times been effective in addressing such challenges, ensuring timely and efficient services to the society of information users.

With the advent of AI and robotic technologies, natural language processing, and data analytics, libraries can now take advantage of them to provide services that were previously done to meet users' expectations (Rashid and Kausik, 2024). AI-powered chatbots and language translators for instance can serve as customer care assistants to instantly respond to users' queries irrespective of their language background. This has helped in reducing the workload on library staff (Akinyemi, 2023). Similarly, AI indexing tools such as Planet AI assists library personnel in indexing documents regardless of the numbers of pages. These advancements in digital technology serves as a catalyst for innovation and efficiency.

The integration of AI in libraries based on previous studies noted that some challenges are attached to it (Gunter, 2024). Some of the prominent downsides are breaches in data privacy and ethical issues. Gunter (2024) noted that for the successful integration of AI in, tangible investments must have been made so far in terms of finance, trainings and infrastructure. Nevertheless, numerous studies concluded that the benefits are more than the challenges indicated, some of which are improved service delivery and enhancement in user satisfaction (Mohamed, et al., 2024). They further noted that the future of libraries solely depends on their readiness and ability to make the optimum use of the new innovations and solutions offered by the advancements in technology to ensure their continuous relevance in the information age.

Libraries especially in developed countries tend to increasingly adopt AI for their day-to-day service delivery (Yakubu et al., 2023). This is evidenced by the findings from various studies across the globe focusing on libraries and integration of artificial intelligence in their operations. Therefore, this study aims to review numerous studies that researched on the concepts of libraries and artificial intelligence for the past ten years. The study aimed to investigate the various service delivery available in library and information centres, explore the emergence of artificial intelligence**,** examine how libraries integrate AI along with the possible issues that can serve as obstacles to the adoption of AI, and lastly look into the future of libraries in this modern and coming era.

Findings from this study are expected to significantly contribute to the growth of libraries across the globe especially in developing countries by helping them apply AI tools for effective service delivery and formulating policies to promote the ethical use of AI.

Statement of the problem

Libraries in recent times face challenges in meeting the evolving needs of users, who increasingly expect fast, personalized, and seamless access to information due to the presence of the Internet. Library often struggle with managing vast amounts of data and providing real-time 24/7 assistance to users, leading to inefficiencies and user dissatisfaction. These challenges call for the need to embrace innovative solutions such as Artificial Intelligence to automate routine tasks, enhance search capabilities, and improve user engagement, ensuring libraries remain relevant in this digital era.

With the integration AI, libraries can seamlessly carry out operations, reduce delays in response to users' queries, and offer a more intuitive user experience, ensuring easy accessibility and inclusivity. However, despite the potential benefits of AI, many libraries particularly in developing countries are yet to adopt AI for their daily activities, which could be due to limited research on the benefits of AI adoption in libraries. This study therefore aims to fill that gap by exploring why AI is essential in libraries, possible challenges to its adoption and ultimately the way forward so as to ensure that libraries can remain relevant and be able meet the evolving needs of their users.

Overview of artificial intelligence

Ever since the emergence of Artificial intelligence (AI), individuals and organizations has been making use of it to cater for their day-to-day activities (Haleem et al., 2022). It is the general name for most assistive technological tools and software that has been programmed to exhibit human-like behaviours in carrying out various tasks. The term "Artificial Intelligence (AI)" can be traced back to the year 1955 which was given by a mathematics scholar John McCarthy. Sheikh, Prins and Schirijvers (2023) defined AI as the imitation of human intelligence by computers to carry out specific tasks. He further stated that it is a form of technology that allows computers to imitate complex human skills which has previously been programmed on it.

The rapid growth and trends in AI have been enabled through more advancements in digital technology, introduction of programming languages and frameworks such as machine learning (Rashid and Kausik, 2024). He further postulated that individuals across the globe have widely adapted and adopt the use of artificial intelligence in multiple sectors such as AI in healthcare, AI in agriculture, AI in education among others. This has increased the speed at which works get done in organisations and in fact, people make use of artificial intelligence for their personal use.

When we talk of artificial intelligence, an ordinary layman thinks we are talking about ChatGPT which is only under the categorization of AI (Dwivedi et al., 2023). It is essential to note that there are various categorization of artificial intelligence which includes generative AI (GenAI), supervised learning AI, reinforcement learning AI and Expert systems. Generative AI as the name suggests are the ones that are utilized in creating contents such as write-ups for research, stories, images, videos, charts, and diagrams using web apps and applications that has been programmed to imitate human intelligence. The most common examples of generative AI are ChatGPT and Gemini to generate written contents, Dall-E and Leonardo.ai for generating images of different scenes and resolutions, and Deepfake technology which is used to generate realistic but fake videos of people.

Supervised learning is a subcategory in the field of machine learning (ML) and artificial intelligence (AI) (Yasar, 2024). In this category of AI, a computer algorithm or model is trained on input data that has been labeled for a particular output. The model is then trained to enable it detect the patterns and relationships and similarities between the input and output data labels, this makes it possible for the model to yield accurate labeling results when a new data that have never been inputed on it before is presented. Yasar (2024) noted that supervised learning is good at regression and classification problems, for instance, it can be used to discover what category of topics a news article belongs to and can also be used to make predictions on different things including projecting the sales volume for a given future date.

Reinforcement learning AI in contrast to supervised learning does not include the training of models based on output and input data, but involves AI agents which are trained to make decisions by rewarding or penalizing them based on their actions (Kanade, 2022). These agents get trained from interacting with their environment and aiming to maximize a cumulative reward over time. It is mostly used for tasks and operations where trial and error can bring about improvements in performance. Examples of reinforcement learning AI is AlphaGo which was developed for gaming experiences.

Another category of artificial intelligence is the expert system (Omehia and Mejin, 2020). The expert system is a computer software system that has been programmed to emulate decision making ability of human experts in a specific niche (Rahi, 2019). This category of AI are created for each domain separately to cater for the activities of each specialty. For instance, MYCIN is used in the medical field for diagnosis e.g identify bacteria related illnesses and suggesting treatments for its cure. Financial expert system is another expert system AI that is used in the finance sector for managing portfolios and making predictions on stock market.

Artificial intelligence has been a go-to tools for organisations and individuals in solving real-life problems (Yakubu et al., 2023). Gunter (2024) indicated that despite the benefits that comes with the invention of artificial intelligence, there are some challenges that are attached to it, some of which are lack of ethical usage by users especially with the use of generative AI such as Chat GPT and Gemini. Dolunay and Temel (2024)

noted that there is a potential of unethical use of AI to be mostly common among students in higher institutions of learning (universities and polytechnics) in writing their thesis and dissertations. It is also a prominent issue that it has contributed immensely to low logical reasoning level of students thereby affecting their cognitive abilities especially in developing countries where legal considerations concerning the use of AI is not taken serious.

Integration of artificial intelligence for service delivery in libraries

Libraries have been custodians of knowledge since the ancient times rendering services to individuals with their peculiar needs in the society (Omehia and Mmejin, 2020). Some services are rendered to library users behind the scene while some are directly offered to the clienteles (Mayende et al., 2021). Kalita (2019) argued that the services rendered behind the scenes make direct service delivery to users possible, without the former, the latter cannot occur. All these services together contribute significantly to the overall user experience and the effective functioning of the library. Ahmed et al. (2020) listed some of these services which includes collection development, cataloguing and classification, research assistance, charging and discharging of information resources, current awareness services, indexing and abstracting among others. All these services were done manually before the invention of artificial intelligence. The manual processing of these services according to research have appeared to be time consuming and repetitive. However, all these processes and services has been made easier and faster with the adoption of artificial intelligence.

Cataloging and classification is a kind of service rendered behind the scene in a library. It is a process of recording the bibliographic details of information resources and categorizing them based on their subject areas to make them accessible to the library users (Olubiyo, 2023). This process requires time and patience so as to bring out the desired result. With the emergence of AI software such as Claude AI, the process of classification have been made easy (Martins, 2024). He further stated that AI software can help in generating subject headings, classification numbers, and other required bibliographic details for library materials based on the content analysis of a book or document. This AI will help in reducing the time and effort that the catalog librarian will put in to make the information resources ready to use by the library users.

Some websites have integrated AI features in making book recommendations to libraries to develop their collection (Subaveerapandiyan, 2023). Dong (2021) noted that OCLC Worldcat & WMS have AI features that can be used for predictive analysis and cataloging automation. AI software such as Yewno AI is also efficient in discovering content that will be of great value to the library users. The AI software is made available through the SirsiDynix Cloudsource OA platform. According to Yewno (2022), it was reported that the AI system through CloudSource OA makes it easy for libraries to take advantage of the growing body of Open Access content available today. It was further stated that libraries can now access a comprehensive collection of vetted, quality open access articles, journals, eBooks, OER, and more in a way that is both seamless and intuitive. Additionally, AI tools such as BiblioCommons helps in recommending resources for acquisitions by analyzing user borrowing trends. This will help the librarians to make decision on which resources will attract users' interest and will save them the cost of acquiring resources that will be of no use in the library collection.

AI tools like **LibChat** assist the library in providing 24/7 virtual assistance to answer users' queries (Ali, 2024). The AI software route all library questions into one place and track the status of all patron inquiries. Question sources include email, SMS, LibChat, and web forms. This allows user to connect to the library irrespective of time and location to get answers to questions that are not clear to them (Springshare, 2024).

Charging and discharging of information resources in the library can be done through the use of artificial intelligence (Isiaka, 2023). This has helped libraries in improving accuracy, and enhancing user experience. Self-checkout AI systems such as Bibliotheca's selfCheck and 3M Self-Checkout use RFID or barcode technology to enable users to borrow materials on their own without the intervention of a circulation librarian (Karna, Pratama, and Ramzani, 2019). Recently, some mobile apps were launched, examples of which are CloudLibrary and MyLibrary to offer self-checkout and loan management via smartphones, ensuring efficient and user-friendly circulation services.

Current awareness services in libraries have gone beyond the traditional way of updating library users on new collections through the use of print-based tools such as newsletters, bulletin boards among others (Thelwall, 2015). In developed countries, messages are no more typed manually and repeatedly to send to individual library users to inform them of new collections, AI software are now adopted to do the tasks (Tella, 2020). Tools like Feedly adopts AI features to gather news and articles from selected sources, to enable users in tracking updates in their fields of interest. Enis (2014) discovered that the EBSCO's Discovery Service also integrates AI in delivering individual's interest-based recommendations for scholarly content and notifying users about new publications. These tools help libraries in the delivery of current awareness services in a timely and efficient manner.

Despite the numerous opportunities that the library can benefit from the integration of artificial intelligence in their service delivery, studies have found that there are some certain consequences to the adoption of artificial intelligence in the library (Moustapha and Yusuf, 2023). In a study by Martins (2024) who investigated the case of Claude-AI as an artificial intelligence-assisted system for classification of library resources, he discovered that AI such as the Claude-AI does not have the intelligence to be consistent in providing subject headings, class mark and other metadata about documents. This implies that artificial intelligence cannot be 100% accurate at all times, there will still be a need for human effort to check for errors and make necessary change to those errors.

Artificial intelligence algorithms depend solely on collecting user data for personalization, this has raised much concerns about users' data privacy, security, and potential misuse, especially with AI systems that have weak security features and lacks data protection policies (Zondi et al., 2024). This itches in the use of artificial intelligence can make individual data vulnerable to attacks form black hat hackers who illegally dig into people's personal data to take advantage of them (Gonzalez et al., 2024).

In libraries that are located in areas with poor internet access and epileptic power supply, or have individuals with disabilities especially with AI systems that lack special features, there may be limit to how AI can be utilized for service delivery (Bello and Abdulsalam, 2023). Manjunathan, (2023) further indicated that over-dependency on the use of AI to carry out certain tasks in libraries can make libraries to be vulnerable to technical issues such as system failures, or outdated software, which can cause obstruction in the flow of delivering services to the library users. In addition, AI tools are not humans, they are only programmed to imitate the human intelligence, therefore, artificial intelligence lacks human intuition and emotional intelligence, which are essential in interacting with users in the library, this can potentially diminish the human touch and empathy that are necessary while offering services to users in the library (Oritsegbemi, 2023). There is a need for libraries to weigh the benefits and the consequences of integrating artificial intelligence for service delivery in other to ensure effective and equitable service delivery to their clienteles.

Future of library and information service delivery

The future of service delivery in libraries is influenced by emerging technologies, changes in user demands and expectations, and the growing need for inclusivity and sustainability which is one of the goal of the United Nations Sustainable goals (Masenya and Chisita, 2022). As digital technologies become widely acceptable in the society, it is important for libraries to adapt and embrace the opportunities that innovative technologies such as artificial intelligence can offer. Integration of the different categories of artificial intelligence such as generative AI, Supervised Learning, Reinforcement Learning and Expert System to streamline the day-to-day services that are delivered in the library.

With the rate at which AI systems are emerging, libraries are likely to permanently transform to hybrid and digital service modes (Kumar and Jyoti, 2024). Many libraries especially in developed countries are already offering seamless services using AI-Based platforms (Zondi et al., 2024). Their users are opportune to access resources in the library via the internet irrespective of time and location, and can also make enquiries without stepping into the four-walls of the library. Some libraries in developing countries like Nigeria have been using Robots to offer services, in no time, there is high chances that such libraries will tap into the adoption of leveraging AI for service delivery. These libraries are likely to greatly influence other libraries within the continent to do the same. This trend is expected to accelerate, transforming libraries to virtual hubs that break geographical barriers, enhancing user experience and enabling them to access resources and services from anywhere in the world.

Future libraries will be able to offer personalized services considering the expectations that AI will become more sophisticated enabling libraries to deliver customized services to each users based on their individual preferences (Akinyemi, 2023). For instance, smart recommendation systems could make use of data gathered during user interaction with AI systems to provide resource suggestions to libraries during acquisition processes and also help in sending updates to users on new arrivals based on their interests and previous activities, thus enhancing libraries selective dissemination of service and current awareness services (Zhang, Lu and Jin, 2020). This improvements in offering personalized services will not only improve library user satisfaction but also help in fostering deeper engagement with library information resources.

The tenth goal of the United Nations' Sustainable Development Goals (SDG) focuses on reducing inequalities (Springer Nature, 2024). Kumar and Sheshadri, (2024) in their study indicated that with the adoption of embedded AI such as Alexa, Siri, Google Assistant in nested devices, users with disabilities can make use of them to solve their information need and to also locate information resources in the library without having to manually consult the catalog, the future libraries will be able to help in reducing inequalities, thereby promoting inclusivity and accessibility. The natural language processor embedded in some AI can help in providing multilingual support to offer services to non-English speakers especially in English-speaking countries, this will enable libraries to remain accessible and equitable spaces for learning and innovation for all users regardless of their cultural and language background (Ashikuzzaman, 2025).

Conclusion

The future of library and information service delivery seems to be promising, with the integration of emerging innovative technology such as Artificial Intelligence, and a commitment towards growth, and customer satisfaction. By adapting to new trends in the modern era, libraries will continue to stay relevant and play a vital role as custodians of knowledge, and promoter of innovation and development.

Way forward

1. Libraries need to keep up with updates on emerging technologies and embrace the use of artificial intelligence (AI) to provide improved services to and for better user experience of their clientele.
2. Libraries should put in measures to address any form of challenges attached to the adoption of artificial intelligence.

3. Libraries should provide trainings and seminars for their staff to gain the necessary skills required on the effective use of artificial intelligence..

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Artificial Intelligence Driven Innovations in Libraries and Information Centers in Nigeria

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Abstract

Libraries and information centers are service oriented institutions saddled with the responsibilities of catering for the educational, research, recreational, cultural and information needs of users. The integration of AI in libraries marks a significant hallmark in this digital dispensation. AI innovations have heralded a new realm in libraries and information centers with robotic process automation, automated storage and data retrieval systems. AI has the ability to transform library services and operations with AS/RS for metadata extraction and analytics, personalized assistance using chatbots for unlimited connectivity and interaction, text-speech recognition and an improved digital curation and preservation systems. While there are numerous benefits affiliated with AI innovations in libraries and information centers, there are salient impediments associated with its incorporation. These challenges must be carefully addressed ranging from ethical concerns, librarians job displacements, technical complexities to exasperating disparities between the existing systems and AI innovations with a focus on the Nigerian context. Tackling these challenges requires a positive synergy between IT consultants, AI specialists and Librarians. Basically, this study examines the importance of libraries and information centers in the society, users' perception and experiences with AI oriented libraries, exploring the potentials of AI innovations in libraries, librarians' readiness in accommodating AI, the skills librarians require in AI management for optimum use, rooting out the challenges of transcending to AI and the future trajectory of AI innovations in libraries and information centers. By bridging these gaps, this study contributes to the growing discourse on AI driven transformations in libraries, offering practical recommendations for fostering innovations while preserving the core values of the parent institution.

Keywords: Artificial Intelligence, Librarians, Libraries, Information Centers, Innovations.

INTRODUCTION

Library and information centers are service oriented organizations that cater for the needs of various categories of students, researchers and communities under the supervision of delegated professionals that facilitates easy access. Ari, (2017) states that libraries supports formal and informal education for lifelong learning. They provide access to the dissemination of timely and accurate information and preserves knowledge for posterity. The technological shift in libraries and information centers like many other sectors is driven by the ever-growing volumes of data and the need for real time data processing and result generation. Anandraj (2024), Libraries have revolutionized from being book storage facilities to becoming knowledge and information repositories providing efficient services to the diverse needs of users in a digitized society. The advent of AI has changed how libraries organize, disseminate, preserve and serve its users. Its application to libraries and information centers is basically important for enhancing interaction among smart technologies, thereby improving its effectiveness and the knowledge structure. Thus, it can be argued that the introduction of AI into libraries has created a new horizon transitioning traditional library services to automated intelligence technologies focusing on users' needs and providing specialized and unique services (Biswas, 2024). Artificial Intelligence is a branch of computer science that aims at performing learning, reasoning, problem solving, perception and language understanding task that typically require human intelligence (Gajbhiye, 2024). The desire of early researchers to know more about the power of computer systema led to the question “can a machine think and behave like humans do?” This curiosity led to the creation of human intelligence in machines (Uwadia 2022). AI are intelligent machines and systems that could automatically perceive situations and expectations of humans and proffer necessary information before it could be required (Ema 2016). AI is producing higher productivity, improving efficiency, facilitates accurate predictions and informed decision.

AI technologies present libraries with new tools and means to achieve goals such as resource digitization, intelligent services, efficient and quality services to meet the diverse and peculiar needs of users. Libraries often have established cataloging systems, digital repositories and user management systems that need to work seamlessly with new AI technologies. Consequently, posing new requirements and expectations for libraries in respect to adapting to trends in the information environment, utilization of AI technologies, user rights protection and data security which births the need for careful considerations for AI sustenance in libraries and information centers.

Cordell, (2020) Artificial Intelligence has created opportunities in many sectors of the society that is widely used in diverse fields like education, healthcare, business, transportation, finance, security which churns out a huge vale to the socioeconomic development of a society. The most powerful applications for artificial intelligence for libraries are "descriptive AI" which can be used to make photos, videos, sound and manuscripts in all collections machine-readable data through computer vision or sound to text techniques and provide description at scale for information retrieval IFLA (2023) mentioned that libraries are expected to adopt AI in ways that align with existing roles, user needs or demand minimal resources. Descriptive AI is a vital tool for enhancing easy access to library collections providing initial metadata. Generative AI will change everyday knowledge work through translation, summary and text generation. As AI techniques become more prevalent in research, libraries will need support from data scientists in areas such as data discovery, copyright issues, data management and preservation.

Problem Statement

The integration of Artificial Intelligence (AI) in libraries has been transformative in developed countries, enhancing efficiency and user experience. In Nigeria, however, the adoption of AI in libraries is still emerging, influenced by various factors like institutional preparedness, librarians' readiness. Ajani (2022) in his study on perspective of librarians on awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services in Nigeria used qualitative approach to study six academic libraries each representing one of the six geopolitical zones in Nigeria highlighting that while Nigerian librarians are aware of AI's Global adoption, there is limited readiness for its integration due to financial, infrastructural and human resource constrains. By addressing this gap, through increased funding, capacity building and infrastructural development will facilitate AI adoption in Nigeria libraries, ultimately enhancing library services and operational efficiency while upholding their underpinning mission of equitable knowledge, access and service.

Objectives of the Study

1. To investigate the current state of AI integration and adoption in libraries and information centers in Nigeria.
2. To examine librarians' readiness in accommodating AI innovations and applications in libraries and information centers.
3. To examine the challenges and limitations associated with AI implementation in library and information centers.

Methodology

This study employs a systematic literature review method to examine artificial intelligence driven innovations in libraries and information centers in Nigeria. The study is based on an extensive literature search of approximately 135 scholarly articles, case studies and reports from multiple databases like WoS, Scopus, Google Scholar from 2015 till date focusing on AI applications in library operations such as cataloging and classification, resource management, this study reviews the implementation of AI-powered library systems used to streamline resource acquisition and selection like Ex Libris Alma, Yewno Discover, OCLC WMS, ProQuest and Rialto analysing their impact on library workflows and efficiency. By analysing existing research, the study also provides an evaluation of the current state of AI integration and adoption, AI effectiveness, highlighting both the benefits and challenges of its integration.

Literature review

Adoption of AI in Libraries and Information Centers in Nigeria

The adoption of AI in Nigerian libraries and information centers is at a low level as supported by Yusuf & Ibrahim, (2024) that the adoption of AI in Nigerian libraries is still in its infancy stage, with limited integration compared to global trends. Many Nigerian libraries are exploring AI's potential, but progress is hampered by infrastructural and financial constraints. Okeke et al. (2022) several Nigerian library and information centers have begun to experiment with AI applications in areas such as automated cataloging and virtual reference services, yet there is a significant gap in the full deployment of AI systems.

Librarians' Readiness in Accommodating AI Innovations and Applications in Libraries and Information Centers

The awareness and perception of librarians in Nigeria about the use of artificial intelligence in university library management as investigated by Abayomi et al. (2021) demonstrated that librarians were knowledgeable about AI's application in library operations but they were worried that its adoption would result in their job loss. Johnson (2018) contends that as AI develops, people might depend on it more and stop going

to libraries or librarians for information. Korinek and Stiglitz (2017) concluded that employment polarization or job losses could arise from advancements in AI technologies and that the adoption of AI could result in a significant increase in inequality because of automation.

Challenges And Limitations Associated with AI Implementation

The implications of AI in libraries can be breathtaking at the same time challenging with the concern that these technologies might not be compatible with the existing systems particularly if the existing infrastructure is outdated or not designed originally with integration plan (Subaveerapandiyan 2023). An important step forward in utilizing cutting-edge technology to enhance operations and services is the incorporation of open-source AI into libraries.

Although the benefits of open-source AI, such its affordability, flexibility, and inventiveness, are very alluring, there are substantial obstacles in the way of its complete adoption (Eiras et al., 2024).

AI innovations in libraries and information centers are threatened with issues ethical concerns and accountability, technical complexities, exasperating disparities between the existing systems and AI innovations. 'Yusuf et al., (2022) posits that while AI holds significant promise for enhancing library services, its adoption in Nigerian academic libraries is currently limited due to financial, technical, and infrastructural challenges. Addressing these issues through strategic planning, investment, and collaboration can pave the way for effective AI integration, leading to improved library services and user satisfaction. Ogungbero, (2025) in his study revolutionizing library services: the impact of artificial intelligence on cataloguing and access to information in Nigeria academic libraries investigates the transformative function of artificial intelligence in improving cataloging and access to information in Nigerian Universities libraries. The study outlines key AI tools like machine learning, natural language processing and robotic process automation and personalized user experiences. The study emphasized the limitations of traditional methods as well as AI-driven solutions. The study highlighted AI implementation issues such as data consistency, ethical considerations and technical training requirements and recommended that continuous training, collaboration, user engagement, ethical considerations and infrastructural investments were made in other to increase the influence of AI on library services. Owolabi et al. (2022) found out that 60% of his respondents admitted their lack of digital infrastructure is related to AI adoption and 28% claimed that they lack digital framework to guide robotic technology adoption.

AI COMPETENCIES IN LIBRARY AND INFORMATION CENTERS

Libraries have evolved from book storage space to digital repositories. The introduction of AI into librarianship has enhanced library services through automation, smart interaction and real-time data processing. AI tools improve cataloguing, digital archiving, resource digitization and personalized services. Okwu et al., (2024) Libraries often have established cataloging systems, digital repositories and user management systems that need to work seamlessly with new AI technologies. Ensuring compatibility between these systems requires adequate planning, and technical expertise.

Metadata extraction and organization: is designed to identify and capture detailed information. this enables better understanding of data in their landscape. AI metadata assistant known as “metadata editor” assist cataloguers by suggesting metadata that they can use when cataloging a resource. This creative tool enhances record creation and enrichment faster, while keeping libraries and librarians in control of data in their catalogue and classification. AI speeds up cataloging and helps classify books more accurately using machine learning.

Smart search information retrieval: with AI enhanced search engines, search results are improved and personalized recommendations are made based on user preferences and reading history.

Digital archiving: with the use of optical character recognition (OCR) that coverts scanned documents and old books into texts, image recognition technologies and automated data backup, AI technologies facilitate the digitization and long-term preservation of digital resources.

Automated reference and citation services: AI systems are motivating new ideas and innovations in referencing through automatically generated citations in various styles (APA, MLA), plagiarism detection that scan documents for originality and citation accuracy and smart research assistances that suggests credible sources and summarizes articles.

Speech recognition: an automated speech and dialogue management is built with a guided conversation capability to attend to callers irrespective of the caller's dialect. This model assists librarians in providing quality and unlimited services to its users without fear or prejudice.

Spam detection: AI algorithms classify billions of messages as spam daily, because it might be difficult for the for the user to classify spam without endangering a greater percent of messages.

Predictive analysis for resource allocation: AI optimizes resource allocation based on usage trends.

AI-Driven Collection development: predictive analysis for book selection analysis trends to help libraries

choose the most relevant books. Automated inventory management tracks book availability and suggests new acquisitions while AI-based demand forecasting predicts future user needs based on past borrowing. Ex Libris Alma, Yewno Discover, OCLC WMS, ProQuest and Rialto are some of the AI tools used to streamline resource acquisition and selection.

AI-Powered chatbots and virtual assistants: AI chatbots offers 24/7 user assistance that answers frequently asked questions, understand users queries and provides tailored responses in multiple languages increasing accessibility.

Circulation management: automated book retrieval systems use robots to locate and retrieve books from the shelves. AI- Shelf checkout stations allow users to borrow and return books without librarians' assistance and books sorting robots organize books and return them to the appropriate shelves in the library. These management and patron service AI robots provides, enhance operational efficiency.

AI security: AI explores user authentication systems to verify users through biometric recognitions, detects fraud through unauthorized access and tracks unusual activities in digital libraries and prevents cyber threats.

Challenges Confronting AI driven Libraries and Information Centers

With the numerous benefits accrued to AI innovations, there are challenges that acts as impediments to its optimal utilization ranging from ethical concern to user privacy and others.

Ethical concerns and accountability: The use of AI systems raises a heightened concerns about accountability. Accountability issues in AI refers to the responsibility and reliability associated with the actions and decisions made by AI systems (Toth et al., 2022). The complex nature if AI makes it difficult to identify who is responsible for the negative impacts of actions and decisions made by these systems.

Inadequate Protection for User Privacy and Security: Data privacy and security compliance is key when incorporating open-source AI into libraries (Oladokun et al. 2024). The main privacy concern related to AI is the potential for personal information to be used for unintended purposes. Libraries manage mass volumes of sensitive information including personal details and borrowing records thus using AI to analyse these data sets raises important questions about how it is stored, handled and protected while, open-source Ai offers transparency, these tools may not always come equipped with comprehensive security features by default (Robinson & Ukaegbu, 2024). Therefore, libraries must ensure that their users' data are encrypted from unauthorized access and potential security breaches.

Algorithmic bias: Challen et.al (2019) mentioned that the major ethical issues surrounding AI is bias. Ai systems can be biased in several ways like racial, gender and cultural basis. AI biased systems can perpetuate and amplify existing societal biases and discrimination and can lead to unfair treatment of individuals for instance facial recognition systems have been shown to have higher error rates for individuals with darker skin tones than for those with lighter skin tones (Krishnapriya et.al., 2020)

Technical complexities: Poor internet connectivity, unreliable power supply, low internet bandwidth and inadequate data storage facilities

Exasperating disparities between the existing systems and AI innovations: Ensuring compatibility between these systems requires adequate planning, and technical expertise. It can also be challenging, particularly if the existing infrastructure is outdated or not designed with integration plan.

Over Dependence on Technology: many AI applications are automated to handle human routine tasks. Depending on the machine to do the job for them make them lazy.

Digital divide: limited access to technology and shortage of skilled AI professionals hinders its adoption.

Fear of Job Displacement: librarians fear that they might lose their jobs because regular library functions can be automated with AI tools. Librarians should see artificial intelligence as a tool that enhance their productivity rather than a threat. This may lead to reduction in the number of staff required for library service. Libraries need to formulate clear policies on how AI will complement its services rather than replacing their roles and duties.

High Cost of Operating AI systems: creating and maintaining AI contents is capital intensive. Finance is needed for the purchase, update, subscription and general maintenance for efficient service delivery.

Infrastructure limitation: creating and maintaining AI contents is capital intensive. Finance is needed for the purchase, update, subscription and general maintenance for efficient service delivery. Poor internet connectivity, unreliable power supply and inadequate data storage facilities pose as a threat to AI sustenance in libraries and information centers.

System Integration Issues: existing library systems may not be compatible with AI and its complexities.

Conclusion

The future of AI in libraries is promising with advancements expected in AI driven knowledge hubs, autonomous library systems, AI-ethics and policies, and better human-AI collaborations. AI libraries is the future because of its ability to share information and connect with vast communities. It is equally people oriented and can make intelligent management and quality service delivery establishing the importance of human rights protection and the specific idea of the principle. AI technology will transform user-library

interactions by improving responsiveness, personalization and effectiveness. AI will increasingly handle routine jobs like categorization and metadata generation, freeing up staff members to concentrate on more important issues. With this change, librarians will have more time to focus on high-impact initiatives including community partnerships, instructional programming, and research support of librarians will undergo substantial change. To effectively use these tools, librarians will need to expand their knowledge. As librarians maintain up to date on AI developments and best practices, learning will become crucial. Librarians will assume the role of ethical stewards in addition to their customary responsibilities, making sure AI systems respect privacy norms and promote equity. Additionally, they will be in charge of spotting and fixing biases in AI algorithms, supporting the library's dedication to fairness and inclusivity in service provision

Digital kiosks, AI-powered interactive displays, and adaptable workstations will be used in libraries to create more lively, user-friendly places (Okwu et al., 2024). Libraries will be more equipped to adapt to the shifting requirements of their communities thanks to these features, which will improve the learning and engagement experience. Artificial Intelligence in Nigerian libraries and information centers is still at an infant stage in Nigeria and librarians are knowledgeable about its application to the services they provide. However, they are skeptical about its adoption because they feel AI will take over their jobs. Challenges such as ethical concerns, workforce adaptation, financial constraints and technical barriers particularly in the context of Nigeria require collaborative solutions among librarians, IT experts and policy makers. This paper highlights AI integration and adoption in Nigeria, assesses librarians' readiness and challenges limiting AI adoption.

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Artificial Intelligence Literacy and Use among Librarians in National Open University of Nigeria

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Abstract

The integration of Artificial Intelligence (AI) into academic library operations presents both opportunities and challenges, particularly within open and distance learning institutions like the National Open University of Nigeria (NOUN). As digital transformation accelerates, there is growing demand for librarians to acquire AI literacy to effectively navigate evolving technologies. However, the extent of AI awareness, literacy, and usage among NOUN librarians remains underexplored. This study investigated the level of AI literacy and usage among NOUN librarians, with specific focus on awareness, communication competence, and ethical practices. A descriptive survey design was adopted. All 65 librarians across central, faculty, and study centre libraries formed the study population, and a total enumeration sampling method was used. Data were collected using a structured questionnaire and analysed with descriptive statistics. Findings revealed that while librarians demonstrated moderate awareness and strong ethical considerations regarding AI tools, their overall AI literacy was not comprehensive. Most respondents were highly familiar with general tools such as ChatGPT and Koha AI, but had limited exposure to more specialized platforms like Ex Libris Alma Analytics and IBM Watson. AI was frequently applied for routine tasks like cataloguing, user support, and personalizing user experiences. The study recommends implementing structured AI literacy training tailored to librarians' roles, and expanding access to diverse AI tools through institutional investment. These strategies will enhance both the confidence and competence of librarians in integrating AI technologies for improved service delivery in a distance learning environment.

Keywords: Artificial Intelligence, Librarians, AI Literacy, National Open University of Nigeria

Introduction

The integration of artificial intelligence (AI) technologies has significantly transformed various sectors, including healthcare, business, education, and information management, with university libraries experiencing substantial shifts in their operations. According to Igbo et al. (2024), libraries serve as critical support systems for academic faculties by providing reliable access to information. However, as the digital landscape rapidly evolves, academic libraries must continually adapt to maintain their relevance in enhancing teaching, learning, and research. This challenge is particularly evident in institutions like the National Open University of Nigeria (NOUN), where digital service delivery has become increasingly complex due to the swift progression of AI and related technologies.

Artificial Intelligence, as defined by Oracle (2022) and elaborated by Isiaka et al. (2024), encompasses software and hardware systems designed to simulate and extend human intelligence. Its applications, ranging from decision-making and language translation to visual perception, are now deeply embedded in university functions such as research, administration, and pedagogy. As McKinsey and Company (2023) noted, AI is not just a technical advancement but a transformative force reshaping societal and intellectual frameworks. The growing presence of AI in higher education calls for a robust understanding of these technologies by academic librarians, who must now possess both functional expertise and critical awareness of AI's role in facilitating personalized learning and administrative efficiency.

Artificial Intelligence literacy—an essential subset of digital literacy—has emerged as a critical competency in the contemporary academic environment. It involves not only technical proficiency with AI tools but also an understanding of their ethical and societal implications. Scholars such as Lo (2023b) and Cetindamar et al. (2022) have emphasized the need to extend AI literacy beyond computer professionals to non-specialists, particularly within educational settings. This need is heightened by global efforts to stay competitive in AI integration and the accompanying concerns over data privacy and ethical use. Academic libraries, therefore, play a vital role in promoting AI literacy through ongoing educational initiatives and inclusive access to AI learning resources (IFLA-FAIFE, 2020; Maher & Young, 2023).

Despite the recognized potential of AI in enhancing library operations, awareness and adoption among librarians vary. Studies (e.g., Owolabi et al., 2021; Yusuf et al., 2022) indicate that while librarians acknowledge the benefits of AI—such as improved service delivery and user satisfaction—implementation

challenges and uncertainty about future roles persist. These challenges are further complicated by ethical considerations, including the need to ensure that AI systems do not reinforce bias or hinder equitable access to information (Bradley, 2022; Wusu, 2023). As libraries increasingly adopt AI, it is imperative to concurrently foster strong communication skills among librarians to effectively mediate the relationship between AI tools and users. This dual focus on AI literacy and communication competence is particularly crucial in open and distance learning institutions like NOUN, where librarians must navigate evolving technologies while maintaining high standards of user engagement and information accessibility.

Statement of the Problem

The growing integration of Artificial Intelligence (AI) across various sectors has significantly influenced the field of library and information science, particularly within academic libraries. AI technologies are being increasingly adopted to enhance information management, automate administrative processes, and improve user engagement. Within this context, librarians play a vital role in supporting access to information and facilitating research, especially in higher education institutions such as the National Open University of Nigeria (NOUN). As a distance learning institution with a geographically dispersed student population, NOUN stands to benefit greatly from the effective application of AI technologies. However, there is limited understanding of how librarians at NOUN perceive, utilize, or are prepared to adopt AI tools, including automated cataloguing, virtual reference services, and data analytics, to improve library services.

Despite AI's transformative potential, the level of AI literacy among librarians at NOUN remains inadequately explored. The successful adoption of AI in libraries is largely dependent on the skills and confidence of library staff in navigating and integrating such technologies. Yet, there is a notable gap in research concerning the competencies, awareness, and readiness of NOUN librarians to implement AI in their professional practices. This study is therefore necessary to investigate the current state of AI literacy among NOUN librarians, identify the challenges they face in acquiring and applying AI-related skills, and evaluate the implications for library service delivery in a digital and distance learning environment. Addressing these gaps is essential for developing targeted strategies to empower librarians and enhance the overall effectiveness of AI-driven library services.

Objectives of the Study

The main objective of the study was to investigate AI literacy and use among librarians in National Open University of Nigeria. Specifically, the study sought to:

1. **examine the level of AI use among librarians at National Open University of Nigeria;**
2. **assess the level of AI communication skills among librarians at the National Open University of Nigeria;**
3. **examine the knowledge of AI ethics among librarians at the National Open University of Nigeria; and**
4. identify the level of awareness of AI tools among librarians at the National Open University of Nigeria.

Literature Review

Literature underscores a growing awareness of artificial intelligence (AI) among librarians, although with varying levels of depth and exposure. Studies such as those by Eiriemiokhale and Sulyman (2023), Ajav and Tor-Akwer (2024), and Isiaka et al. (2024) reveal that while some librarians are aware of AI tools such as chatbots, Dynamed, and facial recognition systems, the overall level of adoption remains low due to persistent challenges. The challenges include poor internet connectivity, insufficient ICT infrastructure, irregular power supply, and lack of technical expertise. Nevertheless, the perceived benefits of AI—such as task automation, improved recommendation systems, and enhanced information discovery—indicate a positive orientation towards its potential in academic libraries.

In terms of AI literacy, research highlights a modest level of confidence among librarians regarding their AI competencies. Achugbue (2024) notes that many librarians in South-South Nigeria acknowledge the need for targeted training to improve their proficiency in AI tools. Similar findings by Oniovoghai et al. (2023) and Lo (2024) emphasize the limited technical skills and inadequate practical experience among library professionals. These studies also point to gaps in ethical understanding and collaborative practices surrounding AI, suggesting the necessity of comprehensive professional development programmes. Notably, Lo (2024) proposes a framework for AI literacy in libraries, emphasizing the need for ethical guidelines and systematic training as libraries increasingly integrate AI into their services.

The practical use of AI in libraries appears minimal, particularly in university libraries in Kwara State, as observed by Moustapha and Yusuf (2023). While some institutions use AI for security and limited reference services, more advanced applications—such as RFID technologies and smart cataloguing tools—are either

absent or underutilized. The findings reiterate known challenges, including resistance to change, skill deficits, and infrastructural limitations. Despite these constraints, there is a growing recognition among librarians of AI's relevance to service delivery, which suggests that strategic intervention could significantly improve adoption rates and operational efficiency.

Ethical considerations in the implementation of AI in libraries form a crucial part of the discourse. Studies by Wusu (2023), Lowe (2024), and Panda et al. (2024) explore the moral and equitable use of AI, identifying core themes such as privacy, intellectual freedom, transparency, and user empowerment. These works propose ethical frameworks and principles—such as explainable AI and fairness—as essential for guiding the integration of AI in library contexts. The literature emphasizes that as AI technologies evolve, so too must the ethical standards and policies that govern their use, requiring ongoing reflection and adaptation from library professionals.

Lastly, the role of communication skills in effective library service delivery remains critical, especially in the context of emerging technologies. Hamid and Younus (2021), Hussain and Richardson (2024), and Aulawi and Mustajib (2022) agree that strong communication skills enhance workplace productivity, foster user satisfaction, and support collaborative environments. These studies recommend sustained efforts to develop communication competencies, which are necessary not only for traditional service delivery but also for navigating AI-related transformations. Thus, while AI presents new opportunities for libraries, foundational skills such as communication remain essential for successful implementation and user engagement.

Methodology

This study adopted a descriptive survey research design to investigate the levels of awareness, AI-related communication competencies, and ethical perspectives on artificial intelligence (AI) among librarians at the National Open University of Nigeria (NOUN). The study population is 65, consisted of all librarians working in the central library, faculty libraries, and study centre libraries as of March 2025. Given the relatively small population, total enumeration sampling approach was employed to study the entire population of this study.

Data for the study was collected through a researcher-designed questionnaire titled *Artificial Intelligence Literacy and Use among NOUN Librarians (ALUNL)*. The instrument comprised four sections: the first captured demographic information; the second addressed the purposes for which librarians use AI; the third measured the frequency of AI tool usage; and the fourth examined AI literacy, with specific focus on awareness, communication skills, and ethical considerations. To establish the reliability of the instrument, a pilot study was conducted at the University of Maiduguri Library. The reliability analysis, using Cronbach's Alpha, yielded a coefficient of 0.92, indicating high internal consistency. Upon obtaining ethical clearance and approval from the University Librarian at NOUN, the questionnaire was disseminated via Google Forms through official WhatsApp and Telegram groups utilized by the librarians. By March 28, 2025, a total of 63 valid responses were received, representing a response rate of 97.0%. Data were analysed using descriptive statistical techniques, including frequencies, percentages, means, and standard deviations. The results, presented in Tables 1 to 4, were employed to address the study's research objectives.

Results

The results are presented in the Table 1-4 below, in line with the stated objectives.

Table 1: Demographic profile

Gender	Freq.	Percent.
Male	26	41.18
Female	37	58.82
Total	**63**	**100.00**
Marital Status	**Freq.**	**Percent.**
Single	15	23.53
Married	41	64.71
Widowed	7	11.76
Divorced	0	0.00
Total	**63**	**100.00**

Age (in years)	Freq.	Percent.
Less than 20	0	0.00
21 – 30	0	0.00
31 – 40	22	35.29
41 – 50	30	47.06
51 above	11	17.65
Total	**63**	**100.00**
Highest Edu. Qual.	**Freq.**	**Percent.**
BLIS	19	29.41
MSC/MLS	33	52.94
PhD	11	17.65
Total	**63**	**100.00**
Designation	**Freq**	**Percent.**
Asst Librarian	26	41.18
Librarian II	19	29.41
Librarian I	7	11.76
Senior Librarian	7	11.76
Principal Librarian	4	5.88
Deputy Librarian	0	0.00
Librarian	0	0.00
Total	**63**	**100.00**
Experience (in years)	**Freq.**	**Percent.**
1 – 5	7	11.76
6 – 10	7	11.76
11 – 15	44	70.59
16 above	4	5.88
Total	**63**	**100.00**

Source: Survey, 2025.

The data presented in Table 1 reflect the demographic characteristics of librarians at the National Open University of Nigeria (NOUN). In terms of gender distribution, the highest proportions of respondents were female (58.82%), while males represented the lower proportion (41.18%). Regarding marital status, the majority of respondents were married (64.71%), whereas the lowest category was divorced, with no respondents (0.00%).

In the age distribution, the highest representation was within the 41–50 age range (47.06%), while no respondents were below the age of 31. For educational qualification, the largest group held a Master's degree (MSc/MLS) at 52.94%, and the smallest group had a PhD (17.65%). Concerning job designation, Assistant Librarians were the most common (41.18%), while the roles of Deputy Librarian and Librarian had no representation (0.00%). Finally, in terms of years of experience, the majority of librarians had 11–15 years of experience (70.59%), while the smallest group had over 16 years (5.88%).

Table 2: Level of AI Literacy among NOUN Librarians
Key: SA = Strongly Agree, A=Agree, D=Disagree and SD=Strongly Disagree
HA=Highly Aware, A=Aware, PA=Partially Aware and NA=Not Aware

AI Communication Skills							
SN	**OPINION**	**SA**	**A**	**D**	**SD**	**x̄**	**Std**
1	I can effectively explain the role of AI tools to library users and colleagues.	30	22	11	0	3.29	0.85
2	I am proficient in using AI interfaces (e.g., chatbots or virtual assistants) to communicate with library patrons	22	15	19	7	2.82	0.50
3	I can provide clear and accurate instructions to AI tools for performing specific tasks	22	26	7	7	3.00	0.63

4	I can interpret and explain AI-generated outputs (e.g., recommendations or search results) to library users	19	26	11	7	2.88	0.52
5	I can troubleshoot basic issues with AI tools and communicate these issues effectively to technical support teams	15	19	26	4	2.71	0.33
	Weighted x̄			**2.94**			
	AI Ethics						
SN	Opinion	SA	A	D	SD	x̄	Std
1	I understand the ethical implications of using AI in library services, such as data privacy and user consent	33	15	15	0	3.29	0.87
2	I am aware of potential biases in AI algorithms and their impact on library users	15	30	19	0	2.94	0.50
3	I ensure that AI tools used in the library comply with ethical standards and guidelines	19	26	19	0	3.00	0.57
4	I consider the societal and cultural implications of AI adoption in library operations	15	41	7	0	3.12	0.63
5	I advocate for transparency and accountability in the use of AI tools in the library	26	26	11	0	3.24	0.79
	Weighted x̄			**3.12**			
	AI Awareness						
SN	**AI TOOLS**	**HA**	**A**	**PA**	**NA**	**x̄**	**Std.**
1	**ChatGPT/OpenAI**	41	15	7	0	3.54	0.07
2	**IBM Watson**	11	15	26	11	2.41	0.09
3	**Ex Libris Alma Analytics**	7	22	22	11	2.41	0.06
4	**OCLC Wise**	11	30	7	15	2.59	0.28
5	**LibraryHelp**	11	22	11	19	2.41	0.14
6	**Koha AI Integration**	41	15	7	0	3.53	0.07
7	**Alexa for Libraries**	15	19	22	7	2.65	0.30
8	**Springer Nature's Smart Assistant**	7	15	26	15	2.24	0.91
9	**Google Cloud AI (Vision AI)**	19	33	7	4	3.06	0.63
10	**ProQuest Rialto**	11	26	15	11	2.65	0.28
	Weighted x̄			**2.75**			

Weighted x̄2.75 Source: Survey, 2025

Decision Rule: 0 – 1.99 = Disagreement; 2.00 – 3.99 = Agreement
Criterion Mean = 2.50
Decision Rule: 1.00 – 1.99 = low awareness; 2.00 – 2.99 = moderate awareness; 3.00 -4.00 = high awareness Criterion mean = 2.50

The analysis of AI Communication Skills in Table 2 reveals a general agreement among respondents, as indicated by a weighted mean score of 2.94, which exceeds the criterion mean of 2.50. This suggests that librarians at NOUN possess a moderately high level of AI communication competency. Specifically, respondents agreed most strongly with their ability to explain the role of AI tools to library users ($\bar{x}$ = 3.29), aligning with Aulawi and Mustajib (2022), who emphasized that effective communication is essential for successful AI integration. The lowest-rated skill was the ability to troubleshoot and communicate technical issues ($\bar{x}$ = 2.71), indicating an area where further training may be needed. Overall, the findings affirm that NOUN librarians are relatively confident in using and explaining AI tools in library settings, supporting user engagement and operational efficiency.

In terms of AI Ethics, the weighted mean score of 3.12 also reflects a strong agreement among respondents regarding their ethical awareness and practices in AI usage. The highest-rated item was understanding the ethical implications of AI use ($\bar{x}$ = 3.29), consistent with Wusu (2023), who reported high levels of ethical sensitivity among librarians. Respondents also expressed substantial agreement on advocating for

transparency and accountability ($\bar{x}$ = 3.24) and considering cultural and societal implications ($\bar{x}$ = 3.12). These findings demonstrate a conscientious approach to AI deployment among librarians, guided by ethical standards. Meanwhile, the AI Awareness component yielded a weighted mean of 2.75, indicating a moderate level of awareness based on the adopted decision rule. Tools like ChatGPT/OpenAI ($\bar{x}$ = 3.54) and Koha AI Integration ($\bar{x}$ = 3.53) had the highest awareness, while Springer Nature's Smart Assistant had the lowest ($\bar{x}$ = 2.24). This aligns with Isiaka et al. (2024), who reported moderate awareness of specific AI tools such as chatbots and Dynamed, suggesting that while exposure to popular AI tools is growing, gaps remain in awareness of more specialized systems.

Table 3: Purpose of AI use among NOUN Librarians

Key: SA = Strongly Agree, A=Agree, D=Disagree and SD=Strongly Disagree

SN	OPINION	SA	A	D	SD	$\bar{x}$	Std
1	AI tools are used to streamline cataloging and classification processes in the library	15	37	11	0	3.06	0.59
2	AI is utilized to enhance user support services, such as responding to patron queries or offering research assistance	19	33	11	0	3.12	0.66
3	AI systems are employed to improve collection management, including acquisitions and resource allocation	22	22	19	0	3.06	0.63
4	AI tools are used for creating personalized user experiences, such as recommending relevant resources or tailoring library services to individual needs	22	30	11	0	3.18	0.72
5	AI is applied to automate routine library tasks, allowing librarians to focus on strategic and innovative activities	19	33	11	0	3.12	0.66
					3.11		

Source: Survey, 2025

Decision Rule: 0 – 1.99 = Disagreement; 2.00 – 3.99 = Agreement Criterion Mean = 2.50

The data in Table 3 indicated a general agreement among respondents regarding the purpose of AI use in the library, with a weighted mean score of 3.11, surpassing the criterion mean of 2.50. This suggests that librarians at the National Open University of Nigeria (NOUN) recognize the functional value of AI tools in enhancing library operations. Specifically, the highest-rated application was the use of AI to create personalized user experiences ($\bar{x}$ = 3.18), followed by its role in enhancing user support services ($\bar{x}$ = 3.12) and automating routine tasks ($\bar{x}$ = 3.12). These findings suggest an encouraging level of integration of AI in core library functions such as cataloguing, user services, and resource management. However, when considered alongside Moustapha and Yusuf (2023), the results highlight a critical nuance: while foundational AI applications are acknowledged, more advanced technologies like RFID systems and smart cataloguing tools remain underutilized or absent. This suggests that although AI adoption is present, its full potential has yet to be realized in more sophisticated or innovative contexts within NOUN libraries.

Table 4: Frequency of AI Use among NOUN Librarians

Key: D=Daily, W=Weekly, M=Monthly, O=Occasionally, and N=Never

SN	AI TOOLS	**D**	**W**	**M**	**O**	**N**	$\bar{x}$	Std
1	**ChatGPT/OpenAI**	44	7	0	7	4	4.29	0.97
2	**IBM Watson**	4	0	7	7	44	1.59	0.46
3	**Ex Libris Alma Analytics**	0	0	11	11	11	2.00	0.63
4	**OCLC Wise**	7	4	4	7	41	1.88	0.91
5	**LibraryHelp**	7	0	7	11	37	1.88	0.85

6	**Koha AI Integration**	15	19	11	7	11	3.29	0.09
7	**Alexa for Libraries**	4	7	4	15	33	1.94	0.85
8	**Springer Nature's Smart Assistant**	4	0	15	4	41	1.76	0.64
9	**Google Cloud AI (Vision AI)**	15	7	11	11	19	2.82	0.74
10	**ProQuest Rialto**	4	7	11	7	33	2.06	0.97
					2.35			

Source: Survey, 2025

Decision Rule: 1.00 – 1.99 = Rarely used; 2.00 – 2.99 = Frequently; 3.00 -4.00 = Always Criterion mean = 3.00

The data in Table 4 reveal that, on average, AI tools are *frequently* used by librarians at the National Open University of Nigeria (NOUN), with a weighted mean of 2.35—falling below the criterion mean of 3.00 and indicating that most AI tools are not *always* in use. Among the tools assessed, **ChatGPT/OpenAI** stands out with the highest mean usage ($\bar{x}$ = 4.29), indicating it is widely and consistently employed, while tools like **IBM Watson** ($\bar{x}$ = 1.59), **Springer Nature's Smart Assistant** ($\bar{x}$ = 1.76), and **OCLC Wise** ($\bar{x}$ = 1.88) are *rarely used*. These findings are consistent with the observations of Eiriemiokhale and Sulyman (2023), who reported a low frequency of use of many AI tools by librarians, possibly due to limited awareness, lack of training, or infrastructure challenges. Despite the popularity of a few tools like ChatGPT and Koha AI Integration ($\bar{x}$ = 3.29), the generally low utilization of most AI technologies suggests that full integration into daily library operations is yet to be achieved.

Major Findings

1. Moderate Level of AI Literacy**:** The study found that while NOUN librarians displayed strong ethical awareness and moderate AI communication skills, their overall AI literacy—particularly in terms of familiarity with advanced AI tools—was limited. Most were highly aware of tools like ChatGPT and Koha AI, but less familiar with more specialized AI systems.
2. Selective Use of AI Tools**:** The level of AI usage among librarians was concentrated on routine and supportive library functions such as cataloguing, user assistance, and task automation. More innovative or data-driven AI applications (e.g., analytics, predictive services) remained underutilized, indicating a gap between potential and practice.

Conclusion

The study concludes that while AI literacy and application among librarians at the National Open University of Nigeria are emerging, there remains a significant gap in comprehensive knowledge and practical deployment of AI tools. Librarians are moderately aware and ethically conscious of AI technologies but require structured capacity-building initiatives to transition from basic to advanced AI applications in library services. Enhancing their technical competence will be essential to fully harness AI's potential in supporting the university's digital and distance learning mandate.

Recommendations

1. NOUN should design and implement AI training programmes that focus on building librarians' technical skills, ethical reasoning, and communication competence with a wide range of AI tools relevant to academic libraries.
2. The university should invest in procuring and integrating diverse AI solutions—such as analytics systems, automated referencing tools, and smart cataloguing software—into library operations, while ensuring librarians are adequately supported to use them.

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Artificial Intelligence, Critical Thinking and Library Usage by Undergraduates in Nigerian Universities

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Abstract

This study investigated the effect of Artificial Intelligence (AI) tools on critical thinking and library usage among undergraduates in Nigerian universities. A survey research design was adopted, involving 180 students across six public universities—one from each of Nigeria's six geopolitical zones. Data was collected through an online questionnaire distributed which is WhatsApp groups, and analysis was conducted using frequency counts, percentages, Findings show that AI tools such as Meta AI and ChatGPT are the most widely used, with 68.7% and 61.8% of students respectively indicating regular usage. These tools are predominantly employed for assignments, studying, and research. Duolingo emerged as the third most used AI tool (9.2%), primarily for study purposes. Significantly, AI usage has reduced their frequency of visiting the library. Conversely, most of the respondents agreed that AI tools have made library resources more attractive. Regarding critical thinking, 85% of the respondents agreed AI tools reduce the need to think critically about search terms, while 50% agreed that AI helps simplify course assignments. The study concludes that while AI tools enhance academic efficiency, they also present a risk to the development of critical thinking. Recommendations include integrating critical thinking into curricula, upgrading library systems with AI, and providing training for both students and academic staff to ensure responsible and constructive AI use.

Keywords: *Artificial Intelligence, critical thinking, Academic Libraries, Nigerian Universities, Undergraduates*

Introduction

Artificial intelligence is one of the technologies that are fast gaining ground in the fifth industrial age, and any academic library that ignores it is preparing to be stagnant in the provision of library services to patrons (Ogungbeni, Obiamalu & Bokoh, 2024). Artificial Intelligence (AI) has rapidly transformed various sectors, impacting everything from healthcare and finance to education and research. As AI continues to evolve, it raises important questions about its integration into human-centered tasks, particularly in areas that require critical thinking. Critical thinking—the ability to analyze, evaluate, and form reasoned judgments—remains an essential skill for navigating complex information and making informed decisions (Paul & Elder, 2014). Libraries, both traditional and digital, serve as hubs for information and learning, offering resources and support for those seeking to develop critical thinking skills (O'Connor, 2017).

With the increasing role of AI in information retrieval and analysis, there is a growing need to understand how AI can both support and challenge critical thinking and library usage. While AI-powered tools like recommendation systems and chatbots offer convenience and efficiency, they also present challenges such as bias in algorithms, information overload, and the potential for diminishing individual cognitive effort (Binns, 2018). Consequently, this intersection between AI, critical thinking, and library usage prompts important discussions about the future of research, information literacy, and the ethical responsibilities of both technology developers and information professionals (Hernandez, 2019). This paper explored the effect of use of AI on critical thinking, and library usage, examining both the opportunities and challenges presented by these intersecting fields.

Statement of Problem

The integration of Artificial Intelligence (AI) tools into academic environments has significantly transformed how students access and interact with information. In Nigerian universities, undergraduates increasingly rely on AI technologies such as ChatGPT, Meta AI, and other digital assistants for tasks related to studying, assignments, and research. While these tools offer efficiency, accessibility, and convenience, they also raise critical concerns regarding their impact on essential academic skills, particularly critical thinking and effective library usage. AI tools often simplify complex academic processes, potentially reducing the need for students to engage deeply with content, evaluate sources critically, or think independently. This shift may lead to

intellectual complacency, where students passively accept AI-generated information without adequate scrutiny. Furthermore, the increased dependence on AI has contributed to a decline in the use of traditional library resources, which have historically played a vital role in fostering critical inquiry and information literacy.

These developments raise important questions about the long-term academic implications of AI adoption. There is a need to investigate how AI tools influence students' cognitive engagement and whether they are supplementing or undermining foundational academic practices. Addressing this problem is essential to ensure AI's integration supports, rather than replaces, critical thinking and responsible information use in Nigerian higher education.

Research Questions

1. What artificial intelligence tools do undergraduates in Nigeria use?
2. What are the academic purposes for which undergraduates in Nigeria use artificial intelligence?
3. What effect does artificial intelligence have on academic activities that require critical thinking?
4. How does artificial intelligence affect undergraduates' use of libraries in Nigeria?

Literature Review

Artificial Intelligence (AI) is rapidly reshaping higher education, particularly in the context of university libraries. In Nigerian universities, AI is becoming an integral part of library operations, enhancing resource access, improving user experience, and streamlining library management. This literature review explores the influence of AI on library usage by undergraduate students in Nigerian universities, highlighting its benefits, challenges, and future potential. AI technologies, such as chatbots, recommendation systems, and digital assistants, are revolutionizing the ways students interact with libraries and access information (Dastjerdi, 2024; Li & Zhang, 2024). AI in libraries is applied to various functions, including cataloging, digital archives management, and improving user interaction. Technologies like machine learning algorithms and natural language processing (NLP) are enhancing search functionalities, automating cataloging systems, and offering personalized recommendations (Smith et al., 2024).

AI can also analyze user behavior to provide tailored resources and improve library services (Gupta & Singh, 2024). For Nigerian university libraries, AI offers a promising solution to the challenges of inadequate infrastructure and limited resources by enhancing efficiency and improving access to information. Undergraduates in Nigerian universities primarily use libraries for academic resources, including textbooks, journals, research papers, and digital databases. While physical libraries continue to play a vital role, there has been a shift towards digital resources. However, challenges such as outdated infrastructure, limited access to digital resources, and a lack of user training hinder effective library usage (Ogunjimi, 2024; Okeke & Eze, 2024). Despite these obstacles, libraries remain central to academic success. The adoption of AI in library management systems is helping address some of these issues by automating tasks like book lending and cataloging, thus improving user experience and reducing human error (Nwachukwu & Ogu, 2024).

AI technologies are being integrated into Nigerian university libraries, improving user experience by offering real-time assistance through AI chatbots (Oluwaseun et al., 2024). These chatbots guide students in navigating databases and locating resources more effectively. Moreover, AI is automating processes such as book lending and returns, which improves efficiency and reduces human error. Machine learning algorithms and NLP techniques are enhancing the organization of digital resources, making academic materials more accessible and searchable for students (Adeyemo & Durojaiye, 2024). AI has also contributed to the development of e-libraries, providing students with access to global digital resources, including textbooks and journal articles, expanding learning opportunities (Ogunbiyi, 2024). AI has notable benefits for library usage in Nigerian universities. By enabling faster, more accurate searches, AI helps students quickly locate materials, saving time and improving the research process (Akintoye, 2024).

Personalized recommendations based on past searches and interests also help students find relevant resources efficiently, which is particularly useful for undergraduates in need of tailored academic content (Chukwu & Adebayo, 2024). AI can even facilitate collaboration by connecting students with peers who have similar research interests, fostering teamwork and collective learning (Onwumere et al., 2024). Despite its potential, the integration of AI into Nigerian university libraries faces several challenges. One of the major obstacles is the lack of sufficient technological infrastructure. Many universities struggle with outdated hardware, unreliable internet access, and inadequate digital resources, making it difficult to implement AI-driven systems effectively (Akinyemi & Aliyu, 2024). The financial cost of acquiring and maintaining AI

technologies is another significant challenge, as many Nigerian universities operate on limited budgets (Adeoye & Sulaimon, 2024). Furthermore, the lack of trained personnel poses a barrier to the successful deployment of AI tools. Library staff needs specialized training in AI technologies and information literacy to implement and support AI systems (Oluwadare, 2024). In many Nigerian universities, there is a shortage of trained librarians who can guide students in navigating digital resources and teach them how to critically evaluate academic materials (Adeyemi & Oduro, 2024).

Critical thinking is an essential skill for university students, enabling them to analyze information, make informed decisions, and solve problems effectively. Libraries play a crucial role in fostering critical thinking by providing access to diverse resources and promoting information literacy. In Nigerian universities, library usage is increasingly linked with the development of critical thinking skills (Fagbola, 2024). Libraries offer resources such as books, journals, and digital materials that encourage independent study, research, and reflection (Akinyemi & Aliyu, 2024). While the adoption of AI in Nigerian university libraries can enhance resource access and user experience, it can also support the development of critical thinking by providing students with tools to engage with a variety of perspectives. AI-enabled information retrieval systems, for instance, can offer personalized recommendations for academic papers and journal articles, helping students broaden their research and engage with diverse viewpoints (Chukwudi & Ogbuehi, 2024). However, for AI to effectively contribute to critical thinking development, students must receive adequate training in information literacy and critical evaluation of resources (Ogunyemi, 2024).

The future of AI in Nigerian university libraries is promising, with the potential to significantly enhance library services and academic outcomes. However, the full potential of AI can only be realized if certain challenges are addressed. Investments in technological infrastructure, including faster internet connectivity and upgraded hardware, are essential for the successful implementation of AI tools. Furthermore, training programs for library staff should focus on equipping them with the skills necessary to integrate AI into library systems effectively (Fagbemi, 2024). One key strategy is the integration of information literacy programs into university curricula, which can help student develop critical thinking skills and the ability to engage effectively with AI-powered tools (Durojaiye & Akinyemi, 2024). Public-private partnerships between universities, government bodies, and technology companies could provide funding and technical support for AI adoption in libraries (Ogunbiyi, 2024). Such collaborations could help overcome financial constraints and facilitate the widespread implementation of AI technologies across Nigerian university libraries. AI is transforming library usage and student experience in Nigerian universities by enhancing access to resources, streamlining management processes, and supporting the development of critical thinking skills. Despite challenges such as limited infrastructure, financial constraints, and a lack of trained staff, the integration of AI holds great promise for improving academic success (Ekeh, Tunmibi & Monu, 2024). For AI to fully realize its potential, Nigerian universities must address these challenges by investing in infrastructure, providing training for library staff, and incorporating AI into the broader educational framework. With continued investment and collaboration, AI can play a pivotal role in shaping the future of library services and academic achievement in Nigerian universities.

Methodology

The research design adopted for this study is a survey research design. Six public universities from which the population of this study was drawn were purposively selected across the six geo-political zones of Nigeria. The universities are Lagos State University (LASU) for the Southwest, Nnamdi Azikiwe University (NAU) for the Southeast, Federal University Otuoke (FUO) for the Southsouth, Ahmadu Bello University (ABU) for the Northwest, Federal University of Technology Minna (FUTMINNA) for North Central and Yobe State University (YSU) for Northeast. The population of the study consists of 43,362 undergraduates of LASU 14, 000, FUO 25,000, NAU 17,000, YSU 21,982 and FUTMINNA 43,938 (Data obtained from the universities' websites). 180 respondents (30 from each university) were randomly selected among undergraduates in the second and third years of their studies. These levels of study were purposively selected because they have sufficiently used artificial intelligence and were not disturbed by loads of academic work associated with students in their final year.

A questionnaire designed by the authors was the instrument for data collection. The questionnaire was deployed on Google Form and sent to WhatsApp groups of the respondents through a librarian in each university. Data analysis was carried out using frequency, simple percentages, mean and standard deviation. The research hypothesis was however tested using t-test.

Data Analyses

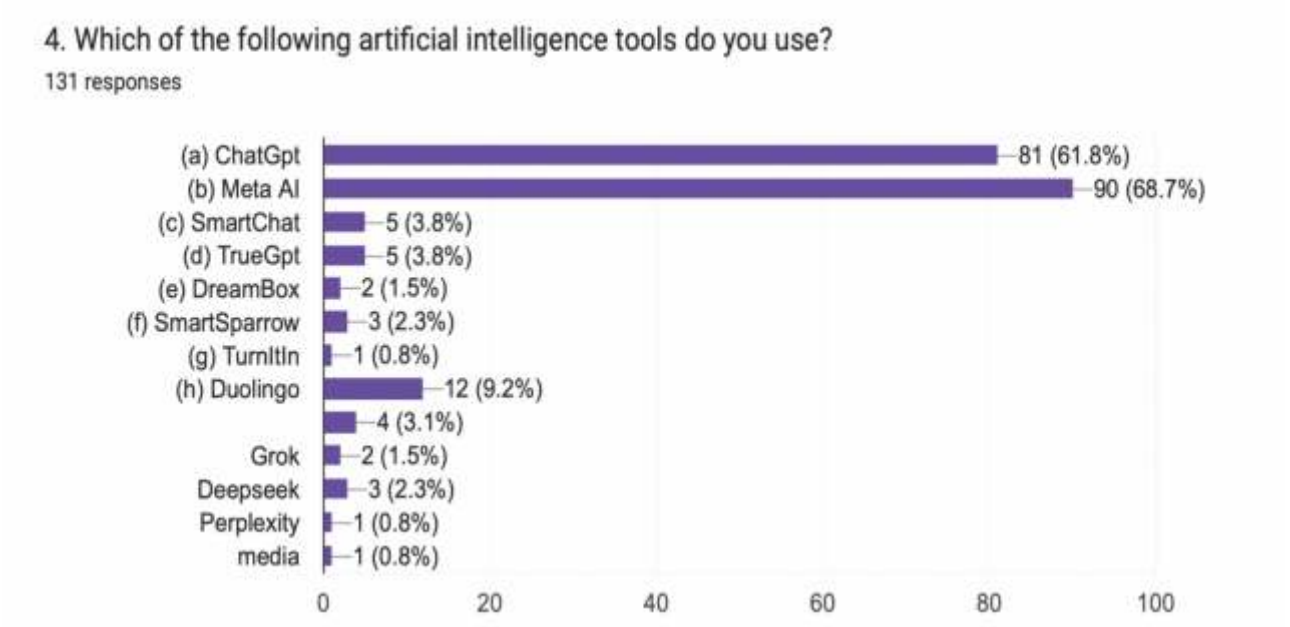


Figure 1

According to figure 1, it shows that from 131 respondents, the most commonly used artificial intelligence tools are Meta AI and ChatGPT. Meta AI leads with 90 users, representing 68.7% of participants, followed closely by ChatGPT with 81 users, accounting for 61.8%. Duolingo is the third most used tool, with 12 respondents (9.2%) indicating they use it. Other AI tools such as SmartChat and SmartSparrow are each used by 5 people (3.8%), while Grok is used by 4 respondents (3.1%). DreamBox and Deepseek both have 3 users (2.3%), and TrueGPT and TurnItIn are each used by 2 people (1.5%). The least used tools are Perplexity and media, with just 1 user each (0.8%). Overall, the data shows that while a wide range of AI tools are available, the majority of users tend to favor more mainstream and widely accessible options like Meta AI and ChatGPT.

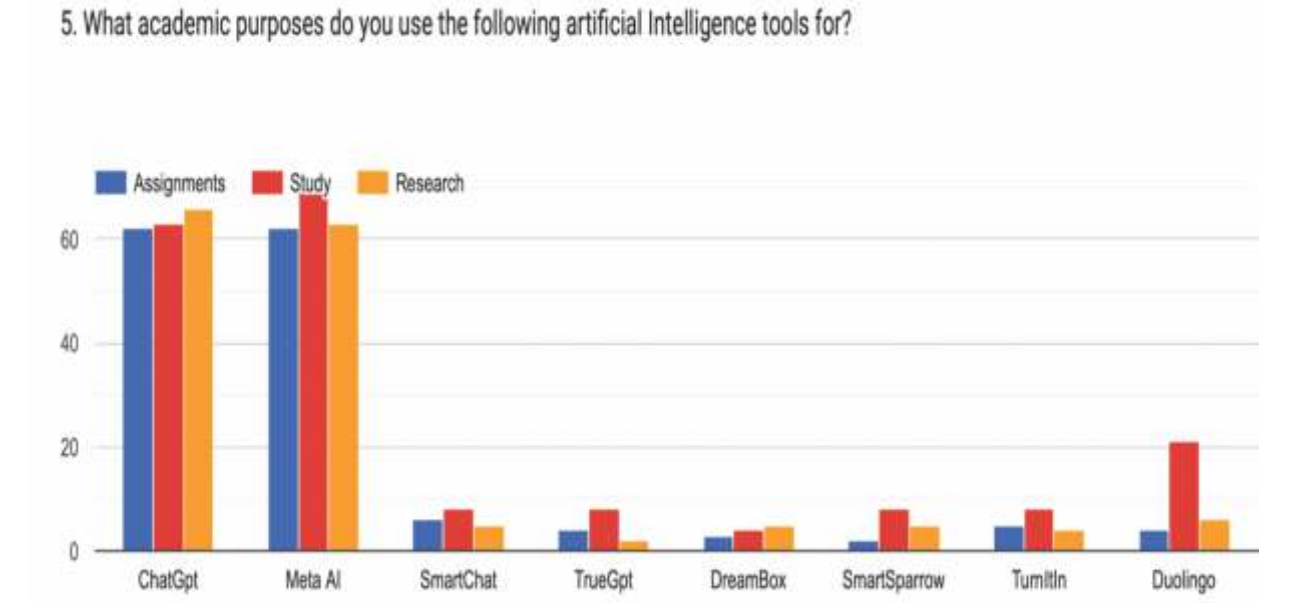


Figure 2: Purpose of Using Artificial Intelligence Tools

Figure 2 reveals that ChatGPT is used by approximately 63 users for assignments, 61 for study, and 60 for research, highlighting its widespread use across all academic areas. Similarly, Meta AI is also heavily utilized, with 62 users for assignments, 60 for study, and 63 for research—demonstrating nearly equal popularity with ChatGPT. In comparison, SmartChat is used by 7 users for assignments, 9 for study, and 5 for research, while TrueGPT is used by 6 users for assignments, 7 for study, and 4 for research. DreamBox shows slightly lower figures, with 4 users for assignments, 5 for study, and 3 for research. SmartSparrow is used by 5 for assignments, 8 for study, and 3 for research. TurnItIn has a fairly consistent but low usage, with 6 users for

assignments, 7 for study, and 5 for research. Duolingo, interestingly, has a distinct pattern—it is used by only 5 users for assignments and 4 for research, but a much higher 20 users for study, indicating its primary use as a study aid, likely for language learning. In summary, ChatGPT and Meta AI are the dominant AI tools used for all academic purposes, each with over 60 users in every category. Other tools like SmartChat, TrueGPT, and Duolingo serve more niche academic functions, with Duolingo being especially favored for studying.

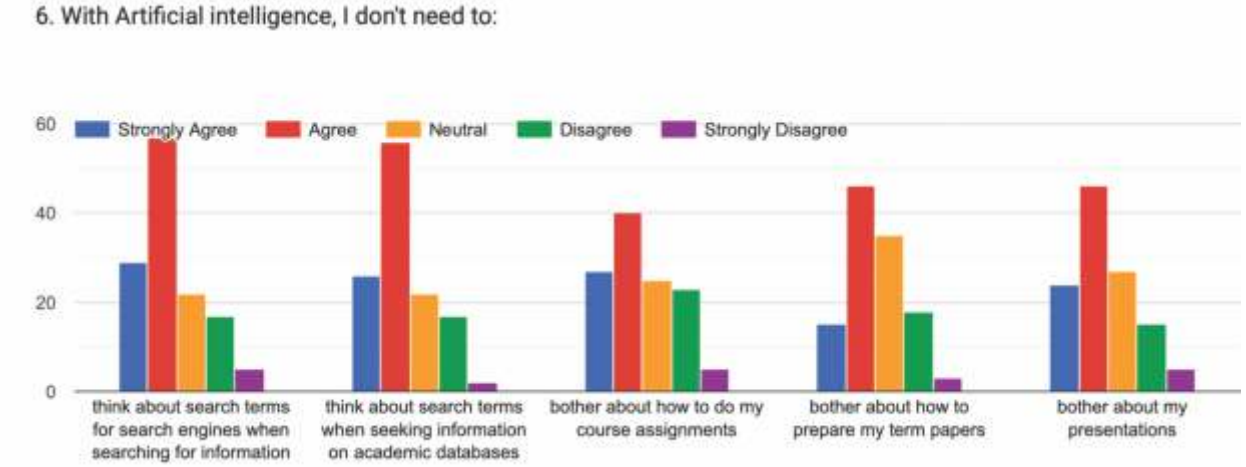


Figure 3: Effect of artificial intelligence on academic activities that require critical thinking

The majority of respondents in figure 3 feel that AI significantly reduces the need to carefully think about search terms. Specifically, 58 respondents agreed that they no longer need to think much about search terms when using search engines, and 27 strongly agreed. A similar pattern is seen with academic databases, where again 58 agreed and 25 strongly agreed, showing strong confidence in AI's ability to simplify information searches. In both cases, around 22 respondents remained neutral, while roughly 17 to 18 disagreed, and a small number—7—strongly disagreed. When it comes to course assignments, 40 respondents agreed that AI reduces the need to worry about how to complete them, and 26 strongly agreed. However, 23 remained neutral, and 21 disagreed, suggesting a more mixed sentiment here. For term papers, the agreement is a bit lower, with 45 agreeing and 16 strongly agreeing. A notable 30 respondents remained neutral, and 20 disagreed, showing that more people are cautious about relying entirely on AI for this task.

Regarding presentations, 45 respondents agreed that AI helps reduce the effort, while 24 strongly agreed. 26 were neutral, and 17 disagreed, with only 5 strongly disagreeing. In summary, most participants feel that AI is especially helpful in easing tasks related to searching for information, while tasks like writing term papers or preparing presentations still show a fair degree of uncertainty or reliance on individual effort.

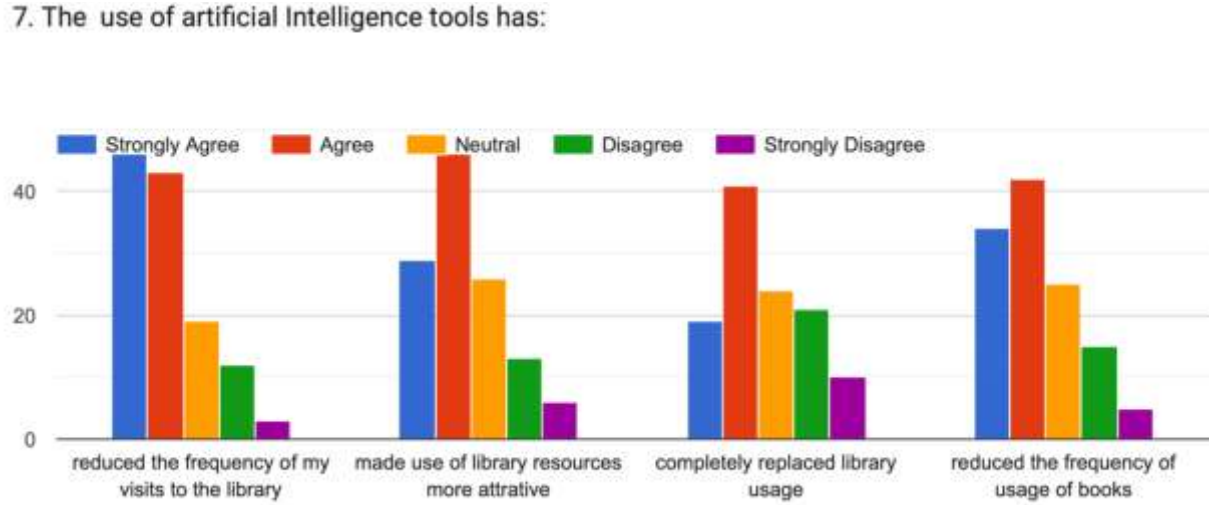


Figure 4: The Use of Artificial Intelligence

According to figure 4, a significant number of respondents (45) strongly agreed that the use of artificial intelligence tools has reduced the frequency of their visits to the library, closely followed by 42 who agreed. Only a small portion disagreed (12) or strongly disagreed (3), while 19 remained neutral. When asked if AI tools made the use of library resources more attractive, the majority agreed (45), with 29 strongly agreeing. Meanwhile, 26 were neutral, 13 disagreed, and only 5 strongly disagreed. On whether AI tools have

completely replaced library usage, 41 respondents agreed, and 18 strongly agreed. However, a notable number disagreed (21), while 25 were neutral and 10 strongly disagreed. Regarding the reduction in the frequency of book usage, 42 respondents agreed and 33 strongly agreed. Around 25 were neutral, while 15 disagreed and just 5 strongly disagreed. Overall, most participants felt that AI tools have led to decreased library visits and book usage, though they also found library resources more attractive due to AI.

The study examined the impact of artificial intelligence (AI) tools on critical thinking and library usage among undergraduates in Nigerian universities. A hypothesis-testing approach was adopted using a t-test to statistically assess the relationship between AI usage and the variables of interest—critical thinking and library engagement.Although the document does not explicitly list the null and alternative hypotheses in standard form (e.g., H_0 and H_1), the implied hypotheses can be interpreted based on the research questions and findings. The key hypotheses inferred from the study are:

1. There is no significant effect of AI tools on students' critical thinking skills.
2. There is no significant effect of AI tools on students' use of university libraries.

Based on the survey results and statistical analysis, the findings rejected the null hypotheses, indicating significant effects in both cases:

- Critical Thinking: The data revealed that 85% of respondents agreed AI tools reduce the need to think critically when searching for information. Many also relied on AI for completing academic tasks like assignments and presentations, which supports the conclusion that AI use negatively affects critical thinking development.
- Library Usage: A large number of respondents (87 out of 180) strongly agreed or agreed that AI use has reduced their frequency of visiting the library. This shows a significant decline in physical library engagement due to AI reliance.

Hence, the hypotheses testing confirmed that the use of AI tools has statistically significant negative implications for both critical thinking and traditional library use among Nigerian university undergraduates.

Discussion of the Findings

The findings of this study reveal that artificial intelligence (AI) tools have become integral to the academic lives of undergraduates in Nigerian universities. Most students reported frequent use of AI platforms such as Meta AI and ChatGPT for assignments, studying, and research. This high rate of adoption is consistent with global trends in education, where AI is being leveraged for its efficiency in information retrieval and task completion. However, while these tools enhance academic convenience, they also introduce significant concerns. A major finding is the reduction in critical thinking among students. Approximately 85% of respondents admitted that AI tools reduce the need to carefully consider search terms or analyze academic content independently. Many students rely heavily on AI for generating content for term papers, presentations, and assignments, potentially diminishing their intellectual engagement and reasoning skills.

Another notable outcome is the decline in library usage. Many respondents agreed that AI tools have reduced the frequency of their visits to the library. Although AI has made some library services more attractive—especially digital ones—students now favor AI tools for quicker access to information. This trend challenges the traditional role of academic libraries in fostering research, independent learning, and critical inquiry. Overall, the findings suggest that while AI tools provide valuable academic support, they also risk weakening students' cognitive independence and reducing their engagement with essential academic resources like libraries. These results underscore the need for a balanced integration of AI in education, emphasizing critical thinking, information literacy, and responsible use of technology.

Conclusion of the study

The integration of Artificial Intelligence (AI) into the academic activities of undergraduate students in Nigerian universities has brought about significant transformations, particularly in relation to the development of critical thinking skills and the use of library resources. The findings of this study have clearly demonstrated the widespread adoption and utility of AI tools such as ChatGPT, Meta AI, Duolingo, and others among students across different geopolitical regions of Nigeria. These tools are predominantly used for completing assignments, conducting research, and studying, which underscores their central role in modern academic practices.

From the data collected, it is evident that AI tools are now embedded in the daily academic routines of undergraduates. A majority of respondents reported that they rely on these tools to simplify tasks that previously required substantial intellectual effort, such as conducting searches, drafting term papers, and preparing academic presentations. This reliance on AI suggests a shift in how students approach academic work—focusing more on efficiency and convenience rather than rigorous intellectual engagement. While this trend reflects the growing relevance and influence of AI in higher education, it also raises concerns about the possible decline in students' independent reasoning and critical evaluation skills.

A particularly noteworthy finding from the study is the significant reduction in library visits and book usage among undergraduates. A large proportion of respondents indicated that they no longer feel the need to visit physical libraries frequently, as AI tools can provide them with quick and targeted access to information. This shift poses a serious challenge to traditional library systems, which are historically regarded as the foundation of academic inquiry and the development of critical thinking skills. Although students acknowledge that AI has made library resources more attractive—especially digital offerings—it is also clear that the nature of library engagement is changing, leaning more toward passive consumption of AI-curated materials than active exploration and analysis.

Moreover, the results suggest a duality in AI's impact on critical thinking. On one hand, AI enhances access to a broad spectrum of information and resources, thereby offering students exposure to diverse perspectives and academic content. On the other hand, this accessibility may promote intellectual laziness or overdependence, where students accept AI-generated responses without questioning their accuracy, context, or relevance. Such tendencies could impair students' abilities to think critically, solve complex problems, and develop original ideas—skills that are essential for success in both academic and professional settings. Despite these challenges, the study also reveals several opportunities. AI tools, if used responsibly and guided by academic frameworks, can significantly support the development of analytical skills.

Features such as personalized recommendations, intelligent research assistants, and real-time academic support can be harnessed to foster deeper inquiry and collaborative learning. Furthermore, the digitization of library services and the integration of AI-driven systems can modernize academic libraries and make them more responsive to the needs of today's tech-savvy learners. Finally, the study underscores the importance of balancing the use of AI with pedagogical strategies that promote critical thinking, creativity, and independent learning. While AI offers numerous advantages in terms of accessibility and academic support, educators, librarians, and policymakers must be proactive in ensuring that its integration into higher education does not undermine the intellectual growth of students.

Universities must take strategic steps to improve information literacy, train academic staff and librarians on the use of AI tools, and invest in infrastructure that supports both technological advancement and critical engagement. If properly guided, AI can become a powerful ally in shaping a more efficient, inclusive, and intellectually robust academic environment in Nigerian universities.

Recommendations

Based on the findings of this study, the following recommendations are proposed to ensure the responsible and effective integration of Artificial Intelligence (AI) into academic environments while safeguarding and promoting critical thinking and informed library usage among undergraduates in Nigerian universities:

- Raise awareness of diverse AI tools beyond popular ones like ChatGPT and Meta AI by incorporating AI literacy workshops into university orientations or general studies courses. This will broaden students' exposure to a wider range of academic AI tools, including those for specialized research, language learning, and data analysis.
- Promote guided and purpose-driven use of AI tools by integrating AI-based assignments and learning activities into the curriculum. Educators should develop clear guidelines on how AI can assist—but not replace—students' academic responsibilities. This helps students understand the supportive, not substitutive, role of AI.
- Integrate critical thinking and information literacy training into the academic curriculum. These should teach students how to assess the reliability, accuracy, and bias of AI-generated content. Active learning methods, peer reviews, and reflection assignments can also be used to promote deeper thinking and reduce over-reliance on AI.
- Modernize university libraries with AI-enhanced features (e.g., smart search engines, chatbots, and personalized digital services) to improve user experience and attract student engagement. At the same time, universities should run library usage campaigns to highlight the importance of physical and digital library resources for comprehensive academic development.

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Artificial Intelligence-Driven Librarian: Harnessing Technology for the Future of Library and Information Science

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Abstract

The integration of artificial intelligence (AI) in library services is transforming the Library and Information Science (LIS) profession, paving the way for enhanced operational efficiency and improved user experiences. This paper, titled "AI-Driven Librarian: Harnessing Technology for the Future of Library and Information Science," *explores the emerging role of AI in reshaping traditional library functions and the skills required for LIS professionals to thrive in this evolving landscape. The study is guided by four key objectives adopted the descriptive research design. Using a mixed-methods approach, data were collected from 100 respondents which comprises of 10 LIS professionals, 30 library users, and 10 administrators each from Anambra and Gombe states using questionnaire and in-depth interviews. The findings reveal that AI technologies, such as machine learning and natural language processing, offer significant potential in areas like resource discovery, automated cataloging, and personalized user support. However, challenges such as skill gaps, limited funding, and ethical concerns regarding data privacy pose significant barriers. In conclusion, the paper argues that while AI presents remarkable opportunities for library innovation, its successful adoption requires deliberate efforts to address technical, infrastructural, and ethical challenges. The study recommends proactive investment in AI technologies, capacity-building initiatives for LIS professionals, and the establishment of clear ethical frameworks to ensure responsible AI use in library environments.*

Keywords: Artificial Intelligence, Library and Information Science, AI-Driven Librarian, Technology Integration, Library Services

Introduction

The evolution of libraries and information science (LIS) has been inextricably linked to technological advancements. From the early adoption of cataloging systems to the digital revolution that brought about online databases and electronic resources, libraries have consistently adapted to meet the changing needs of their users (Agim & Oraekwe, 2019). Artificial intelligence (AI) represents the latest transformative technology poised to reshape the landscape of LIS. AI, with its capacity to automate tasks, enhance information retrieval, and personalize user experiences, is not merely a tool but a potential catalyst for redefining the role of librarians and the services they provide (Subaveerapandiyan, A. (2023). This technological shift necessitates a deeper exploration into how AI can be harnessed to optimize library operations and empower information professionals.

The integration of AI into library operations offers a spectrum of potential benefits. Machine learning algorithms can be employed to streamline cataloging processes, automate metadata creation, and improve the accuracy of information retrieval systems. According to Ajakaye (2022), Natural language processing (NLP) can facilitate more intuitive and efficient interactions between users and library resources through chatbots and virtual assistants. Furthermore, AI-driven predictive analytics can assist in collection development, resource allocation, and the identification of emerging trends, enabling libraries to proactively adapt to the evolving needs of their communities. The application of AI, however, goes beyond task automation; it holds the promise of fostering a more dynamic, user-centric, and data-informed approach to library services.

Despite the transformative potential of AI, its integration into LIS is not without challenges. Many libraries are grappling with the complexities of implementing AI technologies, including the need for substantial investments in infrastructure, the acquisition of new skills by library staff, and the ethical considerations

surrounding data privacy and algorithmic bias (Anumula, Anumula, Anumula & Damerla, 2024). There is a pressing need for research that not only explores the potential applications of AI in libraries but also addresses the practical barriers and ethical dilemmas associated with its adoption. Specifically, there is a need to investigate how librarians can effectively leverage AI tools while upholding the core values of the profession, such as equitable access to information, intellectual freedom, and user privacy.

Statement of the Problem

In the ideal situation, librarians would be fully equipped to harness artificial intelligence (AI) technologies, seamlessly integrating them into library operations to enhance service delivery, resource management, and user experience. AI-driven librarians would utilize advanced tools such as automated cataloguing, digital archiving, natural language processing, and predictive analytics to streamline workflows, provide personalized user assistance, and ensure efficient information retrieval for patrons. In this envisioned future, librarians would possess high levels of AI literacy, regularly participate in targeted professional development, and have access to the necessary infrastructure and funding to support ongoing technological innovation.

However, the current situation in many libraries across Anambra and Gombe states falls short of this ideal. Preliminary investigations by the researchers shows that while some academic libraries have begun adopting AI tools for tasks such as cataloguing, reference services, and digital resource management, significant challenges persist. These include inadequate infrastructure, unreliable internet connectivity, limited funding, and a lack of comprehensive training programs for librarians. Many librarians report only modest confidence in their ability to use AI technologies, with skill gaps and resistance to change further impeding widespread adoption.

Despite growing interest in AI integration within Nigerian libraries, there is a notable gap in empirical research examining the actual level of AI literacy among librarians in these states, their perceptions of AI-driven librarianship, and the contextual barriers they face. This gap underscores the necessity of the present study

Objectives of the Study

1. To examine the potential applications of artificial intelligence (AI) in enhancing library services and operations.
2. To explore the skills and competencies required by Library and Information Science (LIS) professionals to thrive in an AI-driven environment.
3. To analyze the challenges associated with integrating AI technologies into library systems.
4. To identify strategies for effectively harnessing AI to improve user experience.

Literature Review

The integration of AI into Library and Information Science (LIS) has initiated a transformative shift, fundamentally altering how libraries operate and deliver services. AI's potential to automate operations, enhance information retrieval, and personalize user experiences is reshaping the traditional role of libraries (Agim, Abah, & Ezejiofor, 2025). This transformation is driven by AI's capacity to streamline labor-intensive tasks, such as cataloging and metadata creation, thereby freeing up library staff to focus on more complex and user-centric responsibilities. Furthermore, AI algorithms are enhancing information retrieval systems, enabling users to access resources more efficiently and effectively. The ability of AI to personalize user experiences, tailoring information delivery to individual needs and preferences, is also a key aspect of this transformative potential.

The variables at play in this transformation are multifaceted. Automation of library operations involves the deployment of AI to handle routine tasks, improving efficiency and reducing the potential for human error. According to Donkor and Afrane (2023), the enhancement of information retrieval is achieved through AI-powered search engines and recommendation systems, which can analyze user behavior and preferences to provide more relevant results. Personalization of user experiences is facilitated by AI's ability to create customized learning paths and proactive user support systems. These variables are interconnected, with advancements in one area often amplifying the impact in others (Agim, et al, 2025). For instance, more efficient information retrieval can lead to more personalized user experiences, as AI systems gain a better understanding of individual information needs.

Potential Applications of Artificial Intelligence on Library Services and Operations

Artificial Intelligence (AI) is transforming library services by automating routine tasks and enhancing user engagement through intelligent systems. Key applications include AI-powered cataloging and metadata management, which improve the accuracy and discoverability of resources while reducing librarian workload

(Chandrashekara & Mulimani, 2024). AI-driven chatbots and virtual assistants utilize natural language processing (NLP) to provide real-time, personalized reference services, enabling users to navigate collections and databases more efficiently (Pirgova-Morgan, 2023). Additionally, AI recommendation systems analyze user behavior and preferences to deliver customized resource suggestions, thereby increasing user satisfaction and resource utilization. These applications collectively streamline library operations, enhance service delivery, and foster a more user-centered library environment.

Beyond user interaction, AI supports advanced data analytics and preservation efforts. Text mining and data extraction tools enable libraries to process vast digital collections, accelerating knowledge discovery and supporting research activities (Clarivate, 2025). Robotic process automation (RPA) automates repetitive administrative functions such as acquisitions and serials management, freeing staff to focus on strategic initiatives (Ex Libris, 2025). Emerging AI technologies like generative AI and edge computing promise further innovations, including content generation and real-time decision-making at the network edge, which could revolutionize library spaces and services (Pirgova-Morgan, 2023). Overall, AI's integration into library operations is reshaping traditional roles and workflows, positioning libraries as dynamic, technology-driven knowledge hubs.

Skills and Competencies Required by Library and Information Science Professionals to Thrive in an AI-Driven Environment

To thrive in an AI-driven library environment, Library and Information Science (LIS) professionals must acquire a blend of technical and soft skills. Technical competencies include proficiency in AI tools, data analytics, machine learning concepts, and digital literacy, enabling librarians to manage AI systems effectively and interpret their outputs (Achugbue, 2024). Familiarity with natural language processing and metadata standards is also essential for optimizing AI applications in cataloging and user services (Pirgova-Morgan, 2023). Furthermore, understanding cybersecurity principles and data privacy regulations is critical to responsibly managing sensitive user data in AI-enabled systems (Hodonu-Wusu, 2024). Continuous professional development and training programs are vital to keeping pace with rapid technological advancements and evolving library user expectations.

Equally important are soft skills such as critical thinking, ethical reasoning, and adaptability. LIS professionals must critically assess AI outputs for bias, accuracy, and fairness, ensuring ethical deployment of AI technologies (Asemi et al., 2020; Murugan & Khan, 2023). Communication and collaboration skills facilitate effective teamwork between librarians, IT specialists, and users, fostering an environment conducive to innovation (Achugbue, 2024). Moreover, problem-solving abilities enable librarians to troubleshoot AI system issues and customize solutions to meet diverse patron needs. Developing these competencies empowers LIS professionals to harness AI's full potential, transforming libraries into agile, user-focused institutions.

Challenges Associated with AI Integration and Strategies for Effective Harnessing

Integrating AI into library services presents several challenges, including infrastructural limitations, high costs, and skill deficits among library staff (Hodonu-Wusu, 2024; Chandrashekara & Mulimani, 2024). Many libraries, particularly in developing regions, struggle with inadequate internet connectivity, outdated hardware, and insufficient funding, which hinder the deployment and maintenance of AI systems (Achugbue, 2024). Resistance to change and fear of job displacement among staff further complicate adoption efforts, while ethical concerns around data privacy, algorithmic bias, and transparency require careful management (Restackio, 2024). These challenges risk limiting AI's transformative impact if not proactively addressed

Effective strategies to harness AI's benefits include investing in robust digital infrastructure and prioritizing staff training to build AI literacy and technical expertise. Libraries should adopt phased implementation approaches, allowing gradual adaptation and continuous evaluation of AI tools (Murugan & Khan, 2023). Establishing clear ethical guidelines and data governance frameworks helps mitigate privacy and bias concerns, fostering user trust (Hodonu-Wusu, 2024). Collaboration with technology providers, academic institutions, and professional bodies can facilitate knowledge sharing and resource pooling, enhancing capacity for AI integration (Pirgova-Morgan, 2023). With the need to combining technological investment with human-centered strategies, libraries can overcome barriers and unlock AI's full potential to revolutionize service delivery.

Methodology

The study employs a descriptive survey research design, targeting 100 respondents which comprises of 10 LIS professionals, 30 library users, and 10 administrators each from Anambra and Gombe States using structured questionnaires and in-depth interviews. The instrument was validated by 2 experts (one each) from Gombe State University, and Chukwuemeka Odumegbu Ojukwu University Igbariam Anambra State. The Crombach Alpha a reliability method was used to test the internal consistency of the instrument. A reliability coefficient of 0.96 was gotten. The data collected were analyzed using descriptive statistics and standard deviation

Results

The Potential Applications of Artificial intelligence (AI) in Enhancing Library Services and Operations

Table 1: Mean Ratings on the potential applications of artificial intelligence (AI) in enhancing library services and operations

S/N	Item	Mean	SD	Decision
1	AI can automate cataloguing and classification tasks to improve accuracy and efficiency.	3.28	0.62	SA
2	AI-based chatbots can partially replace human librarians for user inquiries.	2.85	0.71	A
3	AI can enhance personalized information retrieval and recommendation services.	3.32	0.58	SA
4	AI applications in academic libraries can streamline interlibrary loan and resource sharing processes.	2.81	0.66	A
5	AI can assist in predictive analytics for user behavior and collection development.	3.11	0.60	SA
6	AI can automate plagiarism detection and improve academic integrity support.	2.96	0.69	A
7	AI can improve library security through facial recognition and smart surveillance systems.	3.14	0.64	SA

Grand Mean = 3.07

The results in Table 1 show that librarians in academic libraries agreed on several potential applications of AI in enhancing library services and operations. Specifically, they agreed that AI-based chatbots can partially replace human librarians for inquiries (Mean = 2.85), that AI applications can streamline interlibrary loan and resource sharing (Mean = 2.81), and that AI can automate plagiarism detection and support academic integrity (Mean = 2.96). Furthermore, the respondents strongly agreed that AI can automate cataloguing and classification tasks (Mean = 3.28), enhance personalized information retrieval (Mean = 3.32), assist in predictive analytics for collection development (Mean = 3.11), and improve library security through smart surveillance systems (Mean = 3.14). These results suggest an overall strong perception of the versatile applications of AI in transforming various aspects of library operations. With a grand mean of 3.07, it is clear that while some AI applications are viewed with moderate enthusiasm, others are highly anticipated for their transformative impact.

The findings align with several empirical studies in the field. Agim, et al (2025) highlighted the significant role AI plays in personalizing information retrieval processes, leading to improved user satisfaction in academic libraries. Similarly, Subaveerapandiyan (2023) found that librarians viewed AI applications like cataloguing automation and predictive analytics as critical tools for increasing operational efficiency. Moreover, Ajakaye (2022) observed that although there is enthusiasm about AI, librarians also acknowledged the need for careful integration strategies, especially regarding user interaction systems like chatbots and plagiarism detectors. These studies collectively support the positive perception and cautious optimism observed in the present study regarding AI applications in libraries.

The Skills and Competencies required by Library and Information Science (LIS) Professionals to thrive in an AI-driven Environment

Table 2: Mean Ratings on the skills and competencies required by Library and Information Science (LIS) professionals to thrive in an AI-driven environment

S/N	Item	Mean	SD	Decision
1	Ability to apply data analytics in user service optimization	2.85	0.92	Agree
2	Understanding of AI algorithms and how they relate to information	3.12	0.89	Strongly Agree
3	Basic knowledge of programming and machine learning tools	2.95	0.94	Agree
4	Capacity to ethically manage AI-generated data and outputs	3.21	0.87	Strongly Agree
5	Skills in digital content curation and metadata creation	3.05	0.91	Strongly Agree
6	Critical thinking for AI-driven decision-making processes	3.18	0.90	Strongly Agree
7	Effective communication of AI-driven insights to users	2.90	0.88	Agree
	Grand Mean	**3.04**		

The results show that respondents agreed that LIS professionals need competencies such as the *ability to apply data analytics* (Mean = 2.85), *basic knowledge of programming* (Mean = 2.95), and *effective communication of AI insights* (Mean = 2.90) to function effectively in an AI-driven environment. More strongly, participants strongly agreed on the need for a solid *understanding of AI algorithms* (Mean = 3.12), *ethical management of AI data* (Mean = 3.21), *skills in digital curation and metadata creation* (Mean = 3.05), and *critical thinking for AI-enabled decision-making* (Mean = 3.18). These findings reflect an awareness of the complex, multi-disciplinary skill sets needed to adapt to technological evolution in the library field. The grand mean of 3.04 indicates an overall strong agreement among librarians in academic libraries that a variety of both technical and cognitive competencies are essential for thriving in AI-integrated library environments.

These findings align with earlier studies. Anumula, et al (2024) emphasized the need for academic librarians to develop digital fluency and critical data literacy to effectively work alongside AI systems. Hodonu-Wusu (2024) further identified AI-related skills—such as programming, metadata creation, and ethical governance—as central to the evolving role of LIS professionals. Additionally, Achugbue (2024) found that AI is reshaping the nature of information services, thus requiring LIS curricula to include competencies in algorithmic thinking, machine learning, and human-computer interaction. These studies collectively support the emphasis on both technical and soft skills evident in the current findings.

The Challenges Associated with Integrating AI Technologies into Library Systems

Table 3: Mean ratings on challenges associated with integrating AI technologies into library systems

S/N	Item	Mean	SD	Decision
1	High cost of acquiring and maintaining AI technologies	3.15	0.84	Strongly Agree
2	Lack of technical expertise among library staff	2.78	0.91	Agree
3	Privacy and ethical concerns regarding AI data usage	2.82	0.89	Agree
4	Resistance to change from traditional library service models	2.73	0.86	Agree
5	Limited infrastructural facilities to support AI integration	2.91	0.90	Agree
6	Insufficient training opportunities for librarians on AI applications	2.88	0.87	Agree
7	Uncertainty about the long-term impacts of AI on library job security and relevance	3.10	0.82	Strongly Agree
	Grand Mean	**2.91**		**Agree**

The results reveal that respondents agreed that major challenges to AI integration in libraries include the *lack of technical expertise among library staff* (Mean = 2.78), *privacy and ethical concerns* (Mean = 2.82), *resistance to change from traditional models* (Mean = 2.73), *limited infrastructural facilities* (Mean = 2.91), and *insufficient training opportunities* (Mean = 2.88). More strongly, they strongly agreed that *high costs of acquiring and maintaining AI technologies* (Mean = 3.15) and *uncertainty about the long-term impacts of AI on job security* (Mean = 3.10) are critical barriers to successful AI integration. This shows that both structural and human factors significantly hinder AI adoption in academic library systems. The grand mean of 2.91 suggests that librarians overall perceive a moderately high level of challenges associated with integrating AI technologies into library operations.

These findings are corroborated by previous research. Murugan and Khan (2023) identified infrastructural deficits, ethical risks, and high implementation costs as primary obstacles to AI adoption in library contexts. Similarly, staff resistance, lack of training, and fears about automation's effect on job security were major hurdles to AI integration in academic libraries. Restackio (2024) also highlighted the twin challenges of cost and lack of technical skills among library professionals as critical bottlenecks. Together, these studies affirm the need for strategic investments in technology, capacity building, and ethical frameworks to facilitate successful AI deployment in libraries.

The Strategies for Effectively Harnessing AI to Improve User Experience

Table 4: Mean Ratings on the strategies for effectively harnessing AI to improve user experience

S/N	Item	Mean	SD	Decision
1	Continuous professional training for librarians on AI tools	2.88	0.86	Agree
2	Development of user-centered AI applications tailored to library needs	2.91	0.84	Agree
3	Incorporating personalized recommendation systems for library resources	3.22	0.80	Strongly Agree
4	Building strategic partnerships with tech companies for AI deployment	2.77	0.89	Agree
5	Implementing AI-driven virtual reference services for real-time user support	3.15	0.83	Strongly Agree
6	Establishing ethical guidelines and protocols for AI integration in library systems	2.93	0.88	Agree
7	Regular assessment and improvement of AI systems based on user feedback	3.08	0.82	Strongly Agree
	Grand Mean	**2.99**		**Agree**

The responses indicated that librarians agreed on the importance of strategies such as continuous professional training on AI tools (Mean = 2.88), development of user-centered AI applications (Mean = 2.91), building strategic partnerships with tech companies (Mean = 2.77), and establishing ethical guidelines for AI integration (Mean = 2.93) to improve user experiences in libraries. More strongly, librarians strongly agreed that strategies like incorporating personalized recommendation systems (Mean = 3.22), implementing AI-driven virtual reference services (Mean = 3.15), and regular assessment and improvement of AI systems based on user feedback (Mean = 3.08) are crucial for effectively harnessing AI for better user satisfaction and engagement. This shows a strong inclination toward both capacity building and technological enhancement for user-centered service delivery. The grand mean of 2.99 suggests that, overall, librarians perceive a high level of strategic importance in both human capacity development and technological innovation for improving user experiences through AI.

The results of this study are consistent with several prior research findings. Agim, et al (2025) emphasized the need for continuous AI training programs for library staff and ethical protocols for successful AI adoption. Pirgova-Morgan (2023) highlighted the effectiveness of personalized AI-driven services, such as recommendation systems, in significantly improving library user satisfaction and engagement. Similarly, Hodonu-Wusu (2024) found that partnerships with tech firms and constant AI system evaluations are critical strategies that helped libraries enhance service quality and maintain relevance in a rapidly evolving digital landscape. Together, these studies reinforce the current findings and demonstrate the pivotal role of well-planned strategies in leveraging AI for superior user experiences.

Conclusion

Based on the findings, it can be concluded that the future of Library and Information Science is heavily dependent on the effective harnessing of AI technologies, requiring both technological innovations and significant investments in human capital development. Librarians in academic libraries recognize the transformative potential of AI, the competencies needed to thrive, and the challenges that must be carefully navigated to ensure successful integration. For libraries to remain relevant and impactful in the digital age, strategic initiatives focusing on awareness, skills development, ethical integration, and user-centered innovation in AI technology must be consistently pursued.

Recommendations

1. Organize continuous awareness campaigns, workshops, and seminars to expose librarians to emerging AI technologies and their potential benefits for library services.
2. Partner with academic institutions and tech companies to offer certification courses and training in AI-related skills tailored specifically for Library and Information Science (LIS) professionals.
3. Develop a comprehensive AI adoption framework that addresses ethical concerns, data privacy, budgetary planning, and infrastructural needs in libraries.
4. Allocate specific budgets toward both staff training and the acquisition of cutting-edge AI technologies that enhance personalized library services.

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Assessing the Preparedness of Nigerian University Libraries for the Fifth Industrial Revolution: A Case Study of Libraries in Lagos and Ogun States

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Abstract

This study aimed to assess the preparedness of academic libraries in Lagos and Ogun States, Nigeria, for the Fifth Industrial Revolution (5IR), focusing on the availability of 5IR technologies, digital literacy skills of information professionals, challenges to adoption, and possible solutions. Using a descriptive survey research design, data was collected from 189 library personnel through structured questionnaires and analysed using SPSS. Findings revealed that 5IR technologies, such as AI, robotics, blockchain, and IoT, were largely unavailable, with only cloud computing moderately adopted. Librarians demonstrated a moderate level of technological literacy, with significant gaps in advanced digital competencies. The study also discovered key challenges such as limited funding, poor infrastructure, lack of training, and low awareness among administrators. The study concluded that while libraries are underprepared for 5IR integration, their willingness to embrace change is evident. It recommended institutional policy development, increased funding, digital infrastructure upgrades, and continuous professional development to drive effective 5IR implementation.

Keywords*: Fifth Industrial Revolution (5IR), academic libraries, technology adoption, digital literacy, Nigeria.*

Introduction

The Industrial Revolution (IR) has profoundly shaped human society, revolutionising how individuals live, work, and learn. Each successive revolution introduced transformative advancements that redefined industries, economies, and education systems. The First Industrial Revolution, which emerged in the late 18th century, shifted from agrarian economies to industrialised societies through mechanisation and steam power (Ziatdriov, Atterayo, & Nabiyev, 2024). The Second Industrial Revolution introduced electricity, automobiles, and telecommunication technologies, laying the foundation for modern industrial processes. Following World War II, the Third Industrial Revolution ushered in the Digital Age, characterised by the proliferation of computers, electronics, and automation (Ekwueme et al., 2024). The Fourth Industrial Revolution (4IR) further advanced this trajectory with interconnected technologies, including the internet, artificial intelligence (AI), robotics, cloud storage, and AI-driven automation, fostering an unprecedented convergence of physical, digital, and biological systems (Ekwueme et al., 2024; Schwab, 2016; Ziatdriov, Atterayo, & Nabiyev, 2024).

Building on these earlier transformations, the Fifth Industrial Revolution (5IR) represents a new era of human-centred innovation. While the 4IR focused on enhancing efficiency through automation and AI, the 5IR emphasises harmonising technological advancements with societal and environmental well-being. It highlights the potential for humans and robots to work collaboratively, with robots assuming routine tasks while enabling more creative and strategic human contributions. In the 5ir, technology platforms such as the Internet of Things (IoT), cloud computing, and big data analytics drive innovation across multiple industries (Noble et al., 2022; de Vries & Kroukamp, 2022). In education, these advancements have paved the way for interdisciplinary learning, requiring students to develop skills that transcend traditional subject boundaries. The integration of AI and other technologies enables personalised learning experiences, allowing universities to tailor education to individual students' needs and aspirations, thereby preparing them to compete in the knowledge-driven era of Society 5.0 (Ziatdriov, Atterayo & Nabiyev, 2024). Similarly, these technological innovations can drive university libraries significantly when adopted, transforming them into dynamic hubs for knowledge creation and dissemination. However, it has been observed that many university libraries are not adequately prepared for their implementation in terms of skills and facilities acquisition, hence, the need for the study.

5IR) introduced transformative technologies redefining library operations and services. The Fifth Industrial Revolution (5IR) introduced transformative technologies redefining library operations and services in the digital era. These advancements enhance efficiency, sustainability, and user experiences, significantly altering how information is accessed, managed, and disseminated (Ajani & Oladokun, 2024; Tunmibi & Okuonghae, 2023; Nwobu et al., 2024). The application of 5IR technologies in libraries has been extensively documented, highlighting their ability to foster inclusivity and expand access to information for all users. Studies by Ajani and Enakrire (2023), Ekwueme et al. (2024), Adigun, Ajani, and Enakrire (2023), and Mamabolo and Durudolu (2025) emphasise enhanced user engagement, global connectivity, and extended library influence that these technologies enable, particularly in reaching marginalised and disaster-prone areas.

Moreover, the integration of 5IR technologies has catalysed a shift in the roles and competencies of librarians and information professionals. This evolution has not only reshaped the services offered by libraries but also necessitated the development of advanced technological skills among librarians, underscoring the transformative potential of 5IR in the library sector (Alayon & Funclara, 2023; Modiba & Ngulube, 2024). In addition, Ajani and Oladokun (2024) highlight transformative 5IR technologies revolutionising library operations to meet evolving user needs. Key technologies include artificial intelligence (AI) and machine learning for personalised services and resource optimisation, data analytics and big data for informed decision-making, and the Internet of Things (IoT) for innovative, sustainable library environments. Blockchain ensures secure digital asset management, while augmented reality (AR) and virtual reality (VR) enable immersive learning and storytelling. Robotic automation, cybersecurity measures, cloud computing, and 5G connectivity enhance operational efficiency, accessibility, and user engagement, positioning libraries as pivotal in education and research.

Despite the growing recognition of the transformative potential of the Fifth Industrial Revolution (5IR) technologies, a significant research gap exists regarding the preparedness of libraries in Nigeria. Comprehensive studies addressing the availability of 5IR technologies and the technological skills librarians require to utilise these innovations effectively are notably scarce. Existing literature has primarily explored themes such as innovation for Sustainable Knowledge Systems, advocacy for technological adoption, AI skills and competencies, and the development of mobile and paperless libraries in the 5IR era (Ajani et al., 2024; Adigun, Ajani, & Enakrire, 2024; Modiba & Ngulube, 2024; Enakrire et al., 2023). However, these studies have relied mainly on quantitative methodologies, leaving empirical evidence. This lack of data-driven research has resulted in an incomplete understanding of the current adoption levels of 5IR technologies, and the specific challenges libraries face in aligning their services with the demands of this transformative era. Addressing this gap is essential for enabling libraries to leverage the opportunities presented by 5IR technologies effectively. This study aims to fill this gap by empirically assessing the availability of 5IR technologies, the technological skills of librarians, and the challenges encountered by university libraries in Lagos and Ogun States as they adapt to the Fifth Industrial Revolution.

Research Objectives

This study's main objective is to assess Nigerian university libraries' preparedness for the Fifth Industrial Revolution using a selected Case Study of libraries in Lagos and Ogun States. The specific objectives are to:

1. Assess the availability of 5IR technologies in university libraries in Ogun and Lagos States.
2. Evaluate the level of technology literacy among information professionals in university libraries in Ogun and Lagos State
3. Identify possible challenges that academic libraries in Ogun and Lagos may encounter in preparing for the 5IR in the State.
4. Establish a possible solution to the challenges that academic libraries may encounter in preparing for the 5IR in Lagos and Ogun State.

Literature Review

The Fifth Industrial Revolution (5IR) marks a pivotal technological and human advancement phase, distinguished by the seamless integration of digital, physical, and biological technologies. In contrast to the Fourth Industrial Revolution (4IR), which prioritised digitisation and automation, 5IR adopts a human-centric approach. This paradigm shift leverages cutting-edge technologies such as artificial intelligence (AI), robotics, and the Internet of Things (IoT) to foster personalised and collaborative environments. Schwab (2017) describes 5ir as a dynamic and boundary-transcending force poised to effectively catalyse innovation and address global challenges. Libraries, as essential knowledge hubs, stand to benefit significantly from 5IR technologies, which can revolutionise service delivery and support diverse learning needs. These advancements enable libraries to transcend traditional physical collections and provide access to expansive digital resources, including e-books, online databases, and multimedia content (Shonfeld, 2020). Integrating 5IR technologies has enhanced the efficiency and accessibility of library services, meeting the evolving demands of users (Ekwueme et al., 2024).

Libraries increasingly adopt AI to refine their operations, from personalising user experiences to enhancing resource management. AI applications support global collaboration, promote library resources, and optimise reference services. Advanced technologies like radio frequency identification (RFID), sensors, and AI-driven archival tools enable efficient retrieval and tracking of archival records (Mashilo & Marutha, 2023). Chatbots, powered by natural language processing (NLP), handle user queries and streamline automated collection management tasks such as indexing, cataloguing, and subject classification. Additionally, Robotic Process Automation (RPA) addresses repetitive tasks, including shelving and book circulation, while fostering user engagement and supporting digital scholarship (Tshabalala, 2025). The practical implementation of 5IR technologies demands librarians with specialised skills and competencies. Paladhi and Maruthaveeran (2024) observed that librarians generally possess a medium level of AI competency, with basic knowledge of AI tools and applications. However, limited adoption of these tools underscores the need for targeted training and resources. Librarians must be proficient in using AI to deliver personalised learning experiences, optimise resource management, and enable collaborative practices. Continuous professional development and digital literacy training are vital to empowering librarians for effective engagement in a 5IR-driven environment (Ekwueme et al., 2024).

Despite its transformative potential, integrating 5IR technologies into libraries is challenging. Ekwueme et al. (2024) identified critical barriers, including inadequate power supply, insufficient professional training, and a lack of infrastructure. Financial constraints further impede the acquisition and maintenance of advanced technologies, compounded by outdated systems and a shortage of skilled librarians (Adigun, Ajani, & Enakrire, 2024). The authors noted that strategic solutions are essential to surmount these barriers, such as investing in continuous learning opportunities, organising workshops and conferences, and improving infrastructural support, which are vital measures. In conclusion, the Fifth Industrial Revolution offers unprecedented opportunities for libraries to transform their services, foster personalised learning, and promote global collaboration. However, realising these benefits requires targeted investment in infrastructure, professional development, and strategic planning. Addressing financial constraints and limited digital literacy challenges is crucial for enabling libraries to thrive in this transformative era.

Ekwueme et al. (2024) conducted research at the National Open University of Nigeria (NOUN), Abuja, to assess librarians' readiness for integrating Fifth Industrial Revolution (5IR) technologies into academic library services. Using a descriptive survey design, data were collected via a Google Form from 44 of 60 librarians and analysed using SPSS with descriptive statistics and regression analysis. The results showed a high level of awareness of 5ir technologies, particularly robotics, intelligent machines, and the Internet of Things, with a mean awareness score of 3.67. However, the study highlighted a significant gap in the ability to evaluate and select appropriate technologies for implementation, with a mean score of 2.98 for this skill area. While respondents expressed confidence in adapting to technological change, challenges like inadequate evaluation of competencies and the fear of job displacement were noted. The conclusion emphasised the need for targeted professional development and collaborative support to equip librarians with the necessary competencies for effective and inclusive integration of 5IR technologies in academic libraries, particularly those supporting open and distance learning.

Ekwueme et al. (2024) conducted research at the National Open University of Nigeria, exploring the challenges faced in preparing academic libraries for the Fifth Industrial Revolution (5IR). The study adopted a survey methodology, utilising structured questionnaires distributed to librarians across selected campuses. The results revealed that while growing awareness and acceptance of emerging technologies, such as artificial intelligence, robotics, and the Internet of Things, several significant challenges hinder full preparedness. These include inadequate funding, insufficient training on 5IR technologies, a lack of robust internet infrastructure, and a general skills gap among librarians. The study concluded that although Nigerian academic librarians are gradually embracing the concept of 5ir, strategic interventions such as government support, targeted professional development, and collaborative efforts with technology providers are essential to overcome these challenges and ensure effective implementation of 5ir in academic library services.

Ocholla and Ocholla (2020) examined how South African university libraries are responding to the evolving demands of the Fourth Industrial Revolution (4IR), which shares foundational technologies with the Fifth Industrial Revolution (5IR). Conducted across 26 public university libraries in South Africa, the study employed a content analysis of library websites to evaluate the availability of 23 emerging trends and technologies. This was followed by verification through direct communication with library staff. Findings revealed that while core digital services such as e-resources (92%), e-catalogues (92%), and digital scholarship (88%) were widely adopted, the availability of cutting-edge technologies directly related to 4IR/5IR such as robotics/AI (4%), maker-spaces (8%), and borrowing ICT devices (19%) remained significantly low. These results underscore a disparity in readiness, particularly in embracing advanced technologies essential for the 5ir. The study concluded that although academic libraries generally adapt well to digital service demands, a more strategic and well-resourced effort is required to ensure equitable access, strengthen infrastructure, and advance innovation to meet the expectations of future revolutions in education and information services.

Adio (2022), which researched an assessment on awareness, adoption and utilisation of fourth industrial revolution devices in Federal Polytechnic libraries in South-West Nigeria, examines the extent of awareness, adoption, and utilisation of Fourth Industrial Revolution (4IR) technologies in academic libraries within

Nigeria. The research, conducted in Federal Polytechnic libraries in South-West Nigeria, utilised a survey design with a total enumeration sampling technique, reaching a population of 120 library staff, of which 98 responses were analysed. Findings indicate that awareness and utilisation of 4IR devices remain low, with challenges such as data quality and transparency hindering their adoption. The study highlighted academic libraries' obstacles in preparing for technological advancements, including cybersecurity concerns, ethical considerations, and a lack of funding. The conclusion suggests that academic libraries must prioritise awareness campaigns, staff training, and government funding to effectively incorporate emerging technologies for improved service delivery.

Eromesele, Omosekejimi, and Ogo (2021) examine the technology literacy skills of information professionals in academic libraries within Southern Nigeria. The study surveyed 362 librarians across 18 federal university libraries using a survey design and a total enumeration technique. Findings revealed a high competency level among librarians in utilising various ICT tools such as computers, scanners, projectors, and library automation software, which are essential for modern information service delivery. The study underscores the necessity of continuous training in digital literacy to meet evolving technological demands. However, challenges such as inadequate ICT facilities, limited training opportunities, poor internet connectivity, and insufficient government intervention pose significant obstacles to preparing academic libraries for the Fifth Industrial Revolution. The authors conclude that increased budgetary allocations, enhanced training programs, and improved infrastructure are crucial for equipping librarians with the necessary skills to navigate digital transformation effectively.

The study by Akparobore, Omosekejimi, and Nweke (2020), on librarians' awareness, positive attitude and ICT skills: A panacea for effective services delivery in the Fourth Industrial Revolution (4th IR) Era in Academic Libraries in Southern Nigeria. Conducted in 84 university libraries and gathered responses from 679 librarians through a structured questionnaire. The findings indicate that awareness of Fourth Industrial Revolution technologies among librarians remains low, while positive attitudes toward adoption and ICT skills significantly contribute to effective service delivery. The study highlights several challenges in preparing for the Fifth Industrial Revolution. These include inadequate awareness of technological innovations, reluctance to embrace digital transformation, and the need for advanced ICT skill training. The study concluded that increased funding for technological advancements, continuous professional development, and proactive engagement with emerging technologies are essential to ensuring academic libraries remain relevant in the evolving digital landscape.

Methodology

The study explored the preparedness of Nigerian university libraries for the Fifth Industrial Revolution: a case study of libraries in Lagos and Ogun State. A survey research design was employed to examine the availability of the IR technologies, the required skills to use the tools, and the challenges of preparing for the 5IR from 566 library personnel (professionals and paraprofessionals) in Lagos and Ogun States. A simple random sampling technique was used to select 229 library personnel via the Krejcie and Morgan's sampling formula from Pan-Atlantic university Library (11), Nigerian Law School library, Victoria Island, Lagos (14), Olabisi Onabanjo University library (45), Otunba Gbenga Daniel library, TASUED (20), University of Lagos Library (32), Lazoti library, Babcock University (19), Nimbe Adedipe Library FUNAAB (26), Fatiu Ademola Akesode Library (LASU) (22). Data were collected through a structured questionnaire to gather insights on the availability of IR technologies, the required skills to use the tools and the challenges in preparing for the fifth industrial revolution. The questionnaire was administered via Google Forms, and 189 responses (response rate 82.5%) were retrieved and deemed fit for analysis. The reliability of the instruments was confirmed through a pilot study, and Cronbach's alpha was used to ensure internal consistency. The data was analysed using SPSS, with descriptive statistics such as mean, standard deviation, and frequencies used to summarise the results.

Presentation and Interpretation of Results

Demographic Information

The study revealed that 123 respondents (65.1%) are female. In comparison, the lowest is male, with 66 respondents (34.9%), indicating that women comprise the majority of academic library staff in Lagos and Ogun States. The highest number of respondents in the age category is 50 years and above (88 respondents, 46.6%), suggesting an experienced and mature workforce. The lowest is the 20–29 years group, with only four respondents (2.1%), indicating limited involvement from younger professionals. Regarding educational qualification, most respondents possess an M.Sc. degree (123 respondents, 65.1%), showing a high level of professional education among the staff. The B.Sc. holders are the least represented (12 respondents, 6.3%), which implies that postgraduate education is prevalent or possibly preferred in the field. Regarding designation, Librarian I/II has the highest number with 99 respondents (52.4%), reflecting a concentration of staff in entry-to-mid-level librarian roles. The lowest is Library Officers with only six respondents (3.2%), indicating a smaller number in more junior roles. For work experience, the most represented group is those with 16 years and above (82 respondents, 43.4%), again underscoring a veteran workforce. The least represented are those with 1–5 years of experience (27 respondents, 14.3%), highlighting a potential gap in newer entrants to the profession. This pattern shows that academic libraries in Lagos and Ogun States are primarily staffed by older, highly educated, and experienced female professionals. The low representation of

younger age groups and junior staff suggests a need for targeted efforts to attract and retain new talent in the field, ensuring sustainability and generational knowledge transfer. The dominance of mid-to-senior level roles also reflects a well-established workforce that could significantly lead the transition to 5IR if adequately supported.

Research Question 1: Availability of 5IR Technologies in Academic Libraries in Lagos and Ogun States

	Highly Available	Available	Not Available	Mean	Std. Dev.	Decision
Cloud computing services for library management	40 (21.2%)	69 (36.5%)	80 (42.3%)	1.79	.770	Available
Artificial Intelligence (AI) tools for library automation	18 (9.5%)	69 (36.5%)	102 (54.0%)	1.56	.663	Not Available
Smart library systems with IoT-enabled devices	18 (9.5%)	70 (37.0%)	101 (53.4%)	1.56	.663	Not Available
Automated self -service technologies (e.g., self-checkout kiosks)	17 (9.0%)	57 (30.2%)	115 (60.8%)	1.48	.657	Not Available
Virtual Reality (VR) and Augmented Reality (AR) for user engagement	10 (5.3%)	63 (33.3%)	116 (61.4%)	1.44	.595	Not Available
Big Data analytics tools for user behaviour analysis	13 (6.9%)	53 (28.0%)	123 (65.1%)	1.42	.619	Not Available
5 G-enabled smart library infrastructure	7 (3.7%)	52 (27.5%)	130 (68.8%)	1.35	.550	Not Available
Blockchain technology for securing library records	6 (3.2%)	48 (25.4%)	135 (71.4%)	1.32	.531	Not Available
Digital twins for library space and resource optimisation	4 (2.1%)	50 (26.5%)	135 (71.4%)	1.31	.506	Not Available
Robotics for library operations and services	11(5.8%)	25 (13.2%)	153 (81.0%)	1.25	.552	Not Available

Decision Rule: if mean is ≤1.66 =Not Available, 1.67 – 2.33 =Available, 2.34 – 3.00 = Highly Available

Table 1 reveals the results on the availability of fifth industrial revolution (5IR) technologies in academic libraries in Lagos and Ogun States, providing a statistical overview of how well academic libraries in these states have adopted emerging technologies. From the above table, none of the 5ir technologies is highly available in the academic libraries in Lagos and Ogun States, with no score mean above 2.33. Only Cloud Computing Services for Library Management had a mean of 1.79 available. This suggests that cloud computing is somewhat integrated into library operations in these states, likely because it has become relatively more common and affordable than other advanced technologies. However, all other technologies fall below the 1.67 threshold, indicating that they are unavailable in most libraries surveyed. These include Artificial Intelligence (AI) tools (mean = 1.56), Smart library systems with IoT-enabled devices (1.56), Automated self-service technologies (1.48), VR/AR for user engagement (1.44), Big Data analytics tools (1.42), 5G infrastructure (1.35), Blockchain for securing records (1.32), Digital twins (1.31), and Robotics (1.25). These low mean scores reflect limited or no implementation of these technologies in academic library environments. The findings imply a significant gap in the adoption of 5IR technologies in the academic libraries of Lagos and Ogun. This lack of availability suggests that these libraries may not yet be prepared to fully engage with the demands of the Fifth Industrial Revolution, which emphasises intelligent automation, human-machine collaboration, and data-driven service delivery.

Research Question 2: Technology Literacy Skills of Information Professionals in Academic Libraries in Lagos and Ogun States

	Very High Level	High Level	Moderate Level	Low Level	Mean	Std. Dev.	Decision
Competency in using AI -based library tools is crucial to	30 (15.9%)	52 (27.5%)	86 (45.5%)	21 (11.1%)	2.48	.891	Moderate Level
Awareness of cybersecurity risks in 5IR technologies is to a	18 (9.5%)	73 (38.6%)	63 (33.3%)	35 (18.5%)	2.39	.896	Moderate Level
Adaptability to emerging 5IR -driven library innovations is key to	18 (9.5%)	65 (34.4%)	74 (39.2%)	32 (16.9%)	2.37	.875	Moderate Level
The ability to use IoT devices for library operations is to	22 (11.6%)	56 (29.6%)	76 (40.2%)	35 (18.5%)	2.34	.913	Moderate Level
Proficiency in managing cloud -based library systems is crucial to a	14 (7.4%)	54 (28.6%)	86 (45.5%)	35 (18.5%)	2.25	.842	Moderate Level
Skills in utilising Virtual Reality and Augmented Reality for learning are to	14 (7.4%)	62(32.8 %)	67 (35.4%)	46 (24.3%)	2.23	.904	Moderate Level
Understanding Big Data analytics for decision -making is crucial to	14 (7.4%)	44 (23.3%)	95 (50.3%)	36 (19.0%)	2.19	.829	Moderate Level
Knowledge of Blockchain applications in library management is limited to a	6 (3.2%)	65 (34.4%)	48 (25.4%)	70 (37.0%)	2.04	.919	Moderate Level
Familiarity with digital twins and smart library environments is key to	14 (7.4%)	38 (20.1%)	75 (39.7%)	62 (32.8%)	2.02	.911	Moderate Level
The capacity to implement robotics in library automation is to	6 (3.2%)	39 (20.6%)	75 (39.7%)	69 (36.5%)	1.90	.832	Moderate Level

Decision Rule: if mean is ≤1.75 = Low Level, 1.76 – 2.50 = Moderate Level, 2.51 – 3.25 = High Level, 3.26 – 4.00 = Very High Level

Table 2 presents data on the technology literacy skills of information professionals in academic libraries across Lagos and Ogun states. The result reveals a generally moderate level of technological literacy of library professionals concerning the Fifth Industrial Revolution (5IR5) technologies. The highest-rated skill area is competency in using AI-based library tools, with a mean of 2.48. This suggests that while some information professionals are becoming familiar with AI applications in libraries, widespread proficiency has not yet been achieved. Similarly, awareness of cybersecurity risks (mean = 2.39), adaptability to emerging 5IR innovations (2.37), and ability to use IoT devices (2.34) also fall into the moderate category, indicating partial readiness but clear room for improvement. Other skill areas, such as proficiency in managing cloud-based systems (mean = 2.25), skills in using Virtual reality and augmented reality (2.23), and understanding of Big Data analytics (2.19), also reflect a moderate level of literacy. However, more advanced and niche technologies such as blockchain (2.04), digital twins and innovative environments (2.02), and robotics (1.90) score below the lower threshold, suggesting significant gaps in familiarity and capacity. The results imply that while information professionals in academic libraries of Lagos and Ogun States are moderately familiar with some 5ir technologies, there is an evident deficiency in advanced digital literacy, especially in cutting-edge technologies like robotics, blockchain, and digital twins. This moderate skill level could impede the adoption and integration of 5IR technologies in library services.

Research Question 3: **Challenges in Preparing for the 5ir in Academic Libraries, Lagos and Ogun States**

	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Std. Dev.	Decision
Limited funding for technology integration in libraries	107 (56.6%)	82 (43.4%)	0 (0.0%)	0 (.0.0%)	3.57	.497	Strongly Agree
The high cost of acquiring 5ir technologies hinders adoption	102 (54.0%)	84 (44.4%)	3(1.6%)	0 (0.0%)	3.52	.532	Strongly Agree
Poor digital infrastructure and unreliable internet connectivity	107 (56.6%)	72 (38.1%)	10 (5.3%)	0 (0.0%)	3.51	.598	Strongly Agree
Insufficient training and professional development opportunities	75 (39.7%)	103 (54.5%)	11 (5.8%)	0 (0.0%)	3.34	.585	Strongly Agree
Ethical and privacy concerns with AI and Big Data in libraries	64 (33.9%)	99 (52.4%)	26 (13.8%)	0 (0.0%)	3.20	.662	Agree
Limited awareness of 5IR benefits among library administrators	76 (40.2%)	79 (41.8%)	28 (14.8%)	6 (3.2%)	3.19	.803	Agree
Lack of skilled personnel to manage 5IR-driven systems	58 (30.7%)	110 (58.2%)	18 (9.5%)	3 (1.6%)	3.18	.660	Agree
Incompatibility of existing library systems with 5IR technologies	61 (32.3%)	94 (49.7%)	31 (16.4%)	3 (1.6%)	3.13	.733	Agree
Government policies and regulations pose barriers to 5IR adoption	51 (27.0%)	97 (51.3%)	34 (18.0%)	7 (3.7%)	3.02	.775	Agree
Resistance to change among library professionals	33 (17.5%)	106 (56.1%)	37 (19.6%)	13 (6.9%)	2.84	.790	Agree

Decision Rule: if mean is ≤1.75 = Strongly Disagree, 1.76 – 2.50 = Disagree, 2.51 – 3.25 = Agree, 3.26 – 4.00 = Strongly Agree

Table 3 presents the challenges in preparing for the 5IR in Lagos and Ogun States' academic libraries. The table revealed most respondents strongly agreed that “limited funding for technology integration” (mean = 3.57), “high cost of acquiring 5ir technologies” (mean = 3.52), and “poor digital infrastructure and unreliable internet connectivity” (mean = 3.51) are significant challenges. Additionally, participants agreed that challenges like “insufficient training and professional development” (mean = 3.34), “ethical and privacy concerns” (mean = 3.20), “limited awareness of 5IR benefits among administrators” (mean = 3.19), “lack of skilled personnel” (mean = 3.18), and “incompatibility of existing systems” (mean = 3.13) are also significant. Further down the scale, “government policies and regulations” (mean = 3.02) and “resistance to change among library professionals” (mean = 2.84) were also agreed upon as challenges. However, they appear slightly less severe compared to the top concerns. This result implies that while various challenges exist in preparing for 5IR, financial and infrastructural issues are the most critical, followed closely by human capacity and awareness-related factors. The consensus among respondents points to a strong need for increased funding, strategic infrastructure investment, and capacity building to adequately prepare academic libraries in Lagos and Ogun states for the demands of 5IR.

Research Question 4: **Possible Solutions to Challenges in Preparing for the 5ir in Academic Libraries, Lagos and Ogun State**

	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Std. Dev.	Decision
Universities should develop policies that support 5IR implementation	118 (62.4%)	63 (33.3%)	4 (2.1%)	4 (2.1%)	3.56	.646	Strongly Agree
Regular training and capacity-building programs are necessary	114 (60.3%)	67 (35.4%)	4 (2.1%)	4 (2.1%)	3.54	.648	Strongly Agree
Strengthening ICT infrastructure is essential for digital transformation	114 (60.3%)	67 (35.4%)	4 (2.1%)	4 (2.1%)	3.54	.648	Stronlgy Agree
Encouraging collaboration with technology experts and industries	112 (59.3%)	69 (36.5%)	4 (2.1%)	4 (2.1%)	3.53	.649	Strongly Agree
Encouraging staff adaptability through change management programs	112 (59.3%)	66 (34.9%)	7 (3.7%)	4 (2.1%)	3.51	.673	Strongly Agree
Increasing awareness of the benefits of 5IR in academic libraries	111 (58.7%)	66 (34.9%)	8 (4.2%)	4 (2.1%)	3.50	.681	Strongly Agree
Implementing strong cybersecurity measures to ensure data protection	100 (52.9%)	81 (42.9%)	8 (4.2%)	0 (0.0%)	3.49	.580	Strongly Agree
Increased government funding will enhance 5IR preparedness	98 (51.9%)	79 (41.8%)	8 (4.2%)	4 (2.1%)	3.43	.678	Strongly Agree
Adoption of public-private partnerships can help in technology acquisition	93 (49.2%)	89 (47.1%)	3(1.6%)	4 (2.1%)	3.43	.638	Strongly Agree
Promoting research on 5IR applications in academic libraries	86 (45.5%)	95 (50.3%)	4 (2.1%)	4 (2.1%)	3.39	.640	Strongly Agree

Decision Rule: if mean is ≤1.75 = Strongly Disagree, 1.76 – 2.50 = Disagree, 2.51 – 3.25 = Agree, 3.26 – 4.00 = Strongly Agree

Table 4 presents respondents' perceptions of strategies to address libraries' obstacles as they transition into the Fifth Industrial Revolution (5IR). All listed solutions received mean scores within the strongly agree range (above 3.26), indicating broad and strong agreement among respondents on the importance of each. The most highly rated solutions include the development of supportive university policies (mean = 3.56), regular training and capacity-building programs (mean = 3.54), and strengthening ICT infrastructure (mean = 3.54). These top scores recognise policy, personnel development, and infrastructure pillars of successful 5IR integration. Other solutions that were also strongly endorsed include collaboration with technology experts (mean = 3.53), promoting staff adaptability (mean = 3.51), increasing awareness of 5IR benefits (mean = 3.50), and implementing cybersecurity measures (mean = 3.49). Even the lower-rated but strongly agreed items, such as public-private partnerships (mean = 3.43) and promoting research on 5IR (mean = 3.39), show consistent support. The result implies that stakeholders in academic libraries of Lagos and Ogun States recognise that a comprehensive and strategic approach is necessary for successful 5IR adoption. Emphasis is placed on technology, funding, human capital development, collaboration, and institutional policy support.

Discussion of Findings

The findings revealed that Fifth Industrial Revolution (5IR) technologies are unavailable in the university libraries surveyed in Lagos and Ogun States, except for cloud computing, which had a mean score of 1.79 and was categorised as "available". All other technologies, including AI tools, IoT systems, robotics, blockchain, AR/VR, and digital twins, were categorised as "unavailable", indicating a substantial gap in adopting advanced technologies. This limited availability reflects the findings of Ocholla and Ocholla (2020), who similarly observed a low uptake of advanced 4IR/5IR-related technologies in South African academic libraries, such as robotics (4%) and makerspaces (8%). Ekwueme et al. (2024) also corroborated this pattern, citing poor adoption of 5IR tools in Nigerian academic libraries despite high awareness. Likewise, Adio (2022) found that awareness and utilisation of emerging technologies in Nigerian polytechnic libraries

remained low due to infrastructural and funding issues. These findings confirm that the technological readiness of Nigerian university libraries for 5IR remains minimal, underscoring the need for more proactive strategies and investment.

The study showed that Lagos and Ogun State library professionals possess moderate technology literacy skills relevant to 5IR. While they demonstrated some familiarity with AI-based tools, cybersecurity awareness, and IoT applications, their proficiency in more specialised technologies like robotics, blockchain, and digital twins remained low. This moderate skill level supports the study by Eromesele, Omosekejimi, and Ogo (2021), who found that although librarians in southern Nigeria were generally proficient in basic ICT tools, there was still a gap in training for advanced digital technologies. Similarly, Paladhi and Maruthaveeran (2024) noted that librarians possess only medium levels of AI competency, with limited application of these tools in practice. Modiba and Ngulube (2024) also emphasised the need for advanced digital competencies, especially in AI management within academic libraries. The findings underscore the need for structured and ongoing professional development to bridge the existing skills gap and fully enable librarians to leverage 5IR technologies.

Respondents overwhelmingly agreed that limited funding, high technology acquisition costs, poor infrastructure, and lack of training were the significant challenges hindering 5IR library preparedness. These findings are consistent with those of Ekwueme et al. (2024), who identified inadequate power supply, lack of robust internet, and insufficient training as significant barriers to 5IR integration. Adigun, Ajani, and Enakrire (2024) also highlighted financial constraints and outdated systems as impediments to innovation in academic libraries. Akparobore, Omosekejimi, and Nweke (2020) further stressed that a lack of awareness and resistance to technological change contributed to the slow pace of 5IR adoption. These shared concerns across the literature emphasise the urgent need for strategic investment, policy support, and training frameworks to overcome these systemic barriers and enable a smoother transition into the Fifth Industrial Revolution.

The study revealed strong consensus among respondents on various actionable solutions that could address academic libraries' challenges in preparing for the 5IR. Among the most highly rated strategies were the development of supportive institutional policies (mean = 3.56), regular training and capacity-building programmes (3.54), and strengthening of ICT infrastructure (3.54). These results suggest that librarians recognise a multifaceted approach that combines administrative, technical, and human resource interventions as essential to readiness. This aligns with Adigun, Ajani, and Enakrire's (2024) recommendations, who argued for consistent investment in continuous learning, infrastructure, and policymaking to facilitate technology integration. Similarly, Ekwueme et al. (2024) emphasised the importance of targeted professional development and collaborative support from institutions and technology providers to enhance librarians' competencies and successfully implement 5IR tools. In the same vein, Akparobore, Omosekejimi, and Nweke (2020) advocated increased funding, capacity-building, and proactive digital engagement as key solutions to overcoming resistance and skill deficiencies. The respondents in the current study also agreed on the value of collaboration with technology experts, implementation of strong cybersecurity measures, and encouraging public-private partnerships, further indicating the need for collective efforts between academia, government, and industry to drive 5IR adoption. These findings confirm that with deliberate, well-funded, and collaborative initiatives, academic libraries in Lagos and Ogun States can overcome existing barriers and become active players in the global 5IR ecosystem.

Conclusion

This study examined the preparedness of academic libraries in Lagos and Ogun States for the Fifth Industrial Revolution (5IR) by assessing the availability of relevant technologies, the digital literacy of library professionals, the challenges encountered, and possible solutions. The findings revealed a low level of availability of 5IR technologies such as AI, robotics, blockchain, and IoT-enabled systems, with only cloud computing showing modest integration. Library professionals demonstrated moderate levels of technological literacy, indicating partial readiness but a significant skills gap in advanced tools. These limitations are compounded by challenges such as inadequate funding, poor infrastructure, insufficient training opportunities, and limited administrative awareness, all of which hinder the full-scale adoption of 5IR innovations in academic libraries.

Despite these constraints, respondents agreed on various viable solutions, including supportive institutional policies, increased funding, regular training and capacity-building programs, improved ICT infrastructure, and collaboration with technology experts. These findings suggest that, although academic libraries in the study area are not yet fully equipped for 5IR, the groundwork exists for meaningful progress. With targeted investments, policy reforms, and sustained professional development, university libraries in Lagos and Ogun States can position themselves as forward-thinking institutions capable of thriving in the evolving landscape of human-technology collaboration that defines the Fifth Industrial Revolution.

Recommendation

Based on the findings of this study, the following recommendations are proposed to enhance the preparedness of academic libraries in Lagos and Ogun States for the Fifth Industrial Revolution (5IR):

1. University administrations and relevant stakeholders should prioritise acquiring and implementing 5IR technologies such as artificial intelligence, IoT-enabled systems, robotics, and blockchain. Special funding allocations and strategic partnerships with technology firms should be explored to ease the financial burden of adopting these innovations.
2. Regular and structured training programs should be organised to equip librarians with the advanced digital skills needed to operate 5IR technologies effectively. This includes workshops, certification programs, and continuous learning opportunities tailored to AI, big data, cybersecurity, virtual reality, and other emerging tools.
3. Academic libraries in Lagos and Ogun states should develop and implement policies that support integrating 5IR technologies into library services.
4. University libraries in Lagos and Ogun states must improve their digital infrastructure, including internet connectivity, server capacity, and energy supply, to create a conducive environment for using advanced library technologies.
5. Library leadership should engage in sensitisation and advocacy efforts to raise awareness of the benefits of 5IR technologies among administrators and staff. Change management strategies should be incorporated to reduce resistance and encourage a technology-embracing culture.

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Assessment of Library Staff Awareness of Online Cataloguing and Classification Tools for Processing Information Resources by University Libraries in Nasarawa State, Nigeria

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Abstract
This study assesses the library staff awareness of online cataloguing and classification tools in processing information resources in university libraries in Nasarawa State Nigeria. The study was guided by 3 research questions. A survey research design was adopted. The population is one hundred and fifty-nine (159) library staff within the three university libraries understudied, which constituted the sample size for the study. Instrument for data collection was checklist and structured questionnaire which was subjected to face validity by three experts. Descriptive statistics was used to analyse the data. The findings revealed that a variety of online cataloguing and classification tools are available in university libraries in Nasarawa State, with staff showing moderate Awareness of these tools, although they face significant challenges such as inadequate ICT infrastructure and skills, there is a strong relationship between library staff awareness of online cataloguing and classification tools and their effectiveness in processing information resources in university libraries. This study recommended that, the universities should conduct regular awareness campaign on the existence of the tools, continuous training and support play critical roles in maintaining and improving this awareness, ultimately benefiting both library staff and users. Finally, the study also recommends amongst other things that library staff should be trained and re-trained on online cataloguing and classification tools through local and international workshops, seminars and conferences in other to meet up with global best practices.
KEYWORD: *Assessment, Awareness, Online Cataloguing & Classification Tools, Processing, University library.*

Introduction

University libraries are set up to satisfy information needs of users and are pivotal in providing knowledge, information resources, and services that support the goals of their parent institutions. Their specific objectives include providing information materials for undergraduate instruction, supporting faculty research, offering resources for postgraduate research, supplying specialized works in professional disciplines, and aiding personal development. Central to achieving these objectives is the proper organization of library information resources through cataloguing and classification processes.

Awareness among library staff regarding the importance of cataloguing and classification has been longstanding. The emergence of Information and Communication Technology (ICT) has facilitated access to vast databases from developed countries, enabling remote libraries to adopt or adapt bibliographic data for their own use. Online cataloguing involves digitally describing and classifying library materials to facilitate easy searching and retrieval (Wells, 2021).

Indeed, the advent of online catalogues has significantly transformed the landscape of cataloguing and classification practices. The availability of Internet resources has streamlined these processes by allowing stress-free access to different web sources (Wang, 2021). Organizations like the Library of Congress have made rapid resource classification possible through their online catalogue databases containing a plethora of records across various material types.

Library online software plays a crucial role in achieving efficient cataloguing practices by enabling functions such as importing bibliographic records from trusted online sources like 'OCLC World Cat' or 'Trove - National Library of Australia'. This significantly reduces manual processing time while ensuring metadata is imported in MARC format to meet library requirements (Adetayo et al., 2023). Automation software also provides timely updates on library material processing progress.

Statement of the Problem

Online Tools for cataloguing and classification information resources are essential in cataloguing and classification process. The emergence and application of the Information and Communication Technology (ICT) in university libraries operation make it compelling for librarians and libraries to embrace online

cataloguing and classification tools. Online cataloguing and classification are one of the innovations brought by ICT in university libraries. This innovation has been adopted long ago by librarians and libraries in advanced countries having recognized its potentials in processing information resources. It has been of tremendous help in ensuring effective service delivery among libraries and library staff; it also facilitates as well as speeds up processing of information resources and grant easy access to information resources. It eliminates the tedious nature of using manual cataloguing and classification tools.
Limited knowledge of online cataloguing and classification tools results in university library staff adhering to traditional methods of managing information resources. This hinders timely access to current resources for users, making the process laborious, challenging, monotonous, delay and time-consuming. The study aims to assess awareness of online cataloguing and classification tools for information resources in university libraries in Nasarawa State, Nigeria.

Research Questions
The following are the Research Question:
1. What online cataloguing and classification tools available for processing information resources in University Libraries in Nasarawa State Nigeria?
2. What is the extent of awareness of online cataloguing and classification tools among library staff for processing information resources in University Libraries in Nasarawa State Nigeria.?
3. What difficulties are encountered by library staff when using of online cataloguing and classification tools in process information resources in University Libraries in Nasarawa State, Nigeria.?

Firstly, the finding of the study is essential for university management to understand the financial implications and necessary budget allocations for acquiring these online cataloguing and classification tools, which will improve library resources and operations.
Secondly, the study findings was emphasize the professional roles and responsibilities of university librarians in creating awareness and usage of these online tools effectively. This will enhance their ability to organize knowledge efficiently within the library setting.
Thirdly, library staff will benefit from insights into societal trends regarding online tools, enabling them to plan accordingly. May also raise awareness among library staff about the importance of using online cataloguing and classification tools for accurate job performance. They can also learn how to address challenges related to using these tools effectively in library operations.
Finally, improved access for library users due to enhanced awareness about these tools would result in a more efficient retrieval process for information resources.

Literature Review
Jibril, Amidu and Adamu (2021) carried out a study on appraisal of librarians' skills and awareness of online cataloguing and classification tools in university libraries in Nasarawa state. Descriptive survey design was used, and the population of the study comprised of 18 librarians in three university libraries under study. Three objectives and three research questions guided the study. Closed ended questionnaire was used for data collection. In all, 18 copies of the questionnaire were distributed and 15 were filled and returned, representing 94% response rate. Descriptive statistics expressed in frequency, percentage and mean scores were used in analyzing the data collected. The findings reveal that, librarians were aware of OCLC bibliographic formats and standard, cataloguing internet resources: A manual and practical guide, library of congress online catalogue, MARC21 format for cataloguing data, AACR II /RDA, OCLC/MARC coding guidelines, LC name authority, KOHA and LC cutter Sanborn table and web Dewey. Also, the shows that, librarians possessed information literacy skills, computer literacy skills, data milting skills, internet skills, use of software, use of uniform resource locator, use of KOHA, use of online cataloguing and classification databases, advanced search techniques, keyword search techniques, search of library databases and use of LC cutter Sanborn table.
Both studies related in the aspect of awareness on online cataloguing and classification tools in university libraries in Nasarawa state. This current studies differ in that, with the previous study in the sense that the gap the present study will look at is the awareness of library staff of online cataloguing and classification tools in processing information resources in university libraries in Nasarawa State.

In the same vein, Gana, Ajibili, and Abel (2019) conducted a study on Awareness and use of Online Public Access Cataloguing (OPAC) by patrons of Bingham University Library, Karu, Nasarawa State, Nigeria. The study was guided by three (3) objectives and three (3) research questions. The population of the study was 4000 undergraduate students and staff of Bingham University Library. The study was randomly selected 350 respondents from the total population as sample size. Descriptive survey research design was used for the study. The research instrument used was a structured questionnaire. Frequency counts, mean and standard deviation were adopted for data analysis using SPSS. Findings of this study revealed that most of the

respondents were not aware of the OPAC services rendered by the library. Thus, only few of the respondents use the OPAC services to retrieve library materials.
Thus, this study under review is related to the current study in that both discussed awareness of Online Cataloguing in University Libraries while they differ in the sense that the previous studied Online Public Access Cataloguing (OPAC) by patrons of Bingham University Library, Karu, Nasarawa State, while the present study is on the awareness of online cataloguing and classification tools to in university libraries in Nasarawa State.

In addition, Omosekejimi, Nweke and Omoadoni (2022) conducted a study on Cataloguers' Awareness, ICT Skills and Use of Resources Description and Access (RDA) in University Libraries in South-South, Nigeria". The study population comprised two hundred and sixty-six (266) librarians from all the 26 university libraries across South-South, Nigeria. The entire population of 266 librarians was used as sample using total enumeration sampling technique. Questionnaire was used to elicit data from the respondents. The data collected were analyzed using percentage and frequency counts as well as weighted mean and standard deviation. Findings from this study revealed that: cataloguers in university libraries in South -South Nigeria were aware of the existence of RDA; the extent of cataloguers' awareness of RDA in university libraries in South -South Nigeria is low; librarians lack major ICT skills such as the ability to use Windows operating system, Macintosh operating system and Disk Operating System (DOS) commands; start a software program such as RDA; mine data and develop metadata among others; the extent of the use of RDA for cataloguing of information resources is very low and lack of ICT skills, lack of ICT facilities among others are some of the factors militating against the use of RDA by cataloguers in university libraries on the study.

Both the present and previous studies are related in the area of awareness in university libraries. They, however, differs in that, previous study placed emphasis on Use of Resources Description and Access (RDA) while the present study will look at Awareness of library staff of online cataloguing and classification tools in processing information resources in university libraries in Nasarawa State which is the gap to be fill.

Methodology

The design for this study is a survey design. It is a type of research in which a group of people is studied by collecting and analyzing data from opinions of a few people considered to be a representative sample of the entire population through the use of questionnaire as one of the methods for data gathering techniques for the purpose of describing, interpreting and evaluating the phenomena as they exist (Emaikwu 2019). The survey research design is considered suitable for this study as it usually describes and interprets data collected on a large population. it is used to assess a situation with a view to correcting inadequacies or effecting improvements. Furthermore, descriptive survey research method deals with describing the situation of a given population using some characteristics that are common among them. It is a process that involves a number of steps such as planning survey, questionnaire design, sampling, data collection, data processing and drawing conclusion. Checklist was equally used to note the available online tools for cataloguing and classification in the libraries studied. The Population of the study of the is 159 staff within the three university libraries under study. The breakdown of the is as follows: 36 from Bingham University Auta Balefe Karu, library staff 73 from Nasarawa State State University Keffi, and 50 from Federal University of Lafia. Since the population of this study is not large, there is no sampling the total enumeration sampling was used in this study. Therefore, all the one hundred andfifty-nine (159) library staff constitutes the sample size for the study. The decision to use the entire population is guided by the view of Bernard (2012) who said that if a population of the is less than two hundred (200), the entire population can be used for the study. The researcher with the aid of a research assistant administered 149 was duly returned which is the possible result. A Observation Checklist and self-structured questionnaire with the title: Assessment of library Staff Awareness of Online Cataloguing and Classification Tools in Processing Information Resources in University in Nasarawa State. (ALSAOCCT).

RQ1: What online cataloguing and classification tools are available for use by library staff to process information resources in universities libraries in Nasarawa state Nigeria?

To answer this research question, data on the types of online cataloguing and classification tools available for use by library staff in processing of information resources in the university libraries in Nasarawa State were collected and Analyzed using mean and standard deviation as presented on.

Table 1: Shows name of institution, items, observed checklist and remarks on types of online cataloguing and classification tools for use by library staff in processing of information resources in the university libraries in Nasarawa State, Nigeria

S/No	Institutions	Items	Checklist	Remarks
1	Bingham University Library Karu		Available/Not Available	
		Cataloguing internet resources	Available	Available
		Classification Web	Available	Available
		DDC Web	NA	Not Available
		LCC Web	Available	Available
		World Cat	Available	Available
		MARC21 concise formats	Available	Available
		Bibliographic format	Available	Available
		Resource Description Access	NA	Not Available
		OCLC	Available	Available
		OLCSH	Available	Available
		Online Cutter Sanborn	Available	Available
2	Federal University Library Lafia	Cataloguing internet resources	Available	Available
		Classification Web	Available	Available
		DDC Web	NA	Not Available
		LCC Web	Available	Available
		World Cat	Available	Available
		MARC21 concise formats	Available	Available
		Bibliographic format	Available	Available
		Resource Description Access	NA	Not Available
		OCLC	Available	Available
		OLCSH	Available	Available
		Online Cutter Sanborn	Available	Available
3	Nasarawa State University library Keffi	Cataloguing internet resource	Available	Available
		Classification Web	Available	Available
		DDC Web	NA	Not Available
		LCC Web	Yes	Available
		World Cat	Yes	Available
		MARC21 concise formats	Yes	Available
		Bibliographic format	Yes	Available
		Resource Description Access	NA	Not Available
		OCLC	Yes	Available
		OLCSH	Yes	Available
		Online Cutter Sanborn	Yes	Available

Key:1 Available= A, Not Available =NA

Table 1 showed that Bingham University Karu, Federal University of Lafia and Nasarawa State University Keffi has 9 Types of Online Cataloguing and Classification Tools except DDC web and RDA were are not available for use by Library Staff to facilitate the Processing of Information Resources in University Libraries in Nasarawa State.

RQ2: What is the extent of awareness of online cataloguing and classification tools among library staff for processing information resources in University Libraries in Nasarawa State Nigeria.?

Table 2: Frequency and Percentage of Level of Awareness Among library Staff of Online Cataloguing and Classification Tools for Processing Information Resources in University Libraries in Nasarawa State Nigeria

S/N	Questionnaire Item	Aware		Not Aware		Remark
		F	%	f	%	
1	Cataloguing internet resources	137	86.2	22	13.8	Aware
2	Classification web	132	83.0	27	17.0	Aware
3	Dewey Decimal Classification Web (DDCW)	89	56.0	70	44.0	Aware
4	Library of Congress Classification Web (LCCW)	118	74.2	41	25.8	Aware
5	World cat	103	64.8	56	35.2	Aware
6	Marc21 concise format Bibliographic data	108	67.9	51	32.1	Aware
7	Resources Description Access	109	68.6	50	31.4	Aware
8	Online Computer Library Center (OCLC)	150	94.3	9	5.7	Aware
9	Online Library of Congress Subject Heading (LCSH)	113	71.1	46	28.9	Aware
10	Bibliographic Formats and Standards	107	67.3	52	32.7	Aware
11	Online Cutter Sanborn	103	64.8	56	35.2	Aware
	Cluster mean	115	72.0 %	44	28.0 %	Aware

Key: A=Aware, NA=Not Aware

Table 2 showed that there is awareness of the existence of online cataloguing and classification tools for processing information resources in university libraries in Nasarawa State. All 11 items fells within the awareness categories with the percentages ranging from 56.0 % - 94% respectively with a cluster percentages ranging from 72.0% which is above the benmark of 50%. This results indicates that library staff are aware of the existence of the online cataloguing and classification tools.

What difficulties are encountered by library staff when using of online cataloguing and classification tools in process information resources in University Libraries in Nasarawa State, Nigeria.?

Table 3 Mean and Standard Deviation of Respondents on the Difficulties Encountered by Library Staff On Online Cataloguing and Classification Tools in Processing Information Resource in University Libraries in Nasarawa State.

S/No	Items	Mean	SD	Decision
1	Lack of ICT	3.23	0.69	Agreed
2	Lack of network connectivity	3.30	0.63	Agreed
3	Lack of online cataloguing and classification tool	3.56	0.72	Agreed
4	Inadequate power supply	3.26	0.55	Agreed
5	High subscription rate of cataloguing and classification tool	3.28	0.69	Agreed
6	Lack of technical known how	3.14	0.63	Agreed
7	Technophobia	3.18	0.51	Agreed
8	Insufficient skilled personnel to trained library staff in the university	3.64	0.63	Strongly Agreed
9	Lack of awareness on the existing tools of online cataloguing	3.31	0.53	Agreed
10	Inadequate fund	3.36	0.55	Agreed
11	Lack of expensive software and hardware	3.23	0.52	Agreed

	package for cataloguing and classification			
12	Low bandwidth	3.26	0.62	Agreed
13	Lack of conducive atmosphere environment	3.59	0.62	Agreed
14	Ignorance and apathy	3.20	0.68	Agreed
15	Lack of enough computer facilities	3.30	0.55	Agreed
16	Nonchalant attitude	3.26	0.49	Agreed
17	Limited training opportunities	3.27	0.62	Agreed
18	Lack of motivation	3.52	0.77	Agreed
	Cluster Mean	**3.33**	**0.61**	**Agreed**

Key: SA= Strongly Agree, A= Agree, DA= Disagree Agree, SD= Strongly Disagree

Table 3 reveals that all the 18 items have range from 3.14-3.59 and SD 0.49-0.77 with a grand mean of 3.33 and SD 0.61, this result indicates the difficulties encountered by the library staff on Awareness of Online Cataloguing and Classification tools in Process Information Resources in University Libraries in Nasarawa State.

Discussion of Findings

The study's findings indicate that a variety of online cataloguing and classification tools are available to library staff in university libraries Nasarawa State's, which is a positive development. However, the mere availability of these tools does not necessarily adequate to their effective use. The tools listed, such as Dewey Decimal Classification Web (DDCW) and the Library of Congress Classification Web (LCCW), are standard in many libraries, but their utility can be compromised if staff are not adequately trained or if the tools are not integrated into a cohesive digital infrastructure.

The low standard deviations suggest consistency in responses, but this could also indicate that staff are uniformly exposed to only a limited set of tools. This raises questions about whether the libraries are keeping pace with technological advancements in library, particularly with the rise of artificial intelligence and machine learning in information retrieval and processing.

Moreover, the availability of these tools might be more symbolic than practical. For instance, tools like MARC21 and OCLC are foundational, but if they are not part of a larger, well-maintained system that includes regular updates and integrations with other library technologies, their effectiveness could be severely limited. This brings into focus the importance of not just the availability of tools, but also their relevance, currency, and the ecosystem within which they operated

This finding agreed with the study of Jibril, Amidu and Adamu (2021) and Omosekejimi, Nweke and Omoadoni (2022) whose findings reveal that librarians were aware of OCLC bibliographic formats and standards, cataloging internet resources.

The finding that 72% of respondents are aware of online cataloguing and classification tools is a positive sign, but it also underscores a significant awareness gap. The remaining 28% of staff who are unaware of these tools represent a substantial portion of the workforce that may not be contributing effectively to the library's mission in a digital age. This lack of awareness could be due to several factors, including insufficient training, a lack of communication from library administration, or a failure to emphasize the importance of these tools in daily operations.

Furthermore, the extents of awareness are not uniformly high across all tools. For instance, awareness of tools like Dewey Decimal Classification Web (56%) and Online Library of Congress Subject Heading (LCSH) (71.1%) is lower compared to other tools. This disparity suggests that some tools, possibly those perceived as less critical or more complex, are not being effectively communicated to or adopted by staff. This could be a result of inadequate training programs that do not cover all available tools comprehensively or an over-reliance on more traditional, well-known tools at the expense of newer, potentially more effective ones.

This uneven awareness also hints at potential issues with information dissemination within the library system. If certain tools are not being highlighted or prioritized, staff might be missing out on opportunities to enhance their workflows and improve service delivery. This raises questions about the strategic direction of the libraries and whether there is a concerted effort to ensure that all staff are on the same page regarding the tools available to them.

This result negate the findings of Ihekwoaba, Ngozi and Mole (2017) who reveal that inappropriate cataloguing tools, poor information and communication technology skills, and poor interest in conventional cataloguing were some of the issues in acquisition and application of conventional and online complementary cataloguing amongst cataloguers in Nigerian University libraries.

While the mean scores indicate that staff generally agree that they use online cataloguing and classification tools, this usage appears to be at a baseline level, suggesting that these tools may not be fully integrated into

library operations. The relatively narrow range of mean scores (3.21 to 3.59) across different tools suggests that while there is some use of these tools, it may be superficial or inconsistent. This could be due to a lack of deep engagement with the tools, possibly because of inadequate training, resistance to change, or the tools themselves being difficult to use or poorly integrated into the library's broader systems.
The challenges identified in the study, such as lack of ICT infrastructure, inadequate network connectivity, and insufficient skilled personnel, are significant barriers that hinder the effective use of online cataloguing and classification tools. These issues highlight systemic problems that go beyond individual libraries and point to broader institutional and infrastructural challenges that need to be addressed.
The high mean scores for these difficulties, particularly the lack of skilled personnel (mean of 3.64), suggest that there is a critical need for capacity building and professional development. Without addressing these foundational issues, the potential benefits of online tools will remain unrealized. The presence of technophobia and nonchalant attitudes among staff further complicates efforts to modernize library practices. These attitudes may stem from a lack of familiarity with digital tools, fear of obsolescence, or resistance to change. Addressing these psychological barriers is as important as resolving technical issues, as they can significantly impact the adoption and effective use of new technologies.

Additionally, the study highlights the issue of inadequate funding, which affects the ability to purchase and maintain the necessary software and hardware for cataloguing and classification. This financial constraint is a significant barrier to digital transformation in libraries, as it limits the ability to invest in the latest tools and technologies. The issue of low bandwidth and inadequate power supply further exacerbates these challenges, particularly in a region like Nasarawa State, where infrastructural issues are prevalent.
The findings also point to a lack of awareness about existing tools, suggesting that even when tools are available, they may not be effectively utilized because staff are not aware of their existence or potential. This highlights a critical gap in communication and training within the library system. Ensuring that all staff are aware of and understand how to use available tools is essential for maximizing their effectiveness.

Conclusion

In conclusion, the study highlighted the current state of online cataloguing and classification tools in university libraries across Nasarawa State, Nigeria. While there is a broad availability of essential online tools such as the Dewey Decimal Classification Web, Library of Congress Classification Web, and MARC21, their usage and integration into library operations appear to be limited. Awareness levels among staff are relatively high, but a significant portion of library personnel remains unaware of these resources, suggesting a gap in communication and training. Moreover, the overall ICT proficiency of the staff, while adequate, is not sufficiently advanced to fully exploit the potential of these tools, indicating a need for targeted training and development programs. The findings also reveal substantial challenges that hinder the effective use of online cataloguing and classification tools. These include infrastructural deficiencies, such as poor network connectivity and inadequate power supply, as well as a lack of technical expertise and financial resources. Additionally, psychological barriers like technophobia and a nonchalant attitude towards digital adoption exacerbated these issues.

Recommendations

Based on these findings, the following recommendations were made:
1. The study recommended that universities conduct a thorough audit of their current tools. This audit should assess the relevance, usability, and scope of existing systems to ensure they meet the libraries' needs. Additionally, there should be a system for the regular review, updating, and maintenance of these tools to keep them current and effective for processing information resources.
2. Universities should implement comprehensive awareness campaigns. These campaigns could include regular training sessions, the distribution of informative bulletins, and the creation of a centralized digital platform where staff can access information about available tools. To ensure all staff are adequately informed, mandatory induction programs that cover the basics of online cataloguing and classification tools should be introduced for both new and existing library personnel.
3. Finally, in response to the third research question, which examined the difficulties encountered by library staff in using online cataloguing and classification tools, universities should prioritize investments in their ICT infrastructure. This includes ensuring stable network connectivity, a reliable power supply, and access to necessary hardware and software. Additionally, creating a supportive environment where staff can openly discuss the challenges they face is essential. This can be achieved through regular feedback sessions, and the establishment of a dedicated helpdesk or technical support team focused on resolving issues related to online cataloguing and classification tools.

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Attitude, Competency, Funding and Policy Readiness for Adoption of 5IR Technologies by Nigeria University Libraries in Delta State

By

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Abstract

This study examines the adoption readiness of university libraries in Delta State, Nigeria, for the 5IR. It assesses the attitude of librarians towards 5IR adoption, infrastructure availability, librarians' digital competencies, institutional policies, and challenges of 5IR adoption in university libraries. The study employs survey research design. The population of the study comprised of 118 librarians in all the university libraries in Delta State. Total enumeration sampling technique was used to sample the entire population due to its small and manageable size. Questionnaire was the instrument used for data collection. The collected data were analyzed using descriptive statistics (Simple percentages and mean). The study found that the attitude of librarians towards adoption of 5IR in university libraries in Delta State is positive. It was also found that level of digital competency of librarians for 5IR adoption is moderate, the funding for technological infrastructure for 5IR adoption is poor and there is lack of institutional policy regarding the adoption of 5IR. The study also revealed that while many librarians acknowledge the potential of 5IR innovations, factors such as limited ICT training, inadequate budget allocations, and resistance to automation may hinder full adoption. The study concludes that while Delta State university libraries show potential for 5IR integration, strategic investments and policy interventions are necessary to fully harness its benefits.Based on these findings, the study recommends targeted capacity-building programs for librarians, increased government and institutional funding for smart technologies, and the development of strategic policies to guide 5IR adoption in academic libraries.

Keywords: *5th Industrial Revolution; Adoption Readiness; Artificial Intelligence; Digital Transformation; University Libraries.*

Introduction

The advent of the Fifth Industrial Revolution (5IR) heralds a transformative era characterized by the seamless integration of advanced technologies with human-centric innovations. Unlike its predecessor, the Fourth Industrial Revolution or industry 4.0 (4IR), which emphasized automation and digitization, 5IR alternatively called industry 5.0, focuses on fostering collaboration between humans and intelligent systems to enhance productivity, creativity, and inclusivity (Albazi, 2025). While Industry 4.0 focuses on automation, it has sparked concerns about job displacement, loss of human touch in production processes, and environmental sustainability, Industry 5.0 addresses these concerns by integrating human creativity with the precision of machines. Instead of replacing humans, AI and advanced technologies work alongside humans to create more sustainable, personalized, and ethical solutions (Qureshi, 2024). Within this context, university libraries are increasingly being recognized as critical hubs for knowledge dissemination, technological advancement, and societal transformation.

University libraries in Nigeria, serve as essential components of higher education institutions, providing access to information resources and supporting academic research. However, their ability to adapt to emerging technological trends remains a subject of concern. The adoption of 5IR technologies in these libraries involves integrating artificial intelligence (AI), robotics, Internet of Things (IoT), cloud computing, and other advanced systems to enhance library services and user experiences. This transformation promises to revolutionize information management by enabling personalized services, automating routine tasks, and fostering human-machine partnerships (Ekwueme et al., 2024). Yet, achieving these goals requires addressing several critical factors, including librarians' attitudes toward technological adoption, infrastructure availability, digital competencies, institutional policies, and the challenges inherent in implementing 5IR innovations.

There is no denying that university libraries are integral to the academic ecosystem as they facilitate access to knowledge and foster intellectual growth. In the 5IR era, libraries are expected to transcend traditional roles by adopting smart technologies that improve efficiency and inclusivity. For instance, AI-driven tools can assist librarians in cataloguing resources more effectively while IoT devices can provide real-

time data on resource usage (Ekwueme et al., 2024). Moreover, cloud computing enables seamless access to digital archives from remote locations, thereby supporting distance learning initiatives. These advancements align with global trends emphasizing the need for libraries to evolve into dynamic spaces that cater to diverse user needs. In Nigeria, studies have highlighted progress in adopting Integrated Library Systems (ILS) within university libraries. These systems have improved service delivery by enabling online cataloguing and resource sharing among libraries (Omeluzor, 2020).

Also, the readiness of university libraries to adopt 5IR technologies is pivotal in ensuring their relevance in a rapidly evolving educational landscape. However, integrating advanced 5IR technologies require addressinginadequate funding, limited ICT training for librarians, and resistance to automation (Akporhonor & Emecho, 2019). Tackling these issues is crucial for ensuring that Nigerian university libraries can leverage 5IR innovations effectively. Should libraries and librarians who are the main drivers of information dissemination in the academic community not be prepared to maximize the benefits of industry 5.0 technologies, the effort of the university management in ensuring its adoption and compliance withthe 21st century library and information practice will be a waste. It is on this premise that this study seek to examine adoption readiness of university libraries in Delta State for the 5th industrial revolution.

Statement of the Problem

The emergence of the Fifth Industrial Revolution (5IR) presents an unprecedented opportunity for university libraries to redefine their roles by integrating human-centric innovations with advanced technologies such as Artificial Intelligence (AI), robotics, Internet of Things (IoT), and cloud computing. While global trends show a shift toward innovative, inclusive, and personalized library services. Nigerian university libraries, including those in Delta State face significant barriers in aligning with this transformation. Despite some progress in adopting Integrated Library Systems (ILS), full-scale integration of 5IR technologies remains limited due to infrastructural deficiencies, inadequate ICT training, resistance to change, and insufficient funding. These challenges raise concerns about the preparedness and willingness of university libraries and librarians to embrace the demands of 5IR.

If not adequately addressed, the inability of these libraries to adopt and utilize 5IR innovations could undermine their relevance in the digital age and impede the broader goals of higher education in Nigeria. Therefore, it becomes imperative to assess the readiness of university libraries in Delta State to adopt and adapt to 5IR technologies to ensure they remain vital agents of knowledge dissemination, innovation, and academic support in a rapidly evolving educational environment.

Research Questions

The following research questions will be answered in this study.

1) What is the attitudes of librarians toward the adoption of 5IR technologies in their library operations and services in university libraries in Delta State?
2) What is the level of digital competences of librarians towards the adoption Fifth Industrial Revolution (5IR) technologies in university libraries in Delta State?
3) What is the extent of funding for 5IR technology adoption in university libraries in Delta State?
4) Are there institutional policies on the adoption and use of 5IR technologies in university libraries in Delta State?
5) What are the challenges militating against the adoption and implementation of 5IR technologies in university libraries in Delta State?

Literature Review

Attitudes are “inclinations and feelings, prejudices or bias, preconceived notions, ideas, fears and convictions about any specific topic” Erhahor, (2012). Idahosa and Eireyi-Edewede (2023) states that an attitude “is a mental and neutral state of readiness organized through experience exerting a directive or dynamic influence upon individual's response to all objects or situations with which it is associated.” Cherry (2021) describes attitude as a set of thoughts, beliefs, and behaviours directed toward a physical item, people, and object. Cherry also mentioned that the manifestation of attitudes might be positive, negative, or ambiguous depending on the instance. Kavanaugh and Solomon, (2013) agreed that attitudes are the positive or negative evaluation of people, objects, ideas, or events. According to Spacey (2013), positive attitudes are fundamental in deploying new technologies such as the 5IR. This means that the attitude of librarians towards modern technology such as the 5IR will play a major role in its adoption and application. In an academic library, effective services and administration will depend greatly on the availability and use of technology, while its implementation depends mainly on the librarian's attitude toward it.

A positive attitude towards the adoption and use of technology could lead to improved performance, which means a positive impact on service delivery; therefore, understanding the attitude of academic librarians

is important to assess their time spent in providing library services more critically, their perception of changes, challenges, use of technology, and the overall impact on service delivery within the context of a rapidly changing university library environment (Bawack & Shafack, 2023). A number of studies have been conducted to examine the attitude of librarians towards adoption and use of modern technologies in academic libraries across the globe and Nigeria in particular. Idahosa and Eireyi-Edewede (2023) conducted a study on librarians' awareness and attitude towards deployment of cloud computing technologies in university libraries in South-South, Nigeria. The study employed the descriptive survey research design with the study population of 246 Librarians in South-South Nigeria. A questionnaire was the instrument used for data collection. The findings revealed an aggregate mean of 3.11, which is greater than the criterion mean of 2.50, demonstrating that librarians have a positive attitude towards the deployment of cloud computing technologies in university libraries.

Also, Ekwueme et al. (2024) explored the awareness, perceptions, and skills of librarians at the National Open University of Nigeria (NOUN) toward5IR integration in university libraries, especially in open and distance learning contexts. The study surveyed all sixty librarians at NOUN using a Google Form questionnaire which yielded forty-four responses. These responses were analyzed with SPSS, withdescriptive statistics and regression analysis. The findings reveal that librarians generally view 5IR technologies positively; believing they can enhance diversity and inclusiveness in library services, particularly by providing individualized learning materials. However, there are concerns about the skills required to effectively operate these technologies, particularly in evaluating and selecting appropriate ones.

Furthermore, Achugbue and Ogbomo (2017) carried out a study on librarians' attitudes toward information and communication technology hardware usage in university libraries in South-South and South-West, Nigeria. The population of the study consists of 512 librarians in these University libraries at the time of this study. The census sampling techniques was used to study the entire population of the study, and a questionnaire was used, to elicit information from the librarians on their ICT hardware attitude and usage. The data were collected and statistical mean, standard deviation, and Pearson Product Moment Correlation Coefficient (PPMCC). The study revealed that librarians have positive attitudes towards the usage of ICT hardware in University libraries in South-South and South-West, Nigeria.

In the same vein, Akparobore et al. (2020) carried out a study to examine librarians' awareness, positive attitude and ICT skills as panacea for effective services delivery in the Fourth Industrial Revolution (4th IR) era in academic libraries in Southern Nigeria. The total population for this study was eight hundred and forty-one (841) librarians from 84 university libraries in Southern Nigeria. The entire population was sample using total enumeration sampling technique because of the manageable size of the population. Questionnaire was used to collect data from the respondents. The data collected for this study was analyzed using simple percentage/frequency counts and weighed mean. Also, it was shown that if librarians exhibit a positive attitude towards embracing the 4th IR era technological advancement, they will be able to: Adapt to changing technologies associated with the 4th IR and accept the shift from conventional service delivery to WWW-based service delivery among others.

In a more recent study by Isebe (2024) which was conducted on librarians' perception, competencies and use of fourth industrial revolution technologies for service delivery in university libraries in South-South, Nigeria. A survey research design was used in the study with a population of eight hundred and forty-two (842) librarians from the 84 university libraries situated in South-South, Nigeria. Total enumeration sampling technique was used to avoid errors. The questionnaire was the instrument used to gather data from the respondents. The data retrieved were analyzed using descriptive statistics methods (frequency count and percentages). The finding revealed that the librarians had a positive perception of 4IR technologies for service delivery in their university libraries. From the literature reviewed, studies across various regions in Nigeria indicate that librarians generally have a favourable perception of technologies such as cloud computing, ICT hardware, and 5IR tools, though concerns about skill gaps remain. Understanding and fostering these positive attitudes is essential for driving innovation and improving library services in a rapidly evolving educational environment.

There is no denying that digital technology has completely changed how academic libraries provide services. Academic libraries in developing countries are seeking to adjust their services to the new realities of offering library services because of these technological advancements. As a result of the development of digital technology, librarians are under a lot of pressure to provide for the needs of tech-savvy users. Academic librarians need to have a specific level of digital proficiency to be able to perform their jobs effectively in the modern era and meet the demands of users. Librarians must be digitally competent to face the challenges of digital librarianship and keep up with the rate of change in academic libraries in this digital world (Khan & Bhatti, 2017). Digital competence is the ability to engage with and use digital technology confidently, critically, and responsibly for learning, at work, and for participation in society (European Union, 2018). In

this sense, "digital competencies" refer to the abilities required of librarians to function well in computerized library settings. These abilities include the capacity to utilize computers and other technological tools to find, assess, utilize, store, produce, and exchange information, as well as to communicate and take part in collaborative networks over the Internet.

Librarians can work efficiently in a digital library setting. For instance, librarians' abilities to assist library patrons in finding, organizing, understanding, and creating information utilizing digital technologies (Atchrimi & Ogunbodede, 2024). Adepoju (2020) stated that communication skills, information retrieval abilities, design skills, database administration skills, and multitasking skills are among the competencies required by librarians to facilitate students' online education. According to Okiji (2019) as cited by Atchrimi and Ogunbodede (2024), knowledge of how to create and manage digital resources, as well as how to use digital library software and scan documents are some of the digital competencies for librarians. Additional skills include resource sharing and helping users find the information they need. Academic librarians must also have these skills to handle library technology facilities and online resources and to make wise judgments about the library's adoption of new technologies (Izuagbe et al., 2019).

While commenting on the digital competencies of librarians in university libraries to utilize modern technologies such as 5IR technologies, Hamad et al. (2023) conducted a study to examine the level of digital competencies for the provision of smart information service at academic libraries in Jordan. Survey research design was adopted for the study. A questionnaire was disseminated to 340 respondents, and 246 questionnaires were returned and were suitable for analysis with a response rate of 72.4%. The results indicated a moderate level of smart information service offered by academic libraries, as well as a moderate level of digital skills associated with the advocacy of smart information services. Atchrimi and Ogunbodede (2024) conducted a study on digital competencies of librarians in university libraries in Nigeria. The descriptive survey design was adopted. The sample of the study comprised 200 librarians. An online survey was used to collect data, and 109 responded to the online survey. Data were analysed using SPSS version 23. The study found that librarians in south-south Nigeria have a high level of basic digital competence skills. However, they need to improve their critical thinking skills and their proficiency in advanced digital competence skills to meet the demands of the digital age.

Furthermore, Mubofu (2025) carried out a study to evaluate digital competencies for enhancing library services in Tanzanian academic libraries. A convenience sample of 71 Tanzania Library and Information Association members participated in the study. Data were collected through an online Google Forms survey and analyzed using SPSS version 20. The results revealed that while participants demonstrated proficiency in digital tools and AI, substantial barriers hindered their ability to leverage these skills in practice fully. Osinulu (2022) carried out a study to evaluate staff digital literacy skills in academic library in South-West, Nigeria. The design of the study was a descriptive survey. Data were collected using a Likert Scale questionnaire distributed among target population consisting of paraprofessionals and analyzed using descriptive statistics. Result revealed proficiency in digital technology and the use of digital devices by the majority of the respondents for personal and official activities. However, the respondents were not too familiar with the use of technological tools and devices relevant to their work.

There is no gain-saying that the procurement of educational facilities depend on the available funds. Since libraries are an educational aspect of every institution, funding the adoption and use of ICT facilities are therefore fundamental in achieving sustainable library development. Libraries have to be continually funded to acquire the information resources in both print and electronic forms needed for scholarship and research (Adekoya, 2020). Academic libraries in Nigeria are usually saddled with a gamut of activities that require adequate funding and deployment of technology to satisfactorily support the teaching, learning and research mandate of their parent bodies. Libraries as the hub of academic institutions need to be well funded. Libraries invest a substantial amount of their budget in acquiring library infrastructural facilities. It is difficult to achieve overall sustainability without financial sustenance. However, the rising costs of library resources and diminishing budget affect the quantity and quality of materials libraries can procure; especially now that there is depletion in government revenue (Rifaudeen, 2015).

Some studies have been conducted to examine the extent of funding for the acquisition and installation of modern technologies in university libraries. Adekoya (2020) conducted a study on funding and ICT use as determinants of sustainable library development. Descriptive survey research design was adopted for the study with a population of 222 respondents (professional librarians). Purposive and total enumeration sampling techniques were used for the study. The questionnaire was used for data collection. Descriptive statistical tools were used for data analysis. The study found that the frequency of securing funds for major library projects to ensure sustainable library development is low.

Also, Shahzad and Iqbal (2020) conducted a study on barriers faced by library professionals for technology adoption in university libraries of Lahore, Pakistan. The research was organized in different parts.

Firstly, relevant literature was observed by the researchers to get a clear insight. Then, data-collection instrument was shaped. The population of the study was all the full-time regular working professional library staff of the universities of Lahore. The response rate was 76%. In the third phase, collected data were tabulated and analyzed through SPSS Version 24.0 to reach conclusions. The study found that the libraries of Pakistan are not rich concerning IT-based resources. The problems mentioned by the respondents indicate the need for formal training to use IT and the availability of sufficient funds.

Similarly, Wada et al. (2022) carried out a study on challenges associated with the adoption and use of digital information resources in federal university libraries in Nigeria. The population of the study consisted 1,695 postgraduate engineering students from 12 selected Federal universities in Nigeria. A multistage sampling technique was adopted to sample 306 postgraduate engineering students. A structured questionnaire was used to collect data. The data was subjected to descriptive statistical analysis. The study found that the challenges faced by postgraduate engineering students in adopting and using digital information resources were inadequate or non-working computer systems, and lack or poor internet services among others. The study recommends that government prioritize the provision of funds and supervision of its policies and plans to ensure that academic libraries function well.

It is glaring that libraries lack the financial support to adopt and utilize modern technologies such as the 5IR. Without sufficient funding, libraries face significant setbacks in acquiring, implementing, and maintaining ICT infrastructure and digital resources. The rising cost of technological tools, coupled with limited budgets, often hampers efforts to modernize library services. Therefore, for libraries to meet the evolving needs of users and remain relevant in a rapidly advancing educational landscape, strategic financial planning, increased government support, and efficient resource allocation are essential.

It is very vital for every library that is preparing to adopt and utilize modern technologies such as the 5IR to have a policy documents that will guide the adoption, implementation and use of such facility. According to Nigerian National Policy for Information Technology (IT) document, the vision statement was clearly stated as "To make Nigerian IT capable country in Africa and a key player in the Information Society by the year 2005, using IT as the engine for sustainable development and global competitiveness" (Federal Republic of Nigeria, 2001). Also, in the mission statement of the same policy document, education is the first domain/area where IT is proposed to be used (Federal Republic of Nigeria, 2001). Thus, examining the policy implementation as adoption factor of any IT will be of immense benefit as Baro (2011) revealed that the policy document needs a review to meet the expected dynamism of the IT profession.Hence availability of policy document is vital to guiding the adoption and use of modern technologies in academic libraries.

Commenting on the availability of policy document for the adoption and implementation if modern technology facilities in academic libraries, Jimoh and Fasasi (2019) conducted a study on institutional policy implementation and adoption of learning management systems in Nigerian universities. The study adopted a qualitative approach by granting interviews with Information and Communication Technology (ICT) Directors of the six selected universities in the South-west geopolitical zone. Thematic analysis was used to analyse the qualitative data collected. The findings showed that Institutional Policy Implementation concerning LMS adoption is still in its infancy.

It is worthy of note that adoption and implementation of modern technology such as the 5IR comes with unique challenges. The primary obstacle to libraries' and librarians' adoption of 4IR technologies, according to Hussain (2019), is a lack of proficiency in navigating and using these tools. The full implementation of 4IR in university libraries is hindered by a number of factors, including lack of funding, inadequate infrastructure, low competencies and skills, intrusion and security concerns, and insufficient exposure to international standards, according to a study by Nkiko and Okuonghae (2021). Jalamneh and Khder (2021) list a number of obstacles to deploying cloud computing in Arab library settings, including a lack of technological expertise and training, as well as technical difficulties like storage space, a large amount of data, privacy concerns, and information security issues, as well as the unavailability of applications and programs. Furthermore, Finance is a great challenge to technology adoption in libraries. Without adequate finance, libraries can't afford the purchase of innovative technologies which automatically makes the implementation of these technologies challenging (Shahzad & Igbal, 2020). Another pivotal challenge centers on the ethical dimensions of utilizing AI and machine learning in intelligent libraries; as these libraries harness AI-driven algorithms to curate content, offer resource recommendations, and tailor user experiences, concerns emerge regarding data privacy and potential biases embedded within AI systems (Budhwar et al. 2023).

Additionally, Olatunji et al. (2020) outlined a few of the obstacles to the adoption of open-source integrated library management software in academic libraries, such as a lack of funding, a lack of technical librarian expertise, an unstable power supply, and inadequate ICT infrastructure. Acheampong and Dei (2020) investigated the difficulties associated with service delivery with mobile technology tools in yet another study. According to the findings, the factors preventing the full adoption of mobile technology in libraries are poor

ICT facilities, bureaucratic obstacles, poor internet access, undertrained ICT staff, a lack of a policy framework, a poor power supply, a lack of management support, and financial difficulties.

Methodology

The study deployed a survey research design as it is a quantitative research. The population of the study is one hundred and eighteen (118) librarians working in the State, Federal, and Private university libraries across Delta State, Nigeria. During the study period, there were three federal, four state and four private universities across Delta State, Nigeria. The total enumeration sampling technique was adopted to select the entire population as sample for the study for accuracy and to eliminate sampling errors. To elicit data from the respondents a structured questionnaire was distributed to the respondents physically in their offices with the aid of 3 research assistants who were adequately briefed by the researchers. 118 copies of the questionnaire were administered and 112 copies were duly filled, retrieved and found usable. Hence there was 95% response rate. The data collected from the study were analyzed using descriptive statistics.

Findings and Discussion

Research Question 1: What is the attitudes of librarians toward the adoption of 5IR technologies in their library operations and services in university libraries in Delta State?

Data in Table 1 provide answer to the question

Table 1: Attitudes of Librarians Toward the Adoption of 5IR Technologies

Statements	Federal University Libraries					State University Libraries					Private University Libraries					Cumulative Mean
	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	
I am positively disposed to using 5IR technologies for service delivery	24	14	5	2	**3.33**	21	12	4	2	**3.33**	15	9	3	1	**3.36**	**3.34**
I am enthusiastic	23	15	4	2	**3.34**	20	13	4	2	**3.31**	15	10	2	2	**3.31**	**3.32**
	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	
about adopting 5IR technologies to improve library operations.																
I believe that the integration of 5IR technologies will enhance user satisfaction in the library.	25	14	4	2	**3.38**	22	12	4	2	**3.35**	15	8	3	1	**3.37**	**3.36**
I am confident in my ability to adapt to 5IR technologies in library service delivery.	22	16	5	2	**3. 29**	19	14	4	2	**3. 28**	14	10	3	1	**3. 32**	**3. 29**
I am willing to undergo training to effectively use 5IR technologies in the library.	28	12	4	1	**3. 49**	24	10	3	1	**3. 50**	18	8	2	1	**3. 48**	**3. 48**

I support the use of intelligent systems (e.g., AI, robotics) to automate routine library tasks.	24	15	4	2	**3. 36**	21	13	4	2	**3. 33**	14	9	2	2	**3. 30**	**3. 31**
I believe 5IR technologies can foster better collaboration between librarians and users.	25	14	4	2	**3. 38**	22	12	4	1	**3. 41**	16	9	2	1	**3. 43**	**3. 40**
I am open to the idea of personalized library services enabled by 5IR technologies.	24	14	4	2	**3. 36**	21	13	4	2	**3. 33**	16	9	2	1	**3. 43**	**3. 38**
	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	
I believe 5IR technologies align with the future goals and vision of university libraries.	26	13	4	2	**3. 40**	23	12	4	1	**3. 42**	16	8	2	1	**3. 44**	**3. 41**
I am ready to champion the adoption of 5IR technologies within my library.	24	14	5	2	**3. 33**	21	13	4	1	**3. 38**	15	9	3	1	**3. 36**	**3. 36**
										Criterion Mean						**2.50**
										Overall Mean						**3.37**

Key: SA= Strongly Agree, A=Agree, D=Disagree, SD=Srongly Disagree.

Table 1 above shows a **mean of 3.37which is higher than the criterion mean of 2.50**, this shows that **librarians in Delta State university libraries have a positive attitude** toward the adoption of 5IR technologies in their operations and service delivery. It can be seen clearly from table 1 that librarians across Nigerian universities exhibit a strong positive disposition toward adopting 5IR technologies, with the highest support shown for undergoing training (mean = 3.48), indicating a clear recognition of the need for capacity building. While confidence in adapting to these technologies is slightly lower (mean = 3.29), especially among state university librarians, there remains a firm belief in the benefits of 5IR for user satisfaction, collaboration, and institutional vision. Support for intelligent systems is consistent, though slightly lower among private universities, which interestingly show the highest openness to personalized services. Overall, despite minor variations, librarians demonstrate readiness and enthusiasm to embrace 5IR technologies, with training and professional development emerging as key enablers for successful implementation.

Research Question 2: What is the level of digital competences of librarians towards the adoption Fifth Industrial Revolution (5IR) technologies in university libraries in Delta State?

Data in Table 2 provide answer to the question.

Table 2: Level of Digital Competences of Librarians Towards the Adoption 5IR Technologies.

Statement	VHL	HL	LL	VLL	Mean
I am proficient with the use of generative AI for service delivery.	25	40	30	17	**2.73**
I can effectively use smart systems and IoT tools in library operations.	28	38	30	16	**2.76**
I am skilled in using robotic process automation for routine library tasks.	24	36	33	19	**2.68**
I am confident in managing digital platforms integrated with 5IR technologies	27	35	31	19	**2.71**
I am capable of analyzing user data to provide personalized library services.	26	38	30	18	**2.73**
I can effectively utilize virtual and augmented reality tools in user engagement.	22	37	34	19	**2.66**
I am competent in the use of machine learning tools for resource recommendation.	23	36	35	18	**2.67**
I can troubleshoot and maintain 5IR-based library systems and applications.	21	34	36	21	**2.61**
I am able to integrate multiple 5IR tools to enhance library service delivery.	26	39	31	16	**2.75**
I have adequate knowledge of cyber-security measures when using 5IR technologies.	29	37	30	16	**2.78**
Criterion Mean				**2.50**	
Overall Mean				**2.71**	

Key: VHL= Very High Extent, HL= High Extent, LL= Low Extent, VLL= Very Low Extent.

Table 2 shows an overall mean of 2.71 which is slightly higher than the criterion mean of 2.50. It can be concluded that the level of digital competency of librarians for 5IR adoption is moderate.

Research Question 3: What is the extent of funding for technological infrastructure for 5IR technology adoption in university libraries in Delta State?

Data in Table 3 provides answers to the question.

Table 3: Extent of Funding for 5IR Technology Adoption in University Libraries

Statement	VHE	HE	LE	VLE	Mean
The university allocates budget specifically for the integration of 5IR technologies	10	15	45	42	2.18
There is regular funding support for the maintenance of 5IR-based systems in the library.	8	18	50	36	2.24
External grants are accessed to support the adoption of intelligent systems in library services.	7	12	48	45	2.07

Funding is available for staff training on 5IR technologies.	11	19	46	36	2.27
The government provides funding for the purchase of robots.	6	10	52	44	2.00
The library receives funding to implement personalized and AI-driven user services.	9	14	49	40	2.16
Private sector partnerships contribute financially to 5IR technology initiatives in the library.	8	13	51	40	2.10
There is sufficient budgetary provision for acquiring smart devices and IoT tools.	12	16	48	36	2.30
The library receives funding for cybersecurity infrastructure related to 5IR tools.	9	18	47	38	2.25
Funding received for 5IR adoption aligns with the library's long-term strategic goals.	10	17	46	39	2.23
Criterion Mean				**2.50**	
Overall Mean				**2.16**	

Key: VHL= Very High Extent, HL= High Extent, LL= Low Extent, VLL= Very Low Extent

Table 3 revealed a an overall mean of 2.16 which is lower than the criterion mean of 2.50, it can be concluded that the level of funding for 5IR adoption in university libraries in Delta State is low.

Research Question 4: Are there institutional policies on the adoption and use of 5IR technologies in university libraries in Delta State?

Data in Table 4 provide answer to the question

Table 4: Availability of Institutional Policies on Adoption and Use of 5IR Technologies in University Libraries.

Statements	Federal University Libraries					State University Libraries					Private University Libraries					Cumulative Mean
	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	SA	A	D	SD	**Mean**	
There is available policy on the acquisition of 5IR technologies in university libraries in Delta State.	3	5	15	14	2.14	2	4	18	13	2.08	3	6	18	10	2.16	**2.13**
Institutional policies exist for the integration of 5IR technologies into library services.	2	4	18	13	2.06	1	3	20	13	2.00	2	5	18	12	2.08	**2.06**

Statements	Federal University Libraries					State University Libraries					Private University Libraries					Cumulative Mean
	SA	A	D	SD	Mean	SA	A	D	SD	Mean	SA	A	D	SD	Mean	
University libraries in Delta State have policies that govern the use of AI-driven systems.	2	3	18	14	2.02	1	3	18	15	1.97	3	4	18	12	2.03	**2.01**
There is a policy framework in place for the maintenance of 5IR-based systems in university libraries.	2	5	17	13	2.09	1	4	18	14	2.03	2	5	17	13	2.06	**2.06**
Institutional policies provide clear guidelines for staff training on the use of 5IR technologies.	1	4	18	14	2.02	1	4	18	14	2.02	2	4	20	11	2.05	**2.03**
University libraries in Delta State have policies to guide the adoption of robotics in library operations.	1	3	20	13	1.97	2	3	20	12	2.03	2	4	18	13	2.00	**2.00**
There are institutional policies to ensure the acquisition and use of smart devices and IoT tools in university libraries.	3	5	15	14	2.14	2	4	18	13	2.08	3	6	18	10	2.16	**2.13**
Policies are in place to address cybersecurity concerns related to 5IR technologies in university libraries.	2	4	18	13	2.06	1	4	18	14	2.02	2	4	20	11	2.08	**2.06**

Statements	Federal University Libraries					State University Libraries					Private University Libraries					Cumulative Mean
	SA	A	D	SD	Mean	SA	A	D	SD	Mean	SA	A	D	SD	Mean	
There are established guidelines for private sector partnerships in the adoption of 5IR technologies in university libraries.	2	3	18	14	2.02	1	3	18	15	1.97	3	4	18	12	2.03	**2.01**
Institutional policies ensure that 5IR technologies align with the long-term strategic goals of university libraries in Delta State.	2	5	17	13	2.09	1	4	18	14	2.03	2	5	17	13	2.06	**2.06**
										Criterion Mean						**2.50**
										Overall Mean						**2.05**

Table 4 revealed an overall mean of 2.05 which is below the criterion mean of 2.50. The table reveals a generally low level of policy implementation regarding Fifth Industrial Revolution (5IR) technologies across university libraries in Delta State, Nigeria. While Federal University Libraries show slightly higher mean scores across most policy areas, the overall responses across all three categories i.e., Federal, State, and Private indicate that institutional policies for acquiring, integrating, and maintaining 5IR technologies such as AI, robotics, IoT, and cybersecurity measures remain underdeveloped. Most mean scores hover just above 2.00, suggesting a prevailing trend of disagreement or uncertainty about the existence of such policies. Notably, areas like the adoption of robotics and private sector partnerships recorded some of the lowest mean scores, pointing to significant policy gaps. It can be concluded that there is lack/poor institutional policy on the adoption and use of 5IR technologies in university libraries in Delta State.

Research Question 5: What are the challenges militating against the adoption and implementation of 5IR technologies in university libraries in Delta State?
Data in Table 5 provide answer to the question

Table 5: Challenges Militating against the Adoption and Implementation of 5IR Technologies in university libraries

Statements	Federal University Libraries				Decision	State University Libraries				Decision	Private University Libraries				De
	A	%	D	%		A	%	D	%		A	%	D	%	
Lack of funding hinders the acquisition of 5IR technologies in university libraries in Delta State.	30	67 %	15	33%	Agree	26	67%	13	33%	Agree	19	68 %	9	32%	Ag
Inadequate infrastructure limits the effective implementation of 5IR technologies in university libraries.	34	76 %	11	24%	Agree	30	77%	9	23%	Agree	21	75 %	7	25%	Ag
Lack of skilled personnel prevents the proper adoption of 5IR technologies in university libraries.	26	58 %	19	42%	Agree	23	59%	16	41%	Agree	16	57 %	12	43%	Ag
Resistance to change among library staff impedes the integration of 5IR technologies in university libraries.	32	71 %	13	29%	Agree	28	72%	11	28%	Agree	20	71 %	8	29%	Ag
Insufficient policy support restricts the adoption and use of 5IR technologies in university libraries.	28	62 %	17	38%	Agree	24	62%	15	38%	Agree	18	64 %	10	36%	Ag
Limited access to external grants and funding for 5IR technologies hinders their implementation in university libraries.	30	68 %	14	32%	Agree	27	68%	13	32%	Agree	19	68 %	9	32%	Ag
The high cost of 5IR technologies poses a barrier to their acquisition and use in university libraries.	24	53 %	21	47%	Agree	21	54%	18	46%	Agree	15	54 %	13	46%	Ag
Limited awareness of the benefits of 5IR technologies among university library administrators affects their adoption.	27	60 %	18	40%	Agree	24	62%	15	38%	Agree	17	61 %	11	39%	Ag
Technological compatibility issues with existing systems delay the integration of 5IR technologies in university libraries.	29	64 %	16	36%	Agree	25	64%	14	36%	Agree	18	64 %	10	36%	Ag
Lack of a clear strategic plan for the adoption of 5IR technologies	31	69 %	14	31%	Agree	27	69%	12	31%	Agree	20	71 %	8	29%	Ag

Statements	Federal University Libraries				Decision	State University Libraries				Decision	Private University Libraries				De
	A	%	D	%		A	%	D	%		A	%	D	%	
in university libraries results in fragmented implementation.															

Table 5 revealed a consistent agreement across federal, state, and private university libraries in Delta State that various challenges hinder the adoption of Fifth Industrial Revolution (5IR) technologies. A significant majority of respondents from all three university types acknowledged issues such as lack of funding, inadequate infrastructure, limited skilled personnel, and resistance to change. Notably, inadequate infrastructure and resistance to change recorded the highest agreement percentages, with over 70% across all categories. Even for factors with comparatively lower agreement levels, such as the high cost of 5IR technologies and the lack of skilled personnel, more than half of the respondents in each university type still affirmed their impact. This widespread consensus underscores a shared recognition of systemic barriers across the different institutions, emphasizing the urgent need for holistic and collaborative interventions to foster the successful integration of 5IR technologies in university libraries throughout Delta State.

Discussion of Findings

This study found that that librarians in Delta State university libraries have a positive attitude toward the adoption of 5IR technologies in their operations and service delivery. This findings agrees with the one by Idahosa and Eireyi-Edewede (2023) who found that librarians have a positive attitude towards the deployment of cloud computing technologies in university libraries. To further corroborate the finding, Ekwueme et al. (2024) found that librarians generally view 5IR technologies positively, believing they can enhance diversity and inclusiveness in library services, particularly by providing individualized learning materials.

The study further revealed that the level of digital competency of librarians for 5IR adoption is moderate. The findings negate those of Atchrimi and Ogunbodede (2024), who found that librarians in South-South Nigeria have a high level of basic digital competence skills. However, the findings slightly conform with the one by Mubofu (2025), who found that while participants demonstrated proficiency in digital tools and AI, substantial barriers hindered their ability to leverage these skills in practice fully. The study also found that the level of funding for 5IR adoption in university libraries in Delta State is low. This finding concurs with the one by Adekoya (2020), who found that the frequency of securing funds for major library projects to ensure sustainable library development is low. To further corroborate this finding, Shahzad and Iqbal (2020) found that the libraries of Pakistan are not rich in IT-based resources.

Also, this study uncovered that there is lack/poor institutional policy on the adoption and use of 5IR technologies in university libraries in Delta State. This finding agrees with the one by Jimoh and Fasasi (2019) who found that Institutional Policy Implementation concerning LMS adoption is still in its infancy in Nigerian universities. Finally, this study found that the most pressing challenges militating against the adoption and implementation of 5IR in university libraries revolve around financial, infrastructural, and organizational readiness, with a significant portion of respondents highlighting the need for better funding, skilled personnel, and policy frameworks to successfully implement 5IR technologies in university libraries. This finding agrees with the one by Nkiko and Okuonghae (2021) who found that the full implementation of 4IR in university libraries is hindered by a number of factors, including lack of funding, inadequate infrastructure, low competencies and skills, intrusion and security concerns, and insufficient exposure to international standards. Acheampong and Dei (2020) who found that the factors preventing the full adoption of mobile technology in libraries are poor ICT facilities, bureaucratic obstacles, poor internet access, undertrained ICT staff, a lack of a policy framework, a poor power supply, a lack of management support, and financial difficulties further corroborated the findings.

Conclusion

It is glaring from this study that librarians in university libraries in Delta State generally have a positive attitude towards the adoption of 5IR technologies as they indicate strong support for the integration of these technologies in library operations and services. However, while there is enthusiasm for adoption, the level of digital competence of librarians for the adoption of 5IR technologies is moderate suggesting that librarians may require additional training and support to fully harness the potential of these technologies. It is also clear from this study that significant challenges impede the adoption of 5IR technologies, particularly in the areas of funding, infrastructure, and policy support. Without addressing these barriers, the full potential of 5IR technologies may remain unfulfilled in these institutions.

Recommendations

Based on the findings, the researchers recommend that:

1. The federal and state government should prioritize budget allocation for 5IR technologies and explore external grants, partnerships, and government support for necessary resources in university libraries in Delta State.

2. The university management should invest in upgrading the university library's technological infrastructure and acquiring essential hardware to ensure compatibility with advanced 5IR tools like AI and robotics.

3. University library management should create and implement clear institutional policies on acquiring, integrating, and maintaining 5IR technologies, ensuring alignment with library goals and staff training.

4. Library management should implement ongoing professional development programs to enhance librarians' digital competencies, ensuring they can effectively utilize 5IR technologies in service delivery.

5. The library management should foster a culture that supports technological innovation, engages staff in decision-making, and provides support and incentives for adopting new 5IR technologies.

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Availability and Utilization of Information Retrieval Tools for Reference Services Delivery in Academic Libraries in Benue State

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Abstract
The paper investigated the level of utilization of Information Retrieval tools for reference service delivery in Academic Libraries in Benue State. It explored the need for information retrieval tools to deliver reference services in academic libraries. A descriptive survey design was adopted for the study. Seven academic libraries, meaning seven reference librarians (7), formed the population, and the instrument used for data collection was a questionnaire. 100% return was ensured by the researcher because of the sparse population. The study found that there is a moderate level of availability and use of IRTs in Benue State Academic libraries. A low proportion of these IRTs, 45.5%, representing 5 out of 11, are used frequently by the librarians, even though they are central to reference service delivery. The research recommended that University libraries should, from time to time, train their staff on necessary and emerging IRTs to acquaint them with their use. This is necessary to expand and enhance the use of such tools for reference service delivery in the era of the 5th Industrial Revolution.

Keywords: *Availability, Use, Information Retrieval Tools, Librarians, Reference Service.*

Background to the Study

Reference service at the library is one of the most vital and visible expressions of the library's
Purpose and mission, for it is fundamental to the library's service role as a Centre for information dissemination for research and independent learning. Library reference service in the 5th industrial revolution encompasses the adoption of various information technologies, computer systems, and networks. Meaning that, reference librarian and the information seeker must be skilled in Information and Communications Technologies (ICTs) applications and use to make smarter and faster use of the information resources for reference services.

In other words, the information needs of library users in the 5th industrial revolution cannot be met without human mediation over the internet. This gives rise to the investigation of the availability and use of information retrieval tools for reference service delivery in universities in North-central Nigeria. The delivery of reference services in an academic library is premised on available resources, tools to retrieve the information, and the technology savvy of the personnel involved. The Reference and User Services Association (2021); Hussain (2024) opined that every product and service is the result of the interaction of materials with tools or technology and human resources (Rana, Saikat, Shikder, & Ahmad, 2023). Information retrieval tools availability and use are of great importance in the process of reference service delivery.

Irrespective of the skill or competence of librarians, coupled with the information resources that are available in the library (Stephanie, Mende, Dhruv, and Parasuraman,2022). The Fifth Industrial Revolution, April 2022), Ali, Al-Sultan, and Al Rubaie (2022). Okwu and Obi (2022) asserted that there is a need for the availability of information retrieval tools and, use of these tools by librarians to deliver reference services. The available tools have to be used to retrieve or access the required information or information material within areas within a time frame that will be useful to the users. The use of these various information retrieval tools will positively affect/enable the reference service delivery, which must be time and resource-conservative.

Statement of the Problem

Technological growth and expansion, increased research and innovation, and increased user information needs have affected library services in recent times. Traditional library reference services are being transformed through the application of the internet and electronic devices to meet users' needs and speed up access to information**.** This is to say that, technological development and innovations has brought about a change in users' information aspiration and so the primary responsibilities of libraries also have to change from mere collection and organization of information resources mostly in books and journals formats to include pragmatic technological skills acquisition and the use of diverse information retrieval tools for dissemination of information. More so, the global trends in library and information services have affected the archival and passive nature of the library to a dynamic service institution in the 21st century. (Madu, Usmans, and Abba, 2020). While IRTs are considered essential for discovering, pinpointing, selecting, and obtaining information resources, the extent of their availability and subsequent utilization by librarians in academic libraries in Benue State remains uncertain. This lack of clarity represents the core problem, as inadequate availability or utilization of these crucial tools could impede the efficient and effective delivery of reference services, thereby failing to fully support the research and learning activities of library clientele in the current technological environment.

The study, therefore, seeks to investigate the gaps between the need for available and utilized IRTs in the modern library and their actual standing in academic libraries in Benue State.

Objectives of the Study

The main objective of this study is to investigate the Availability and Use of Information Retrieval Tools for Reference Service Delivery in North-central Nigeria Universities. The specific objectives of the study are to:

i. Identify the availability of information retrieval tools for reference service delivery in academic libraries of Benue State.

ii. Investigate the commonly used information retrieval tools for reference services delivery in academic libraries in Benue State;

Research Questions

.i. What are the information retrieval tools that are available in academic libraries in Benue State?

ii. What are the commonly used information retrieval tools for reference service delivery in academic libraries in Benue State?

Research Hypothesis: The formulated null hypothesis for the study was tested at a 0.05 alpha level of significance as follows:

HO1: Use of Information Retrieval Tools does not significantly predict the quality of reference services by librarians in academic libraries in Benue State.

Literature Review

A review of related literature was done under the following subheadings: Conceptualizing Information Retrieval and Retrieval Tools, Availability of Information Retrieval Tools in Academic Libraries, Utilization of Information Retrieval Tools for Reference Services, Reference Service Delivery in the 5th Industrial Revolution, Interrelationship Between Availability, Utilization, and Service Quality.

1. Conceptualizing Information Retrieval and Retrieval Tools

Information retrieval (IR) has been fundamentally defined as the process of identifying and accessing relevant information from large repositories of structured or unstructured data (Fwenshimwa, 2024; Olubiyo, 2022). The growth in information resources, especially in academic settings, necessitates effective tools for information identification, location, and access. Adetarami and Bande (2023) emphasize that IR is vital in supporting users' needs, particularly when navigating voluminous and complex academic repositories.

Information retrieval tools (IRTs), therefore, serve as technological and procedural mechanisms that assist users and librarians alike in the discovery of relevant information. According to Heidi (2018), IRTs are essential components of modern information retrieval systems, ranging from traditional card catalogues and bibliographies to modern search engines and online databases. Ziatinov et al. (2024) and Iglobal (2023) highlight that these tools are indispensable in facilitating precision, speed, and relevance in the search for academic resources.

2. Availability of Information Retrieval Tools in Academic Libraries

Availability is a critical prerequisite for effective use. In academic libraries, the presence of both traditional and digital IRTs is a determinant of the quality of reference services provided. Tools such as OPAC, search engines,

subject directories, bibliographies, indexes, and abstracts form the core infrastructure for resource discovery (Olalekan et al., 2021; Hussain, 2024). However, the study found that only 45.5% of the surveyed tools were significantly available in the academic libraries of Benue State. This aligns with Madu, Usmans, and Abba (2020), who reported infrastructural and technological deficits in many Nigerian libraries.

Ali, Al-Sultan, and Al-Rubaie (2022) argue that with the advent of the Fifth Industrial Revolution (5IR), libraries must transition from traditional static repositories to dynamic, technology-enabled knowledge systems. Consequently, the availability of IRTs must extend beyond presence to include adequacy, accessibility, and technological relevance.

3. Utilization of Information Retrieval Tools for Reference Services

Utilization is contingent not only on the presence of tools but also on users' skills, institutional culture, and perceived usefulness. The study reported that while tools such as internet search engines and online databases were used frequently, traditional tools like printed abstracts and card catalogues were less utilized. This shift is consistent with global trends emphasizing digital fluency and ICT adoption (Adetarami & Ugwoke, 2022; Singh, 2019).

The frequency of use of IRTs has been linked to several factors, including training, awareness, infrastructure, and relevance of the tools to current academic needs (Fwenshimwa, 2024; Gajbhiye, 2020). Okwu and Obi (2022) stressed that without adequate training, even well-stocked libraries may experience underutilization of their IRTs.

4. Reference Service Delivery in the 5th Industrial Revolution

Reference service delivery is a cornerstone of academic library services, serving as a direct interface between users and the knowledge system (Rana et al., 2023). The 5IR, characterized by the synergy between human intelligence and smart technologies, places increased pressure on libraries to enhance their service delivery through automation, personalization, and real-time access. In this context, the deployment and integration of IRTs are indispensable. Online Public Access Catalogues (OPACs), databases, search engines, and Artificial Intelligence-enhanced platforms now enable librarians to respond to queries faster and more accurately. As Avila et al. (2022) note, reference services have evolved from a reactive model to a proactive and predictive model of engagement. Furthermore, libraries that fail to integrate modern IRTs risk becoming obsolete in the face of rapidly changing user expectations and technological innovation. This underscores the recommendation by scholars like Nwobu et al. (2024) and Ibinaye & Jiyane (2021) that reference librarians must be continuously trained in digital competencies.

5. Interrelationship Between Availability, Utilization, and Service Quality

The study's hypothesis states that there is no significant relationship between availability and frequency of use of IRTs, which was tested to explore whether mere availability guarantees usage. While the study indicated a moderate correlation, other literature suggests that strategic alignment of tools with training, policies, and user needs enhances both utilization and service quality (Olubiyo, 2022; Stephanie et al., 2022). Fwenshimwa (2024) also observed that the usability of IRTs is a more significant predictor of utilization than mere availability. That is to say, IRTs must be user-friendly, well-publicized, and integrated into the library's workflow to impact service delivery.

The literature reveals a complex interaction between the **availability and utilization** of information retrieval tools and the **quality of reference service delivery** in academic libraries. The rise of digital technologies and the 5th Industrial Revolution compels academic libraries and librarians, especially in developing contexts like Benue State, Nigeria, to rethink and redesign their service models around user-centered, technology-driven paradigms. Key to this transformation are accessible, usable, and contextually relevant IRTs, supported by skilled personnel and responsive library management.

Research question one: **What are the various information retrieval tools available in the Academic Libraries in Benue state?**

Data to answer this question were derived from section C of the research questionnaire and presented in the Table below.

Table 1.1: Identification of Various Information Retrieval Tools in Academic Libraries in Benue State?

S/N	IRTs N (%) N (%) N (%)	Available	Not available	Not sure	Mean	Decision
1	Online Public Access Catalogue (OPAC)	189(80.0)	38(16.2)	7(3.0)	1.65	Accept
2	Internet Search Engines	228(97.0)	1(0.4)	6(2.6)	1.97	Accept
3	Subject Gateways	141(60.5)	57(24.5)	35(15.0)	1.36	Reject
4	Subject Directories	126(53.8)	71(30.3)	37(15.8)	1.24	Reject
5	Bibliographies	170(77.3)	38(17.3)	12(5.5)	1.60	Accept
6	Databases accessible	208(86.7)	19(8.1)	7(3.0)	1.81	Accept
7	Use Online Abstracts	140(60.1)	58(24.9)	35(15.0)	1.35	Reject
8	Printed Abstracts	106(46.1)	81(35.2)	43(18.7)	1.11	Reject
9	Online Indexes	88(38.4)	80(34.9)	61(26.6)	1.03	Reject
10	Printed Indexes	81(34.8)	98(42.1)	54(23.2)	0.93	Reject
11	Catalogue (Card/Book/Boxes)	188(80.3)	38(16.2)	8(3.4)	1.64	Accept
	Grand%/ mean	**65.2**	**22.8**	**12.0**	**1.43**	**Reject**

The result from the table above shows the identification of various information retrieval tools available in academic libraries under review, using the cut-off mean score of 1.50; the libraries with a mean score of 1.50 and above were accepted as having a significant number of information retrieval tools identified. Those with mean scores below the 1.50 cut-off point were rejected, meaning they lack a significant number of the identified information retrieval tools.

What are the frequently used information retrieval tools by academic librarians in Benue State?

Table 2. Frequently Used Information Retrieval Tools by Librarians for Reference Services Provision

S/N	Information Retrieval Tool	Frequency of Use				Mean	Decision
		VR(%)	RR(%)	O (%)	NT (%)		
1	Internet/Search Engines	200(86.2)	19(8.2)	13(5.6)	0(0)	2.81	Accept
2	Subject gateways	96(41.4)	87(37.5)	22(9.5)	27(11.6)	2.09	Accept
3	Subject directories	67(29.0)	70(30.3)	59(25.5)	35(15.2)	1.73	Reject
4	Bibliographies	76(33.0)	62(27.0)	56(24.3)	36(15.7)	1.77	Reject
5	Online databases	119(52.7)	69(30.5)	25(11.1)	13(5.8)	2.30	Accept
6	Printed abstracts	90(40.0)	69(30.7)	30(13.3)	36(16.0)	1.95	Reject
7	Online abstracts	53(23.0)	75(32.6)	52(22.6)	50(21.7)	1.57	Reject
8	Printed indexes	62(26.7)	53(22.8)	63(27.2)	54(23.3)	1.53	Reject
9	Online indexes	92(40.4)	66(28.9)	32(14.0)	38(16.7)	1.93	Reject
	Grand mean(N/%)	**95(36.3)**	**63(27.6)**	**39(17.0)**	**32(14.0)**	**1.96**	**Reject**

Table 2 presents the results on frequently used information retrieval tools by librarians in academic libraries in providing reference services. The mean score benchmark of 2.0 is used for the decision to either accept or reject the result as significant or not. Means of 2.0 or above are accepted as significant, while scores below 2.0 are considered not significant. Frequency counts and corresponding percentages are also presented.

Discussion of Findings

It was found that a total of 11(eleven) IRTs were available in the academic libraries investigated. However, only 5 or 45.5% of the IRTs were significantly available. They include Online Public Access Catalogue (OPAC), internet search Engines, Bibliographies, accessible databases, and card catalogues. This finding shows that the libraries have a substantial number of IRTs at the disposal of librarians, which can be deployed for effective reference service delivery.

A critical look at the available IRTs, which were found at a significant level, shows that they are very central to reference service delivery by the librarians and library users. For instance, online public access catalogue (OPAC), Internet search engines, and databases are all online IRTs which can fast track service delivery quickly and efficiently by the reference librarians to meet library information seekers' queries (Madu, Usmans, and Abba, 2020; Nwobu, Dumbri, Lbia, and Oladokun, 2024). Moreover, libraries as well as library users tend to make use of these available IRTs in Nigerian university libraries for their enabling effects in information search (Ibinaye and Jiyane, 2021).

The fact that IRTs are significantly available in these academic libraries is cheering news because, with their availability, even those libraries and their users who lack the skills for use can be trained or motivated to train themselves on their use, or they can eventually benefit from their ready availability. For library staff, they can be used for hands-on training or organized in-house training. Furthermore, IRTs are the basic building blocks of the information retrieval system, which enables librarians and users to get the desired information. They enable users to find, identify, select, and obtain information resources. Hence, the finding on the level of IRTs availability portends good hope for reference librarians and library users of the university libraries for a qualitative and satisfying reference service delivery.

On research question two and the use of available IRTs, it was found that three IRTs were significantly utilized by librarians for the delivery of reference service. These were Internet search Engines, subject gateways, and online databases. These findings strongly suggest that librarians are tending towards the use of ICT in providing reference services rather than the traditional tools such as printed Bibliographies, abstracts, card or book catalogues. This finding is in tandem with those of other scholars. Ali, et'al (2022), Apriliyanti , (2022).

The commonality or frequency of use of these IRTs by librarians for reference service delivery is predicated on several reasons. One of which is that there are online or virtual information retrieval tools that tend to ease the task of librarians in retrieving information for library users. Their ability to sieve the relevant information from the 'sea 'of information sources makes them the first line of IRTs for quick and efficient reference service delivery to their clientele. Perhaps this explains why a very large proportion of librarians in some of these libraries use ICT-based IRTs for the delivery of services to researchers and in answering users 'queries (Adetarami and Bande, 2023).

The second reason is that with the advancement in technologies, most information resources are easily available online, and this requires the use of Internet search engines and other online IRTs to retrieve such information for library users. The significant use of these digital/online IRTs by librarians in academic libraries in Benue State means that they can provide timely and relevant information to their clientele based on their current information needs. Moreover, search engines in particular tend to enhance the quality of digital reference service provision. (Fwenshimwa, 2024).

Conclusion

The fact that reference service is one of the major components, indeed the backbone of library services, cannot be overemphasized and is therefore indisputable. This realization is brought to the fore in the course of the study, as each of the university libraries surveyed had at least one reference librarian in charge of the unit/section. The findings of the study have led to the following conclusions: There is only a moderate level of availability of IRTs in academic libraries in Benue State. Only a very low proportion of these IRTs are used in frequent measures by the librarians. The study added that reference librarians of these universities make use of the available IRTs very often, as often as the rate of use of students and users of the library.

Recommendations

Based on the findings of the study, it is recommended that;

I To encourage the use and availability of IRTs in Benue State, Nigeria, academic libraries should increase awareness of these resources among librarians by organising workshops and orientation, and user guides.

ii Academic library management in the state should affect the implementation of regular training sessions for staff through workshops and capacity-building conferences. This will enhance information literacy and retrieval skills among librarians through practice.

iii Academic libraries must imbibe the culture of regular maintenance and upgrade of the available resources to enable them to last longer and for optimal results. Frequent change of password for security purposes, migrating to higher versions of applications, and other tools will go a long way.

IV. Institutions should invest in infrastructure to improve power supply and internet connectivity. This will aid constant access to these electronic resources.

v. Furthermore, it will be pertinent to provide channels for feedback from users; this will ensure that the quick identification of users' needs for continuous improvement on the resources.

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Awareness of Librarians on the Use of Artificial Intelligence in Academic Library Services: Knowledge, Benefits and Challenges

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Abstract

This study examined the topic Awareness of Librarians on the Use of Artificial Intelligence in Academic Library Services: Knowledge, Benefits and Challenges. To this end the researcher came up with four objectives which are: Assessing the awareness of librarians on the use of Artificial Intelligence (AI) in Academic Library Services; Ascertain librarians' level of knowledge on the use of AI in rendering academic library services; Identify benefits that librarians can derive from the use of AI in academic library services; Highlight challenges associated with the use of AI in academic library services delivery. A qualitative research methodology was used for this study and the population for the study comprises librarians of the various tertiary libraries in the following order: Western Delta University, Oghara (5), Michael and Cecilia Ibru University (3), Delta State University Otefe (8), Edwin Clark University (4), Federal Polytechnic Orogun Delta State (5) which amounted to the total population of (25). The sampling size is the total population due to its sizeable number. The sampling technique used is the total enumerating sampling technique. A self-designed questionnaire is the instrument used for data collection. The findings of the study among others include: that librarians are acquainted with AI tools, AI robot, face recognition technology. However, they are not awareness RFID technology, AI Classification tool. The study also revealed from the findings challenges which are: inadequate ICT facilities, insufficient funding from the parent institution and inadequate internet service provision. etc the study was concluded by the researchers that If libraries are to thrive in the new knowledge economy and era, they must innovate their services and re-examine their practices, a veritable means to achieve this is the application of artificial intelligence in libraries and it was recommended that Activities such as seminars, workshops, conferences should be conducted for librarians either in house or outside the working environment where the librarian is employed; Sufficient funding should be made available, adequate ICT facilities should be acquired with the funds provided etc.

***Keywords**: Intelligence, Artificial Intelligence, Academic Library, Library Services*

Introduction

The world has over the years migrated from different levels of technological innovation, in the earliest times , the computer systems served as just input aiding devices and output devices but as man's activities progresses, the need for ease of work became prevalent, hence interactive technologies came to the picture, where man can communicate with another person irrespective of the distance and the location, researches have shown that expert continuously work endlessly on the different ways that can bring about a more efficient system to yield high productivity and as well reduce the challenges imposed by human factor, in some developed countries of the world where the working population are aging and decreasing, the need to have a system that can ensure continuity birthed the vast innovation of emerging technologies. Thus, systems that can imitate human behaviours and intelligence came to the picture which is known as Artificial Intelligence. Before we elucidate on the concept of Artificial Intelligence, it is imperative that the term intelligence is succinctly explained.

Intelligence as a term can be defined in several ways, from the layman perspective, intelligence simply means the ability to comprehend and apply knowledge, and however, the definition of intelligence can be understood from different point of view. The concept of intelligence is not a recent term, thus, Hindes Schoenberg. & Saklofske (2011) in their research defined intelligence in terms of judgment, practical sense, initiative, and adaptability, this definition stills suit this current generation and it could be noted that intelligence has different types such as moral intelligence, emotional intelligence, human intelligence, spatial intelligence, musical intelligence, linguistic intelligence, naturalistic intelligence as well as artificial intelligence. For the sake of time and this study the researchers will be considering the term artificial intelligence.

In our contemporary time, the broad variety of technologies that support several daily goods, activities and services used by people are referred to as "Artificial Intelligence." In fact it is becoming so pronounce to the extent that many are having the fear that jobs that were being done by humans will be taken away. It is a wide range of technologies, which include computer vision, natural language processing, machine learning, and others, which falls into the AI landscape. In a study conducted by Kanade (2022), Artificial Intelligence (AI) is

regarded as the intelligence of a machine or computer that enables it to imitate or mimic human capabilities. AI uses multiple technologies that equip machines to sense, comprehend, plan, act, and learn with human-like levels of intelligence. In a similar vein, Bassey (2023) also opined that artificial intelligence can be understood as the collection of technologies that enable machines to sense, comprehend, act, and perform several functions matching those of humans.

Glover (2024) on the other hand stated that artificial intelligence refers to computer systems that are capable of performing tasks traditionally associated with human intelligence, such as making predictions, identifying objects, interpreting speech, and generating natural language. AI systems learn how to do so by processing massive amounts of data and looking for patterns to model in their own decision-making. In many cases, humans will supervise an AI's learning process, reinforcing good decisions and discouraging bad ones, but some AI systems are designed to learn without supervision. Scott (2024) mentioned that artificial intelligence (AI) technology allows computers and machines to simulate human intelligence and problem-solving tasks. The ideal characteristic of artificial intelligence is its ability to rationalize and take action to achieve a specific goal. AI can perform tasks that would otherwise require human intelligence or intervention. Therefore, after the foregoing exposition on the term AI, what then do librarians perceive about AI in library services? Before this question can be answered it is expedient that the concept perception is explicitly elucidated.

The successful implementation of AI in libraries is heavily influenced by the perceptions and attitudes of library professionals. Understanding these perceptions is crucial for developing strategies that encourage the adoption of AI technologies. Research indicates a spectrum of attitudes among librarians, ranging from enthusiastic acceptance to cautious scepticism (Huang, 2022; Kashive, Powale, & Kashive, 2020; Mckie & Narayan, 2019).

Many librarians view AI as a powerful tool that can revolutionize library services. They recognize the potential for AI to automate routine tasks, freeing up time for more complex and creative activities. For example, AI can handle repetitive cataloguing duties, allowing librarians to focus on curating unique collections, conducting research, and engaging with the community. Additionally, AI's ability to provide personalized recommendations and enhance search capabilities is seen as a significant improvement in user services (Hamad et al., 2023; Lund, Omame, Tijani, & Agbaji, 2020; Wang, 2017; Wood & Evans, 2018).

However, there is also apprehension about the integration of AI in libraries. One of the primary concerns is job displacement. Librarians worry that the automation of tasks traditionally performed by humans could lead to job losses. This fear is compounded by the rapid pace of technological advancement, which can make it challenging for professionals to keep up with new developments and acquire the necessary skills (Huang, 2022; Okunlaya et al., 2022; Shen & Zhang, 2024; Subaveerapandiyan & Gozali, 2024). Addressing these concerns requires a lot that is why the researchers are considering the topic librarian perception on the use of Artificial Intelligence in Academic Library services: Challenges and Prospects.

Statement of Problem

Artificial Intelligence (AI) as a concept is seen as a man-made intelligence that is not natural which was invented by man to assist in performing the roles that were originally executed by humans in time past. Their coming has really being useful and resourceful to mankind.

However from observation, there are different ideologies and misconception librarians are having concerning the Artificial Intelligence (AI) some school of thought are of the view that Artificial Intelligence (AI) is going to make many of librarians jobless if it is eventually and fully adopted into the library. The other school of thought are of the opinion that the adoption of Artificial Intelligence into the library services will help librarians to be more effective and efficient in performing their job in meeting information needs of information seekers.

This therefore, necessitated the researchers to undertake this study.

Objective of the Study

The general objective of this study is to examine the Librarian perception on the use of Artificial Intelligence in Academic Library services: Challenges and Prospects. While the specific objective is to:

1. Assess the awareness of librarians on the use of Artificial Intelligence (AI) in Academic Library Services
2. Ascertain librarians level of knowledge on the use of AI in rendering academic library services
3. Identify benefits that librarians can derive from the use of AI in academic library services,
4. Highlight challenges associated with the use of AI in academic library services delivery.

Review of Literature

Librarians view and awareness on the use of Artificial Intelligence (AI) in Academic Library Services.

In the work of Safana and Fari,(2024) it was postulated In a simple terms, that"awareness" is the state of being conscious, knowledgeable or familiar with a certain phenomenon. However, in the context of this study "awareness" is the ability of librarians to know, become familiar or understand the existence of AI for academic libraries service delivery. On the other hand, Brynko (2018) views awareness of AI as the understanding and recognition of the capabilities and potential impact of AI technologies or tools on library operations and services. It involves library members of staff's knowledge of how AI can be applied to enhance user experiences, streamline processes and improve the effectiveness and efficiency of information service delivery.

Librarians' state of awareness of AI-related technologies is of interest to many researchers. A study by Yu (2018) on Artificial Intelligence in academic libraries, opines that awareness of AI in academic libraries is crucial for enhancing and leveraging quality and efficiency in library services. It was added that it is only when the library staff are aware of the capabilities of AI that they may understand how it could be applied to provide library services. Awareness of AI among librarians in academic libraries helps foster innovation and enables librarians to stay ahead of technological advancements. As noted in their study, Singh and Qazi (2020) stated that librarians who are aware of the latest development in AI can proactively adopt it and develop strategies to meet the emerging needs of their users and provide cutting-edge services. Another study by Thompson and Williams (2019) on the attitude of librarians towards AI reveals the potential of AI to streamline library operations and improve users' satisfaction; while others were skeptical about its impact on job security, and privacy concerns. This demonstrates the need for more education and training on AI technologies in the field of libraries

Awareness refers to librarians' knowledge of AI technologies and their relevance to their work, including understanding AI tools and their functions (Bawack et al., 2021). Similarly, Gasparini, & Kautonen (2022) indicated in their work that some librarians are of the view that librarians are uncertain about the future of AI in research libraries and the roles of libraries and librarians in AI. Also, Yusuf, et al (2022) stated clearly in their study that in Nigeria, librarians are aware of the integration of AI systems in libraries globally, but they have mixed feelings about the readiness of academic libraries to adopt AI.

The Level of Knowledge of Librarians on the use of AI in rendering Academic Library Services

Librarians' knowledge and skills play a critical role in effectively integrating and operating AI technologies within library services. Neumann et al. (2022) highlighted key areas of knowledge and skills that librarians should possess or develop to successfully navigate the operations of AI in libraries. It is expected that librarians should have a foundational understanding of what AI is, its capabilities, limitations and various AI techniques such as machine learning, natural language processing and data mining. Since AI relies on data for training and decision-making, several studies have indicated that librarians should be proficient in data literacy, including understanding data types, sources, quality, privacy concerns and ethical considerations related to data collection and usage (Lund and Wang, 2023; Neumann et al., 2022; Oyetola et al.,2023).

According to Hanson and Okorie (2024) some of the benefits that can be derive from using AI for academic library services delivery are outlined as follows: it helps to enhance search and information retrieval; it provides virtual assistants and Chabot's which serves as instant support and guidance to patrons; it enhances library cyber security by detecting anomalies, monitoring access logs and identifying potential security threats; it assists librarians in organizing, categorizing and recommending content based on user interests, preferences and demographic information. In a similar vein, Manik (2024) highlighted some benefits as well and they are: it helps to improve the accuracy of search results and library catalogs. Librarians are involved in designing these AI tools and educating the public on how to use them; they are being used to answer user questions and provide personalized recommendations. Libraries are also using AI to improve accessibility to digital materials; it provides tailored learning support system to patrons of all ages. Ogwo, Ibegbulem, and Nwachukwu, (2023) also stated in a study they conducted some of the benefits of AI inclusion in library services delivery as follows:

AI helps to automate processes and repetitive tasks and reduce the time it takes to analyze big data sets. This helps to save time and resources by eliminating the need for employees to perform tedious and repetitive tasks; It Saves Labour and Increases Productivity**.** An example here is the use of warehouse automation, which grew during the pandemic and is expected to increase with the integration of AI and machine learning; AI helps to personalize content, messaging, ads, recommendations and websites to library users. AI-powered tools can provide personalized learning experiences to students; Availability and Accessibility of Information is 24/7 due to the fact that AI-powered virtual agents are always available. AI programs do not need to sleep or take breaks, providing service; AI helps to facilitate collaboration and knowledge sharing among Librarians and

library users. For example, AI-powered platforms can connect users with similar research interests, facilitating interdisciplinary collaborations and fostering a sense of community within the academic environment; it helps to improve the effectiveness of library services and ultimately reduce operational costs with sustainable libraries; AI-powered Chabot's can offer immediate assistance to library users, answering research questions and guiding users to relevant resources.

Challenges Associated with the Use of AI in Academic Library Services Delivery.

Ogwo, Ibegbulem, and Nwachukwu, (2023) asserted and outlined in their study some of the challenges that are associated with the use of AI in academic library services delivery which are:

Poor ICT Skills and Technical Expertise Among Library Staff; Financial Constraints; Poor Content Digitization Process; Phobia for Job Displacement; Privacy and Ethical Issues; Poor Maintenance Culture; Epileptic Power Supply; Poor Infrastructure and Technological Development; Poor Network Connectivity and Resistance to change. Studies in Nigerian Libraries have found out low level of adoption of AI in operations and services. The studies of Rotimi et al, (2022), Owolabi et al, 2022 and Adeyeye, et al (2023) attested that Nigerian libraries are yet to exploit abundant opportunities offered by emerging innovations, services are still dominated by manual operations and there is obvious low level of readiness to incorporate emerging technologies in library operations and services. The above scenario implies that the possibility of adopting AI in theses libraries is slim. This could be linked to institutional inadequacies. In their analysis of the obstacles of using AI in academic libraries, Bawack and Nkolo (2018) and Tella (2020) identify institutional concerns as the most significant barrier to AI deployment in libraries, particularly in African countries. These factors include, lack of necessary facilities, policies and 'dearth of innovative library managers' that would promote the implementation of AI technology in libraries. Similarly, different studies of Odeyemi noted a low level of and partial readiness of application of AI in libraries in Nigeria, attributing it to the challenges of financial uncertainties/high cost of implementing AI system, incomplete automation, emerging skill gaps/ absence of technical skills, fear of job loss, lack of adequate technological infrastructures and erratic/unreliable power supply. In addition to institutional factors, are the challenge of ethical concerns and privacy issues (Suberveerpandiyan, 2023) and high system development and maintenance cost, limited availability of artificial intelligence experts among library automation vendors (Omame and Alex-Nmecha 2020)

Research Methodology

A qualitative research method was adopted for this study. This method was adopted because it allows gathering of data from a sample of a given population to estimate the true value of the population. The target population of this study cut across all the librarians which were derived from these various tertiary librarians: Western Delta University, Oghara (5), Michael and Cecilia Ibru University (3), Delta State University Otefe (8), Edwin Clark University (4), Federal Polytechnic Orogun Delta State (5) which amounted to the total population of (25). The researchers made use of all the population since it is a manageable size. Therefore, the sampling technique used for this study by the researchers was a total enumerating sampling techniques. this was used because of the sizeable population for the study.

Out of the twenty-five (25) questionnaires administered by the researchers to the respondents, hundred percent 100% were returned; analyzed using frequency distribution, tables and percentage to arrive at the findings of the study.

Results and Findings

Table 1 Demographic Information of the Respondents

Gender	**Percentage**
Female	14(56%)
Male	11(44%)
Qualification	
Bsc/HND	3(12%)
MLIS/MSc	11(44%)
M.Phl	Nil
PhD	11(44%)

Designation	
Graduate Librarian	2(8%)
Assistant Librarian	1(4%)
Librarian II	6(24%)
Librarian I	5(20%)
Senior Librarian	4(16%)
Principal Librarian	4(16%)
Deputy Librarian	2(8%)
University/Polytechnic/College Librarian	1(4%)
Work Experience	
Less than 1 – 5 years	3(12%)
5 – 10 years	9(36%)
10 – 15 years	5(20%)
15 – 20 years	5(20%)
20 – 25 years	2(8%)
25 years and above	1(4%)

Source: Research Field Survey, 2025

Table 1 above shows the demographic information of the respondents and it revealed the total percentage of the genders in accordance to their responses, where 14(56%) of females and 11(44%) which implies that there are more female genders in the librarianship profession than males. On the area of their qualifications, 11(44%) of the respondents are PhD and Master degree holders which shows that the desire for self-development, improvement and growth is on the high in the profession. The designations and the working experiences of the how long they have been in the profession and also the category of librarians are working in the libraries.

Table 2 showing the mean score on Librarians awareness
Rating Scale: HA: Highly Aware, A: Aware, RA: Rarely Aware, NA: Not Aware

Librarians awareness on the use of Artificial Intelligence (AI) in Academic Library Services	HA	A	RA	NA	Mean	Decision
Aware of AI Robots	9	9	5	2	3.0	Accept
Aware of face recognition technology	7	9	7	2	2.84	Accept
Aware of Virtual References	5	9	8	3	2.48	Reject
Aware of Micromedex	3	7	11	4	2.01	Reject
Aware of AI Expert Systems	5	11	6	3	2.72	Accept
Aware of thump recognition technology	8	7	6	4	2.76	Accept
Aware of Chatbots	8	9	4	4	2.84	Accept
Aware of Dynamed	2	10	8	5	2.36	Reject
Aware of Humanoids	5	6	9	5	2.44	Reject
Are you aware of security scanning machines for scanning users at the point of entrance of university libraries	2	8	7	7	2.12	Reject
Aware of RFID technology in libraries	4	8	8	5	2.44	Reject
Aware of Machine readable catalogue (MARC)	4	10	6	6	2.56	Accept
Aware of AI classification tools like, Shelf Pro, CUTT x. Coal Sort and N-cube	3	10	6	6	2.4	Reject

Source: Research Field Survey, 2025

Table 2 above shows the mean score of Artificial Intelligence awareness level of librarians in the various tertiary institutions under study. From the responses of the respondents, it was indicated that librarians are aware of the AI tools AI Robots, with (3.0) mean value, face recognition technology (2.84), AI expert systems (2.72), thump recognition technology (2.76), Chatbots (2.84), and Machine Readable Catalogue (2.56). From the mean score value indicated in the table above, it revealed that those AI tools that below (2.50) mean score such as RFID technology, AI classification tool, Dynamed, Micromedex, virtual references, Humanoids and security scanning machines are the various AI tools that the librarians under this research study are not aware of.

Table: 3 showing the mean score Librarians views on the use of AI
Rating Scale: (SA) = Strongly Agree, (A) = Agree (SD) = Strongly Disagree (D) = Disagree

Librarians views on the use of Artificial Intelligence (AI) in Academic Library Services	SA	A	SD	D	Mean	Decision
AI has been utilized in libraries	6	9	7	3	2.72	Accept
AI is replacing human intelligence in libraries	3	7	11	4	2.36	Reject
AI will not replace librarians but will support them in performing advanced task	4	9	9	3	2.56	Accept
Phobia is affecting its acceptability by librarians	3	7	9	6	2.28	Reject
AI will bring about unemployment	5	7	8	5	2.48	Reject
Jobs will be limited since AI will be doing what humans are meant to do	2	13	7	3	2.56	Accept
AI should be integrated in libraries because it will make work more easier	5	9	6	5	2.56	Accept

Source: Research Field Survey, 2025

Table 3 revealed the perception of librarians towards the existence of AI. Some of the librarians are of the view that AI as a tool is been utilized in libraries already with the mean score (2.72), other librarians from their perceptions; it was revealed that AI will not replace librarians rather it will support them in performing advanced task. Also, they pointed out that jobs will be limited since AI will be doing what humans are meant to do. Some of them revealed from their responses that AI should be integrated in libraries because it will make work easier and these views of the librarians are represented with (2.56) mean score respectively.

Table: 4 showing the mean score for Librarians level of AI knowledge

The Level of Knowledge of Librarians on the use of AI in rendering Academic Library Services	SA	A	SD	D	Mean	Decision
I have read articles and publications that discuss the use of AI in library	7	16	2	0	3.04	Accept
I have attended training sessions and workshops on AI specifically tailored on information management	5	8	6	6	2.46	Reject
I have interacted with AI powered tools and I have the knowledge on how to used them for service delivery	4	10	8	3	2.60	Accept
I know the ethical consideration about the potential impact of AI use in the library	2	9	10	4	2.36	Reject
I can use AI tools to render library services effectively	3	14	6	2	2.72	Accept
The AI tools are user friendly to me	1	12	8	4	2.40	Reject
I have lesser knowledge of the AI tools for library services	5	8	9	3	2.60	Accept

Source: Research Field Survey, 2025

Table 4 above shows the mean score on librarians' level of AI knowledge. From the table, it was revealed that majority of the respondents with the mean (3.04) have read articles and publications that discuss the use of AI in library, followed by (2.72) mean score stating that I can use AI tools to render library services effectively, (2.60) mean score which stated that I have interacted with AI powered tools and I have the knowledge on how to use them for service delivery and I have lesser knowledge of the AI tools for library services. However, I have attended training sessions and workshops on AI with mean value (2.46), the AI tools are user friendly to me (2.40), I know the ethical consideration about the potential impact of AI use in the library were rejected due to the fact they are below the average means score.

Table: 5 showing the mean score for librarians benefits from AI

Benefits librarians can derive from AI for academic library services delivery	SA	A	SD	D	Mean	Decision
There is easy availability and accessibility of information	13	8	2	2	2.88	Accept
It improves customer satisfaction through personalisation	4	18	1	2	2.96	Accept
It brings about effective delivery of library services and elimination of human errors in library operations	7	14	3	1	3.08	Accept
The presence of AI in library can make research more discoverable and also boost research discovery among faculty members	7	12	1	5	2.84	Accept
It reduces manual and repetitive task performed by librarian	8	12	3	2	3.04	Accept
It provides patron-tailored recommendations to items	4	14	2	5	2.68	Accept
It saves time spent on generating information	6	13	3	3	2.88	Accept
It brings about the discovery of new knowledge in university libraries	4	13	3	5	2.64	Accept

Source: Research Field Survey, 2025

Table 5 above shows from the responses of the respondents that one of the major benefits librarians will derive from the AI tools for academic library services is that it will bring about effective delivery of library services and the elimination of human error in library operations with mean score (3.08) followed by it reduces manual and repetitive task perform by librarians (3.04), it improves customers satisfaction through personalisation (2.96), there will be easy availability and accessibility of information and it saves time spent on generating information with mean score (2.88) respectively. Also from their responses it was indicated with the mean score (2.84) that the presence of AI in Library can make research more discoverable and also boost discovery among faculty members,

Table 6 showing the mean score for challenges associated with AI, it provides patron tailored recommendation to items (2.68) and that it will bring about the discovery of new knowledge in universities libraries.

Table 6 showing the mean score for challenges associated with AI,

Challenges Associated with the Use of AI in Academic Library Services Delivery.	SA	A	SD	D	Mean	Decision
There is low level of awareness of AI among librarians	15	7	1	2	2.80	Accept
Inadequate ICT facilities for AI technologies	11	12	2	0	3.36	Accept
Inadequate internet service provision	12	10	3	0	3.36	Accept
Epileptic electricity or power supply	12	11	0	2	3.32	Accept
Insufficient funding from the parent institution	13	8	4	0	3.36	Accept
Potential loss of job	6	13	4	2	2.92	Accept
Lack of technical skills to operate AI technologies	9	12	3	1	3.16	Accept
Lack of maintenance culture	9	12	3	1	3.16	Accept
Resistance to change from librarians and library users	9	11	4	1	3.12	Accept
High cost of implementing AI systems	8	13	3	1	3.12	Accept

Source: Research Field Survey, 2025

Table 6 shows the challenges associated with AI. From the responses of the respondents, it revealed that inadequate ICT facilities, insufficient funding from the parent institution and inadequate internet service provision are the major challenges with (3.36) mean score respectively. Followed by epileptic electricity or power supply (3.32), lack of technical skills to operate AI technology and lack of maintenance culture with (3.16) mean score respectively, resistance to change from librarians and library users, high cost of implementing AI systems with (3.12) mean score respectively. Conclusively, the last challenge indicated by the respondents is that there is low level of awareness AI among librarians with (2.80) mean score.

Discussion of Findings

Librarians' awareness on the use of Artificial Intelligence

The finding of this study shows the awareness level of librarians on Artificial Intelligence. From the responses librarians are acquainted AI tools, AI robot, face recognition technology, AI expert system, thump recognition technology, chatbots and machine readable catalogue. However, they are not awareness RFID technology, AI Classification tool, Dynamed, Micromedex, virtual references, Humaniod and security scanning machine**.**

Librarians level of AI knowledge

The study revealed the level of knowledge of librarian on Artificial Intelligence. From the study, the findings shows that librarians knowledge of AI is majorly on articles and publications consulted by them, followed by those who believe that they can make use of AI tools to render library services effectively, also with those who indicated that they have interacted AI powered tools. The findings from the study also show that some of the librarians have not attended any training or workshop on the use of AI.

Benefits librarians can derive from AI

from the respondents, the findings shows that one of the major benefits librarians will derive from the AI tools for academic library services is that it will bring about effective delivery of library services and the elimination of human error in library operations which is followed by reduction in manual and repetitive task perform by librarians, improvement in customers satisfaction through personalisation, easy availability and accessibility of information and it saves time spent on generating information. Also from their responses it was indicated the presence of AI in Library can make research more discoverable and also boost discovery among faculty members.

Challenges Associated with the Use of AI

The findings of the study shows the challenges associated with AI. From the responses of the respondents, it revealed that inadequate ICT facilities, insufficient funding from the parent institution and inadequate internet service provision are the major challenges which is followed by epileptic electricity or power supply, lack of technical skills to operate AI technology and lack of maintenance culture, resistance to change from librarians and library users, high cost of implementing AI systems and low level of awareness AI among librarians.

Conclusion and Recommendations

If libraries are to thrive in the new knowledge economy and era, they must innovate their services and re-examine their practices, a veritable means to achieve this is the application of artificial intelligence in libraries. Based on the findings of this study, it was discovered by the researchers that a few of the practicing librarians are aware of what Artificial Intelligence (AI) is all about and some of them are of the view that it will make work done in the library easier, some perceived from their myopic point of view that it will bring about unemployment to librarians if fully embraced into the Nigerian tertiary institutions libraries. As a result of these findings, the researchers conclude with the following recommendations:

1. Activities such as seminars, workshops, conferences should be conducted for librarians either in house or outside the working environment where the librarian is employed in order to create enough awareness for the librarians about the AI tools because from the responses of the respondents it revealed that some of these librarians do not know what these AI tools entails, what they are been used for despite the fact that they have been hearing about them.
2. Sufficient funding should be made available, adequate ICT facilities should be acquired with the funds provided. It shouldn't be diverted for other purposes, and then the parent institution should ensure that constant subscription for internet services is done on yearly bases and should be regular and not the irregular type that is provided only when visitors such as NUC are coming for accreditation purposes.
3. Based on the findings from the study that It will bring about effective delivery of library services and elimination of human errors in library operations therefore, the issue of electrical power should be looked into by providing alternative means such as generator, solar system and inverter to support the electrical power provided by government so that there will be constant availability of light that will aid the functionality of the internet and other facilities for effective library services delivery.

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Awareness, Readiness of Librarians and Gaps for the Integration of 5th Industrial Revolution in Delta State, Nigeria

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Abstract

This study investigated the awareness and readiness of librarians for the integration of the 5th industrial revolution in Delta State. Quantitative methodology using survey design was adopted for the study and the population was all librarians in Delta State. Data was collected using a self-structured questionnaire based on the objectives of the study and analyzed using descriptive statistics (mean and standard deviation) to answer research questions. Findings of the study revealed that awareness and readiness of librarians in Delta State for the 5th industrial revolution is on a moderate level. Findings show that some librarians in Delta State are already armed with the required skills but there are still knowledge gaps to be filled to be able to work effectively with the new trend. Also, State government, organizations, and parent body of libraries are not showing interest and support in partnering with librarians and library schools to facilitate the holistic adoption of this revolution. It was concluded that the readiness of librarians to work with the 5th industrial revolution depends on their extent of awareness, therefore, there is a dire need for thorough training of librarians for proper understanding of its technological trends. It was recommended that all hands should be on deck to ensure an effective use of these technologies as it will offer a facelift to library service operations.

***Keywords**: 5th Industrial Revolution, advanced technologies, Artificial intelligence (AI), librarians' awareness, technological trends*

Introduction

The fifth industrial revolution (5IR) is the use of advanced technologies in transforming industries and the world at large. It is the use of advanced technologies such as artificial intelligence, Robotics, Big data, Internet of Things (IoT) among others in achieving tasks. In order to shape the future of information and to sustain its relevance in the society, libraries and librarians as a critical hub of information and knowledge dissemination has to consider every possible measure to discover and adapt to these trending technologies. Due to our ever-changing world, the awareness of 5th industrial Revolution serves as a beacon which comprises of the ongoing and imminent transformation in industries and societies. It is the harmonious integration of diverse technological domains (Noble et.al, 2022).

5IR emerged with improvement in various activities developed in the 4th Industrial Revolution (4th IR). The 5IR is marked with advance improvement in activities such as digital technologies artificial intelligence (AI), robotics, Internet of Things (IoT) cloud computing, big data, 3D printing, based on the need for higher flexibility to support new information communication devices such as moving robots or drones. In the LIS domain, the readiness of information specialists to apply the 5IR wireless communications to enhance service provisions for their clients is non-negotiable even though it requires the need for further training in the specific areas of demand. Hatzivasilis, Fysarakis, Soultatos, Askoxylakis, Papaefstathiou and Demetriou (2018) opined 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)". This integration enhances the library experience, allowing users to access content anytime and from anywhere. The link between 5IR, data science and library services relate to the prospect of using wireless technologies to solve the problem of communication as earlier stated especially in the libraries. Data are used to facilitate learning methodology for students or lecturers as well as provide easy access and use of information resources by every category of users.

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 upholding the need to create awareness in adopting 5IR in carrying out library activities. 5IR was seen by

Enakhrire, Scholtz, and Khulekani (2024) as the process of human interaction between technology or machines either to solve individual and organizational societal problems from a general or specific perspective thereby filling the gap in information service delivery. This will build synergy between humans and technology in addressing the required support for task accomplishment, thereby, achieving organization set goal. The idea of 5IR is best described as using machines and digital technology to get library task done, this shift is enabled by the integration of advanced technologies and digital platforms within library systems as such making the jobs of librarians easier and library patrons glued to a refined library.

Statement of the Problem

The fifth Industrial Revolution (5IR) is noted as a transformative approach to information management, dissemination and preservation of information resources. In Delta State Nigeria, where librarians play a vital role in disseminating and preserving information materials, there is dire need for them to be aware of the 5IR, to understand its impact especially its transformative effect in library services. Librarians' readiness to acquire the required skills through training, workshops and conferences is considered a crucial step in the right direction. Although, the researcher can't help but wonder if the level of awareness and readiness by librarians to harness the full potentials of 5IR in Delta state has birthed the gap for its integration in library and information services. More so, despite the enormous benefit in the use of the fifth industrial revolution in library practice, its impact is not evident in most libraries in Delta State; as they do not have any library fully operating with the 5IR tool. Hence, the need to find out if librarians in Delta State are aware of these trending technologies. If they are, we want to ascertain their level of readiness in acquiring and adopting this technology to enhance the information service delivery in their libraries.

Objectives of the Study

This study seeks to examine the awareness and readiness of librarians in Delta State Nigeria of the 5th industrial revolution and the gaps for its integration, The specific objective are to:

1. Find out the awareness and readiness of librarians in Delta state on the 5th Industrial revolutions
2. Identify the required skills and the gaps for the integration of the 5th industrial revolution technology.
3. Ascertain the level of support and measures in place to harness the full potential of the 5th industrial revolution

Literature Review

The increasing demands from library patrons have prompted librarians to adapt their methods of delivering services **(**Hussain, 2022**).** These emerging technologies have also brought about shifts in approaches to teaching and learning. In response to these changes, librarians are actively seeking novel and innovative technologies to enhance user experiences within their libraries. The literature review will be discussed under the objective of the study.

Awareness and Readiness of 5th Industrial Revolution by Librarians

AI and machine learning have assumed central roles in libraries' adaptation to the 5th Industrial Revolution. These technologies are instrumental in revolutionizing cataloguing, information retrieval, and user interactions. AI-driven virtual assistants, chatbots, and recommendation algorithms are enhancing user experiences, and providing personalized and efficient library services (Chaturvedi & Verma, 2023). Ekwueme, Oluwaseun, Ajie, Ofodu, and Ambrose (2024) opined that Librarians in Open and Distance Learning exhibit a high level of awareness of 5th Industrial Revolution Technologies, they are of the opinion that Librarians must improve their awareness, perceptions, and skills to effectively support open and distance learning, which is a key challenge they face. Staying up to date on contemporary technological breakthroughs such as artificial intelligence, machine learning, and big data analytics is critical since they are transforming how information is accessed, analysed, and used in education.

Librarians must stay current on students' changing needs and expectations in the digital age, as students today expect ongoing access to information from anywhere and at any time. Abayomi, Adenekan, Abayomi, Olateju, Ajayi, and Aderonke (2021) research sought to analyse the level of awareness and perception of artificial intelligence in the management of Nigerian university libraries. The research takes the form of a survey and employs both qualitative and quantitative approaches. It was discovered that academic librarians are aware of the usage of artificial intelligence (AI) technologies in library operations. However, the most major barrier to embracing new technologies is the fear of losing their jobs. This is even though they understand that modern technology will allow for efficient user delight.

Required Skills and the gaps for integration of 5IR

Adjusting to technological changes and making sure that varied and inclusive services are offered to all users, irrespective of their learning environments is the core role of the library in this AI, Big Data, Internet of Things (IoT) era and librarians play a critical part in this transition.

Digital literacy, or the capacity to use digital tools and technology for information management and service delivery, is one of the core competencies for librarians in the 5IR (Jyotsna & Madhu 2021). To satisfy the varied demands of users in the learning contexts, librarians must be adept at leveraging digital resources, databases, and information systems.

Librarians should also be skilled in data management, which includes data collecting, analysis, and visualization to be able to facilitate evidence-based decision making and improve service inclusiveness (Thiruppathi, 2024). To accommodate a variety of learning needs, librarians should also be knowledgeable in information retrieval to obtain and distribute material from a variety of sources, including online databases and digital repositories (Bokoh, Ajiboye, & Bello 2023). To promote accessibility and diversity, librarians must integrate digital catalogs, e-books, and online learning platforms into their services. To cooperate with other individuals and organizations to share resources and expertise, librarians need to have strong networking and collaboration abilities, this will improve the overall diversity and inclusiveness of library services (Chisita, Shoko & Ngoaketse 2019). Librarians must exhibit flexibility and a dedication to continuous education to stay up to date with the latest technology developments and the changing needs of their Users (Ekwueme, et. al. 2024).

Furthermore, it is expedient that librarians should have a foundational understanding of what AI is, its capabilities, limitations and various AI techniques such as machine learning, natural language processing, data mining and basic understanding of coding languages like Python and R can be beneficial. Since AI relies on data for training and decision-making, several studies have indicated that librarians should be proficient in data literacy, including understanding data types, sources, quality, privacy concerns and ethical considerations related to data collection and usage (Oyetola, Oladokun, Maxwell & Akor 2023). Oladokun, Owolabi, Aboyade, Wiche, and Aboyade (2023) indicated that librarians need to comprehend how AI algorithms work, including their biases and potential impact on the information retrieved. Enakrire, Scholtz, and Khulekani, (2023) made mention of software skills such as teamwork, adaptability, problem-solving, decisiveness, flexibility, ability to work under pressure and it is believed that the software skills would help to equip librarians with best library practices to meet user's information needs. Proficiency with digital tools and technologies is essential, as librarians should be comfortable using various software, databases and platforms to leverage AI tools effectively in their workflows.

Additionally, Librarians should be able to coordinate tasks, manage resources and meet project timelines, troubleshoot issues and identify areas where AI can add value to library services. Librarians who possess this knowledge and skills are better equipped to leverage AI (5IR) technologies to enhance library services, foster innovation and support their communities' (Enakrire and Oladokun, 2024).

Level of support and measures in place to harness the full potential of the 5IR

The preparedness to embrace 5IR in libraries involves a combination of knowledge, skills and supportive measures. Evans and Ward (2018) stated that librarians need access to training programs that cover the basics of AI, its applications in libraries and ethical considerations. Oladokun et al. (2023) in support indicated that librarians should be educated on how AI can complement their skills by automating routine tasks, allowing them to focus on higher-level responsibilities such as user engagement and innovative projects.

More so, adequate training programmes and professional development opportunities can help librarians transition smoothly to the AI-enhanced environment. Lund and Wang (2023) found that a lack of familiarity with AI technologies leads to a fear of the unknown, and librarians who are not technologically literate might find it challenging to embrace AI solutions. Therefore, it is believed that training initiatives that provide basic technological literacy and hands-on experience with AI tools can help overcome this phobia.

Access to digital infrastructure in libraries remains a critical barrier for many innovations to be introduced, in most cases there is no money to acquire the necessary digital infrastructure both in hard ware, software and internet subscription. Until this investment in digital infrastructure is done in our libraries, laying the groundwork for widespread participation in the 5IR may be a simple wish.

The need to review the educational curriculum and system of librarianship to prepare librarians for the hybrid roles that will emerge in the 5IR. Boison (2024) added that traditional curricula are no longer sufficient, instead, interdisciplinary programs that integrate technical skills with creativity, ethics and problem- solving are needed to promote the use of this technology. Also, supporting libraries with a renewable energy and green energy initiatives due to the abundant solar, wind and geothermal resources can drive for the sustainable use of the 5IR in Nigeria, this will reduce on the use of fossil fuels, and reduce reoccurring cost in powering the library at the long run.

Furthermore, collaboration and partnership with other institutions, organization and stakeholders are essential for librarians to enhance their readiness (Nwobu, Dumbiri, Ibia, & Oladokun 2024). Above all, librarians need to explore and experiment with new technologies, including those associated with 5IR in order to enhance the delivery of library services.

Methodology

This study employed the descriptive survey research design. The population for the study comprised of 149 librarians in government established academic libraries across Delta State, the censored sampling technique was used as all the population was involved because it is not very large, however, the responses retrieved was not as high as expected perhaps it's as a result of collecting data through Google forms. The research instrument for data collection for this study was a self-structured questionnaire which was distributed using Google forms to collect data and a total of 83 responses was retrieved. Google forms was chosen as a means of collecting data because it is easy to use and can reach more respondents than physical contact. Data was analyzed using descriptive statistics with the Statistical Package for the Social Sciences (SPSS) version 25.

Results

Objective One: Determine the extent of awareness of librarians in Delta State, Nigeria, of the 5th industrial revolution and their readiness for the technological trends associated with it.

Table 2: Extent of awareness of librarians in Delta State, Nigeria, of the 5th industrial revolution and their readiness for the technological trends

Item	Mean	Std. Deviation	Decision (Extent of Awareness/Readiness)
I use digital tools for library operations (e.g., Big Data, IoT, Robotics)	3.27	0.682	Moderate awareness/readiness
I utilize online learning platforms for training on digital analysis	3.65	0.480	High readiness
I attend advanced technology - related trainings regularly	3.27	0.565	Moderate readiness
I am familiar with digital library management systems and use them	3.20	0.658	Moderate awareness
I apply AI tools in my daily library routines	2.94	0.915	Low readiness
I am always open to learning and using unfamiliar ICT tools	3.52	0.503	High openness
I am open and ready for more training and workshops for 5IR	3.40	0.604	Moderate readiness
What is the extent of your awareness and readiness for 5IR application?	3.31	0.725	Moderate awareness/readiness

What is the extent of your awareness and readiness for 5IR application?3.310.725Moderate awareness/readinessTable 2 shows the degree of awareness and readiness of librarians in Delta State towards the 5th Industrial Revolution (5IR) and its technological trends. The mean scores recorded between 2.94 and 3.65 show the level of variation in the extent of engagement with emerging technologies. Librarians indicated most readiness in using online learning platforms for training on digital analysis (mean = 3.65, SD = 0.480), an indication that a good number of them are taking steps to acquire new skills. They also indicated a willingness to learn and use new ICT tools (mean = 3.52, SD = 0.503), generally willing to undergo more training on the 5IR (mean = 3.40, SD = 0.604). Their engagement with much newer technologies, like AI tools and robotics, is not as marked. This is evidenced by a mean score of 2.94 (SD = 0.915) for applying AI in daily library routines and 3.27 (SD = 0.682) for the use of digital tools such as IoT and robotics. The librarians know about it somewhat well—digital library management systems—mean=3.20; SD=0.658, but may not yet be fully implementing cutting-edge technologies in their daily work routines. Averagely rated at 3.31 (SD = 0.725),

their general awareness and readiness for 5IR show that there is strong interest built along some levels of implementation of modern technologies, but much more can still be done to take it to higher levels of adoption and expertise.

Objective Two: Identify the required skills and the gaps for integration and utilisation of the technological trends associated with the 5th industrial revolution.

Table 3: Required skills and the gaps for integration and utilisation of the technological trends associated with the 5th industrial revolution

Item	Mean	Std. Deviation	Decision (Skill Gap/Readiness)
I can operate library automation without supervision	2.81	0.756	Moderate proficiency
I am proficient in database management	2.82	0.829	Moderate proficiency
I can use digital preservation tools	3.00	0.733	Moderate proficiency
I am skilled in digital information retrieval	2.99	0.804	Moderate proficiency
I can manage digital collections	2.93	0.677	Moderate proficiency
I can understand the basic coding languages (e.g., Python)	2.19	0.670	Skill gap
I can operate virtual reality operations	2.65	0.480	Skill gap
I am skilled in digital content creation	2.84	0.614	Moderate proficiency

The results showed moderate competency in some of the basic digital skills required for the 5th Industrial Revolution (5IR), but equally revealed gigantic gaps missing among their toward more advanced technologies. The respondents claimed to have operated library automation systems by themselves moderately (mean = 2.81), followed by database management (mean = 2.82), and the use of digital preservation tools (mean = 3.00). This, therefore, implies that they have been quite well prepared in the traditional operations of a digital library. Similarly, it was reported that skills in digital information retrieval average appropriately (mean = 2.99), managing digital collections (mean = 2.93) falls under the average category, and creating digital content (mean = 2.84). However, it recorded the lowest mean score under such areas as basic coding languages like Python, with a mean score of 2.19; this therefore puts it within the range of low proficiency, showing a great gap in fundamental emerging skill area. Also, running virtual reality tools (mean = 2.65) showed a kind of low readiness level. As a whole, while librarians display good skill in usual digital talents, there are big lacking areas in advanced and new 5IR technologies, which means there is a great need for focused training programs to close these important gaps.

Objective Three: To ascertain the level of support and measures in place to harness the full potential of the 5th industrial revolution for the librarianship profession.

Table 3: level of support and measures in place to harness the full potential of the 5th industrial revolution for the librarianship profession

Variables	Mean	Std. Deviation	Decision
Modern technological infrastructure in my library	3.06	0.687	Agree
Training opportunities	3.07	0.677	Agree
Budget for technology adoption	2.55	0.887	Disagree
Reliable internet connection	2.75	1.010	Disagree
Sufficient hardware resources	2.67	0.700	Disagree
Stable power supply	2.73	0.871	Disagree
Provision for software licence	2.53	0.817	Disagree
Update educational curriculum to embrace new emerging technologies	2.78	0.583	Disagree
Workload affects the time to learn	2.72	0.786	Disagree
Morale to practice what has been taught online	2.95	0.679	Agree
Partnership and collaboration with stakeholders, experts, institutions, etc.	2.73	0.700	Disagree

From the findings above, it can be said that the librarians in Delta State, Nigeria, generally believe that some support mechanisms are in place towards integrating the 5th Industrial Revolution (5IR) into the profession. Like modern technological infrastructure (mean = 3.06, SD = 0.687) and training opportunities (mean = 3.07, SD = 0.677), were positively rated. This shows that there is some access to resources and development. Nevertheless, most of the key support structures that would enable librarians to fully harness the potential of 5IR were rated as disagree. Such areas include critical infrastructure like budget for technology adoption (mean = 2.55, SD = 0.887), reliable internet connection (mean = 2.75, SD = 1.010), sufficient hardware resources (mean = 2.67, SD = 0.700), stable power supply (mean = 2.73, SD = 0.871), and software licenses (mean = ,2S3 sd=0-.817). These disagreeing scores indicate major shortfalls in the basic materials needed for carrying out 5IR properly. Also, though there is moderate morale for using learned knowledge (morale to practice what has been taught online: mean = 2.95, SD = 0.679) workload (mean = 2.72, SD = 0.786) and curriculum updates (mean = 2.78, SD = 0.583) were rated as disagree shows that both logistical and academic barriers still exist. Partnerships and collaborations (mean = 2.73, SD = 0.700) also showed disagree scores, which indicates low external involvement to aid in the assimilation of the technologies of the 5IR. These results imply that though some basic support exists, large gaps in infrastructure and resources block such an enormous advance toward embracing and integrating the 5IR within librarianship.

Discussion

This study has found moderate to high engagement with emerging technologies. In particular, the librarians reported high readiness for online learning platforms and openness to learning and using ICT tools required by the new revolution. However, there is some openness and moderate readiness to learn about new technologies; many have been less proactive in adopting newer technologies like AI tools, digital equipment such as IoT and robotics. This finding agrees with the work of Deja et al. (2021), who noted that while emerging technologies had attracted the interest of the librarians, their actual implementation was very slow, predominantly because they did not have hands-on experience or support from the institution. The mean score of 3.31 for overall awareness and readiness on awareness and readiness of librarians shows a gap between interest and practical implementation, an indication that although 5IR is known about its adoption is still in infancy. This finding is similar to that of Adjei and King (2024) Adjei and King compared Ghana and South Africa's readiness for the 4th Industrial revolution Fourth Industrial Revolution and found that both countries lack Lib 4.0 policies and face budget constraints, inadequate ICT. This necessitates targeted training programs to close this difference more specifically regarding AI, robotics, and IoT integration into library operations.

In addition to highlighting the critical need for focused skill development among librarians, Objective Two also identified the required skills and gaps for integrating and exploiting 5IR technologies. The reported moderate proficiency in traditional library operations such as database management, digital preservation tools, and digital information retrieval corroborates with what is found in the literature about how competent librarians should be regarding standard digital library tools (Deja et al., 2021). However, there was a significant difference in the skills related to the core of the 5IR that includes basic coding languages and virtual reality which have been left largely untapped by a tendency indicated elsewhere in this material wherein librarians tend not to be hoisted up to an adequate level of more advanced digital skills. Inadequacy in coding skills and new technologies such as virtual reality strengthen the argument by Moonasar (2024) that libraries should focus more on the investment of upskilling librarians to keep pace with technological advancements. From these findings, there is a call for more extensive training programs that specifically cater to advanced digital competencies, most especially about 5IR.

Finally, the research also sought to examine the support and measures in place to harness the full potential of the 5IR in the librarianship profession. A mixed picture was found. While librarians agreed there existed some level of modern technological infrastructure and training opportunities, indicating that resources are somewhat allocated towards this issue. This confirms the research of Evans and Ward (2018), who pointed out that libraries in some regions are stepping up efforts to provide more training opportunities on technology adoption. From the scores below, agreement registered towards major parameters like budget for technology adoption, reliable internet connection, and sufficient hardware resources, it is clear that support structures for full embracing of the 5IR do not exist. These findings fit with the digital divide that Thiruppathi (2024) pointed out, stressing that lots of libraries in developing places still have big gaps because it is hard to take on new technologies. The differing answers on updating the curriculum (mean = 2.78, SD = 0.583) and working with outside stakeholders (mean = 2.73, SD = 0.700) also show how there is not enough support from both inside an organization and systems to add 5IR into a job field. The challenges from workload (mean = 2.72, SD = 0.786) make it harder too for librarians to engage completely with training and development reinforces when trying to adjust to fast-changing technologies.

Conclusion and Recommendation

Librarians have been moderately skilled in the digital operations of libraries under the old regime, but have huge skill deficiencies regarding areas critical to their full participation in the 5IR— artificial intelligence, coding, and virtual reality technologies. Some of the institutional support mechanisms noticed did not mask critical barriers: low budgetary allocation, unstable internet connectivity, inadequate hardware resources, and lack of consistent updates to professional education curricula. It will be seen from this study that a willingness by librarians to embrace technological advancement has not been matched by systemic support towards achieving readiness for the 5IR. Bridging this gap will necessitate intentional strategic interventions directed at skill enhancement as well as infrastructural development and institutional support.

Therefore, the following are recommended:

1. Libraries and professional associations must design and conduct periodic training specifically on emerging technologies such as AI, robotics, virtual reality, and coding skills. To build competence and confidence, certification-based training modules can be introduced for librarians in these advanced digital areas.
2. Library authorities and policymakers should spend more on stable internet connectivity, hardware, software licenses and power supply systems for the success of 5IR. Library funding frameworks must mandate budgetary allocations for the purchase and maintenance of technologies.
3. The curricula of library and information science educational institutions should be revised to include 5IR technology competence to meet the future demands of library and information professionals. For more recent technological trends, these should also feature in workshops and CPD programmes.
4. A library should partner with technology companies, universities, and industry experts to facilitate knowledge transfer, resource access and upskilling opportunities. Outreach programs will let librarians see how 5IR technologies can be used in practice, in the library and beyond.
5. The institutions must design their workload policies to allocate a period for professional development for the librarians so that they can attend the training without getting overburdened with daily work.

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Bridging Library Patronage Gaps with Technology: Insights from Library Staff at Federal Polytechnic, Bida

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Abstract
This study investigated bridging library patronage gaps with technology: insights from library staff at Federal Polytechnic, Bida. The study was guided by four research objectives that focused on level of patronage to library services, library staff perception on integration of information and communication technology to library services as a response to poor library patronage, type of available information and communication technology that can encourage library patronage and challenges associated with the use of available information and communication technology facilities that can encourage library patronage. The study adopted descriptive research design. The population of the study was forty eight participants, where total enumeration was applied in choosing sample size. Structured questionnaire was used as the research instrument for data collection. Out of forty-eight questionnaires administered, only thirty-eight were retrieved and found usable. Data collected were analyzed using frequency counts, tables, percentages and mean. The research findings showed that there is very low level of patronage of library services among staff and students in the polytechnic. Library staff strongly agreed that adequate integration of information and communication technology to library services would improve library patronage among staff and students in the polytechnic. The study revealed that computer system, printer, scanning machine, photocopier, and offline database are ICT facilities available in the library. Meanwhile, library website, e-mail/social media platforms, online public access catalogue, library management software, institutional repository and closed and open access online database subscription are required. The challenges associated with the use of information and communication technology facilities for library services include instability in power supply and inadequate ICT skills. Based on the findings, it was recommended that information and communication technology facilities be leveraged upon for improved library patronage among staff and students in Federal Polytechnic, Bida.
Keywords: Information and Communication Technology, Library Service, Library Users

Introduction
Libraries are recognized as essential instruments for societal and national development. They are vital facilitators to education as they help in fostering reading culture, literacy, learning and research. Libraries also ensure the acquisition, processing and dissemination of relevant information to users. Academic libraries especially, serve specific kind of users in any academic clime be it university, polytechnic, college of education and monotechnic institution respectively. Invariably, academic libraries are very important components of all higher institution of learning across the globe. They are the heart of the learning community, providing a place for students, scholars, teachers and faculty members for teaching, learning and research. The major aim of academic libraries according to Uwaifo (2010) cited in Anaehobi and Odume (2020), is to provide the educational needs of the students as well as supporting the teaching staff in the provision of up-to-date materials required for teaching.

The Polytechnics are institutions that help in the quest for technological and economic growth. As institutions of higher learning, polytechnics provide manpower needed to advance education sector and national development, just as they are specifically charged with the primary responsibility of producing technical

manpower needed for industrial growth especially in Nigeria. Polytechnic education places a strong emphasis on practical based learning and attachment of requisite skill acquisition in every facet of course delivery. Polytechnics in Nigeria are set up to impart knowledge and necessary technical skills for provision of competent and well skilled labour force for industrial and technological development (Ayankola and Busari, 2024).

In addition to their academic knowledge, every polytechnic staff is to acquire interpersonal skills, communication and presentation skills as well as problem solving skills to enhance their productivity and also assist their students to be able to compete with their contemporaries, globally. Sometimes for the purpose of career and professional growth, staff are to conduct research, publish scholarly articles, teach classes, council their students and also serve in various committees, therefore the need for staff in Federal or State Polytechnics to embrace the full use of library and it services is a necessity.

User's patronage to library and its services involves creating awareness among users about the relevance of the library, especially with arrival of new information resources, whether physical or electronic information resources. According to Chegwe and Anaehobi (2015), encouraging library patronage and it services involves activities such as identifying user's needs, designing suitable services or product to meet their needs, communication and distribution to inform, motivate and serve the users. The major aim of bringing library and it services close to users is to identify current and potential users and begin to develop a relationship with them. Polytechnic libraries can achieve such relationship with their users through the use of Information and Communication Technology (ICT). The use of ICT has steadily increased in all life spheres, including economic, social, political and cultural; hence, library is not an exception. The gradual introduction and advance extensive use of such technological inventions as personal computers, cell phones and internet has impacted every aspect of life, making it incredible to provide awareness to library users (Umar, 2017).

Lack of ICT integration, out-dated facilities, and a focus on traditional services can contribute to the decline in library patronage among users. In other words, libraries that don't adapt to the digital age and provide digital resources and services are less likely to attract users, especially younger generations who are accustomed to digital platforms. Pagore (2024) stated that digital acquisition, digital preservation and access have all helped to make collection management procedures more effective and user-focused. ICT has a revolutionary effect on library collection management, changing how libraries gather, arrange, store, and make resources available to users. Libraries need to be flexible and open to new ICT solutions as technology develops further in order to keep their collections current, varied, and user-friendly in the quickly changing digital clime.

Statement of the Problem

Integration and impact of information and communication technology to library and information service provision cannot be over emphasized, especially in addressing ugly trends of poor library patronage among students and staff in any academic community. Information and communication technologies (ICTs) are a necessity especially in the 21st century; therefore, having ICTs in any academic library, especially to encourage usage of library information resource and services is a welcome development. It is observed by the researcher that there is poor patronage to library and its collection, including information resources and services among staff and students in Federal Polytechnic, Bida. It is against this background that this research; 'bridging library patronage gaps with technology: insights from library staff at Federal Polytechnic, Bida' is embarked upon.

Objective of the Study

This research focus on bridging library patronage gaps with technology: insights from library staff at Federal Polytechnic, Bida. However, the specific set objectives were to:

1. determine level of patronage to library services among staff and students in Federal Polytechnic, Bida.
2. determine library staff perception on integration of information and communication technology to library services as a response to poor library patronage among staff and students in Federal Polytechnic, Bida.
3. determine type of available information and communication technology that can encourage library patronage among staff and students in Federal Polytechnic, Bida.
4. find out challenges associated with the use of available information and communication technology facilities that can encourage library patronage among staff and students in Federal Polytechnic, Bida.

Literature Review

Library services, according to Olatunji (2023), are regarded as social services which are bound to stimulate the reading habit of the society, including people in the academic environment. Library services present a picture of remarkable variety and play an important role in the educational, economic, cultural and recreational life of the entire population. To be most functional, the services library provide should correspond with the needs of

its users because the user is the very reason for the existence of the library and ensures that the services so provided are exploited to the maximum.
Library and information services are activities that aim at disseminating desirable information to library users. Libraries have provided a range of services including current awareness service, selective dissemination of information, audio visual service, e-library service, online book reservation, online information service, user education, computer literacy skills service, photocopying/printing service, circulation/book loan service, reference service, inter library loan.

Benefit of Information and Communication Technology and Library Patronage
To state importantly in this literature review, according to Awotona, (2019) information and communication technology is a diverse set of technological tools and resources used to communicate, create, disseminate, store, manage information and promote human activities. These technologies include; computers, Internet, printer, scanner, photocopy machine, binding machine, and laminating machine, broadcasting technologies, projector and telephony among others that are widely used in education today, most especially in academic settings. Anyim (2021) stated that ICTs constitute integration of computers, telecommunications and microelectronics used for acquisition, storage, retrieval, transfer and dissemination of information to a wider and dispersed audience. Libraries should expand these pursuits, after providing the important training necessary to its staff especially, to secure position in the digital environment and to advance information delivery to the end users. With the recent wave of ICTs in knowledge-based institutions, such as Nigerian polytechnics, effective teaching and learning is almost impossible without application of various ICT based instructional resources.
Odunola and Tella (2019), defined library patronage as the consultation or use of library information resources by users of the library either physically or via remote access. In essence they defined library patronage as simply the regular utilization of library services by the intended users. Hence, in the context of this study library and information services patronage will imply the regular consultation of information resources and services and the usage by patrons. Jamogha and Jamogha (2022) opined that the essence of evaluating the patronage of a library is to gather useful information on whether the library is fulfilling its mandate and to also help in the reform of services provision, planning and the effective management of the library.

Information and Communication Technology in Nigerian Polytechnic
With the advent of ICTs and other environmental changes in Nigerian Polytechnic, the role and concept of library service has to change and quickly. The range of services that take place outside the physical library is expanding due to the new technology. For libraries and information services to stay viable in the current climate, it is important that they adopt ICTs to help meet institutional mission, goals and objectives. According to Shabahat (2015) the most common applications of ICT-based tools in academic libraries include e-mail, telephone, video-conferencing, and social media. Online public access (OPAC) is mentioned by Kumarjit and Mohan (2014), who say that with the arrival of the internet, most libraries have made their OPAC accessible. Users can search for the required information by connecting to the uniform resource locator (URL) of the Web OPAC at any time during the day and from anywhere in the world.

Challenges Associated with Use of Information and Communication Technology
Several challenges were reported to have associated with the use of ICT facilities to encourage library and information services. Uzoagba (2019) identifies lack of good infrastructure in terms of epileptic power supply in Nigeria or low current which might result in damaging ICT equipment in the libraries. It was also discovered that lack of adequate bandwidth and appropriate anti-virus and other necessary software in academic libraries poses serious threat to ICT use in the library. From the human resources point of view, Abiolu and Okere (2019) opined that lack of human capacity in the management of the ICT facilities in the libraries is a huge constraint. They also mentioned that inadequate skills of human resources, inadequate finance, power supply, system law, ICT literacy and inadequate ICTs infrastructure constitute the major challenges affecting adequate use of ICT products and services.\

Methodology
Descriptive research design was adopted for this study. The population consists of forty seven library staff in Federal Polytechnic, Bida. Total enumeration or a complete census technique was used for the population. Hence, Forty seven structured questionnaires were administered as the research instrument. However, only thirty eight were retrieved and used for analysis. Data collected were analysed using descriptive statistics such as the frequency counts, percentages and mean. The essence of the data analysis is to provide answers to the research objectives/question. However, to confirm the reliability of the instrument, pilot test was conducted using twenty participants from a state polytechnic – the Bida Campus

Results and Discussion

Research Question 1: What is level of patronage to library services among staff and students in Federal Polytechnic, Bida?

Table 1: level of patronage to library services among staff and students in the polytechnic

S/N	Item Statement	VHL (4)	HL (3)	LL (2)	VLL (1)	Sum	X (Mean)	SD
1	Photocopying/Printing Service	18	13	4	3	122	3.21	0.92
2	Circulation/Book Loan Service	21	7	4	6	119	3.13	1.13
3	Reference Service	16	13	7	2	119	3.13	0.89
4	User Education/Computer Literacy Skills Service	17	5	4	12	103	2.71	1.32
5	E-library/Internet Service	9	12	9	8	98	2.58	1.07
6	Current Awareness Service	6	2	15	15	75	1.97	1.04
7	Audio Visual/Multimedia Service	2	2	14	8	50	1.92	0.83
8	Selective Dissemination of Information	3	3	15	17	68	1.79	0.89
9	Online Book Reservation/Online Information Service	0	2	15	21	57	1.50	0.60
10	Inter Library Loan	0	0	0	38	38	1.00	0.00

Keys: VHL = Very High Level, HL = High Level, LL = Low Level, VLL = Very Low Level

In table 1, the analysis of library service patronage among staff and students in Federal Polytechnic, Bida; revealed that traditional services such as photocopying/printing (Mean = 3.21), circulation/book loan (Mean = 3.13), and reference services (Mean = 3.13) are the most frequently utilized. In contrast, digital and specialized services like selective dissemination of information (Mean = 1.79), online book reservation (Mean = 1.50) and inter-library loan (Mean = 1.00) experience very low patronage, indicating either a lack of awareness or non-existence of services challenges. User education/computer literacy skills services (Mean = 2.71) and E-library/internet services (Mean = 2.58) show moderate usage, this also include Current Awareness Service (Mean = 1.97) and Audio Visual/Multimedia Service (Mean = 1.92); suggesting a growing interest in digital resources. The overall trend highlights a strong reliance on physical materials and printing services, with limited engagement in digital and online resources. This suggests the need for increased awareness, improved accessibility, and training to enhance the utilization of digital library services.

Research Question 2: What is library staff perception on integration of information and communication technology to library services as a response to poor library patronage among staff and students in Federal Polytechnic, Bida?

Table 2: Library staff perception on integration of information and communication technology to library services as a response to poor library patronage among staff and students in the polytechnic

S/N	Item Statement	SA (4)	A (3)	D (2)	SD (1)	Sum	X	SD
1	Availability and access to open-ended offline databases such as Directory of Open Access Journals can facilitate e-library service and encourage library patronage among staff and students	36	2	0	0	150	3.95	0.22
2	Availability and use of multimedia projector, electronic interactive board, digital/video camera and television/satellite gadgets can facilitate user education/literacy skill service, audio visual/multimedia services and encourage library patronage among staff and students	32	6	0	0	146	3.84	0.36

3	Availability and use of Institutional Repository (IR) can facilitate reference service and encourage library patronage especially among staff	29	9	0	0	143	3.76	0.43
4	Availability and use of computer system can generally facilitate library services and encourage library patronage among staff and students	28	10	0	0	142	3.74	0.44
5	Availability and use of computer server, switches and routers can appreciably facilitate electronic library service and encourage library patronage among staff and students	27	11	0	0	141	3.71	0.45
6	Availability of 24/7 internet access, library website/portal and library's email address/social media platforms can enhance current awareness service, selective dissemination of information and online information services, hence, encourage library patronage among staff and students	30	4	4	0	140	3.68	0.65
7	Availability and access to closed ended online databases such as Scopus, ProQuest, EbscoHost, PubMed, Web of Science, Science Direct, JSTOR, IEEE Xplore, etc. can facilitate online information service and encourage library patronage among staff and students	30	4	4	0	140	3.68	0.65
8	Availability and use of printer, scanning machine and photocopier that can enable library user to own copy of any relevant information material can improve circulation/reference service and encourage library patronage among staff and students	25	13	0	0	139	3.66	0.47
9	Availability and use of online public access catalogue (OPAC) and Koha/Alexandria/VTLS library management software can facilitate online book reservation, inter library loan and circulation services, hence, improve library patronage among staff and students	21	17	0	0	135	3.55	0.50

Key: SA=Strongly Agreed**, A**=Agreed**, D**=Disagreed**, SD**=Strongly Disagreed

Table 2 highlights a strong agreement among respondents regarding the importance of ICT infrastructure in enhancing library services and patronage. The highest-rated item is the availability and access to open-ended offline databases (Mean = 3.95, SD = 0.22), indicating a strong belief that such resources significantly facilitate e-library services. Similarly, multimedia tools like projectors, interactive boards, and digital/video cameras (Mean = 3.84, SD = 0.36) are highly valued for improving user education and literacy skills. The use of institutional repositories (Mean = 3.76, SD = 0.43) and computer systems (Mean = 3.74, SD = 0.44) are also seen as essential for promoting library patronage, particularly among staff. Other technological tools such as digital databases (Mean = 3.68, SD = 0.65), internet access (Mean = 3.68, SD = 0.65) and library management software (Mean = 3.55, SD = 0.50), also receive strong approval. These findings indicate that a well-equipped digital infrastructure, including computer networks, online catalogue, and research databases, is crucial for improving library usage among staff and students in the polytechnic. Therefore, investing in advanced ICT tools, expanding internet access, and enhancing digital resources would no doubt lead to increased improved service efficiency and library patronage among staff and students in the polytechnic.

Research Question 3: What are the type of available information and communication technologies that can encourage library patronage among staff and students in Federal Polytechnic, Bida?

Table 3: Type of available information and communication technologies that can encourage library patronage among staff and students in the polytechnic

S/N	Available ICTs	Available	Not Available	Sum	X	SD
1	Computer System (Desktop/Laptop)	38	0	76	2.00	0.00
2	Printer	38	0	76	2.00	0.00
3	Scanning Machine	38	0	76	2.00	0.00
4	Photocopier	38	0	76	2.00	0.00
6	Television and satellite gadgets/accessories	38	0	76	2.00	0.00
9	Database for Offline Digital Library	38	0	76	2.00	0.00
22	Closed Circuit Television (CCTV)	38	0	76	2.00	0.00
7	Internet 24/7	26	12	76	2.00	0.00
8	Library Website/Portal	0	38	76	2.00	0.00
5	Electronic Interactive Board	0	38	76	2.00	0.00
13	Library's E-mail/Social Media Platforms	0	38	76	2.00	0.00
11	Institutional Repository (IR) e.g. DSpace	0	38	74	1.95	0.22
10	Multimedia Projector	36	2	74	1.95	0.22
12	Server e.g. Mikrotic	33	5	71	1.87	0.34
15	Koha/Alexandria/VTLS Library Management Software	0	38	70	1.84	0.36
20	Online Public Access Catalogue (OPAC)	0	38	70	1.84	0.36
14	Router	32	6	70	1.84	0.36
16	Storage Devices (Sharable)	25	13	63	1.66	0.47
17	Digital/Video Camera	28	10	63	1.66	0.47
18	Closed and Open Access Online Database Subscription e.g. Scopus, ProQuest, EbscoHost, PubMed, Web of Science, Science Direct, JSTOR, Cambridge Core, IEEE Xplore, DOAJ etc.	7	31	63	1.66	0.47
19	Switches	23	15	61	1.61	0.49
21	Library Software	9	29	47	1.24	0.43

21Library Software929471.240.43Table 3 reveals significant gaps in the availability of ICT resources in the library, despite the presence of essential hardware. Computer systems (Mean = 2.00), printers (Mean = 2.00), scanners (Mean = 2.00), photocopiers (Mean = 2.00) are widely available, ensuring basic document processing and printing services. However, critical digital infrastructure such as library software (Mean = 1.24), online public access catalogues (OPAC) (Mean = 1.61), library management software (Mean = 1.84), and institutional repositories (Mean = 1.95) are completely lacking. Similarly, library website/portal, electronic interactive board, and social media platforms (all with Mean = 2.00 but marked as not available) indicate a lack of online engagement and digital accessibility.

While networking devices such as servers (Mean = 1.87), switches (Mean = 1.61), and routers (Mean = 1.84) exist. The absence of open and closed ended online databases (Mean = 1.66), and a functional library management system (Mean = 1.84) severely limits digital library services. The findings suggest that while the library is equipped with basic ICT hardware, the lack of essential digital resources, online services, and automation tools hampers full digital transformation and efficient digital service delivery. Investing in library software, online databases, and internet infrastructure is crucial to improving access and patronage among students and staff in the polytechnic.

Research Question 4: What are the challenges associated with the use of available information and communication technology facilities that can encourage library patronage among staff and students in Federal Polytechnic, Bida?

Table 4: Challenges associated with the use of available information and communication technology facilities that can encourage library patronage among staff and students in the polytechnic

S/N	Item Statement	SA 4	A 3	D 2	SD 1	Sum	X	SD
1	Lack of Library Website/Portal	38	0	0	0	152	4.00	0.00
2	Non Availability of Library Management Software (e.g. Koha, Alexandria, VTLS Virtua etc.)	38	0	0	0	152	4.00	0.00
3	Non Availability of Institutional Repository (D-Space)	38	0	0	0	152	4.00	0.00
4	High Cost of Subscription to Online Database	25	13	0	0	139	3.66	0.47
5	Instability in Power Supply and Inadequate ICT Skills among Library Staff	20	15	2	1	130	3.42	0.71
6	Users Reluctance to Use ICT Facilities in the Library	20	10	4	4	122	3.21	1.00
7	Lack of Social Media Platform for Library Users	15	16	6	1	121	3.18	0.79
8	Lack of Internet Connectivity/Facility in the Library	15	15	4	4	117	3.08	0.96
9	Inadequacy of the ICT Facilities in the library	15	13	5	5	114	3.00	1.03
10	Obsolescence of the Hardware and Software Facilities in the Library	8	9	10	11	90	2.37	1.11

Key: SA=Strongly Agreed**, A**=Agreed**, D**=Disagreed**, SD**=Strongly Disagreed

Table 4 highlights the challenges associated with using available ICT facilities to encourage library patronage among staff and students in Federal Polytechnic, Bida. Key findings indicate that critical ICT tools such as a library website/portal, library management software (e.g., Koha, Alexandria, VTLS Virtua), and institutional repository (e.g., D-Space) were entirely unavailable (X = 4.00, SD = 0.00), representing significant barriers to effective library services. Challenges such as users' reluctance to use ICT facilities (X = 3.21, SD = 1.00), instability in power supply and inadequate ICT skills among library staff (X = 3.42, SD = 0.71), and lack of internet connectivity/facility in the library (X = 3.08, SD = 0.96) were highly rated, indicating widespread agreement on their adverse effects. Additional challenges included obsolete hardware and software (X = 2.37, SD = 1.11), lack of social media platforms for library users (X = 3.18, SD = 0.79), and inadequacy of ICT facilities (X = 3.00, SD = 1.03). Moreover, high subscription cost to online databases (X = 3.66, SD = 0.47) were identified as another critical barrier. These findings underscore the need to address infrastructural deficiencies, upgrade ICT tools, and ensure adequate training and internet connectivity to enhance library patronage among staff and students in the polytechnic.

Discussion of Findings

Research Question 1: What is the level of patronage to library services among staff and students?

The findings reveal that library patronage among staff and students is generally low, particularly for digital and electronic services. Traditional library services such as photocopying, book loans, and reference services are

more frequently used, whereas digital services like online book reservations, inter-library loans, and selective dissemination of information receive minimal patronage. This suggests that users may prefer conventional library services due to little integration of, or inadequate ICT infrastructure. This aligns with the findings of Oyedele and Grace (2021), who noted that inadequate technological infrastructure and limited awareness of digital library services often contribute to poor library usage. The low patronage of ICT-based library services suggests a need for increased sensitization and training on the benefits of utilizing digital resources.

Research Question 2: What is the library staff perception on integration of information and communication technology to library services as a response to poor library patronage among staff and students?

The results indicate that library staff strongly agreed that ICT integration enhances library patronage by improving access to information and facilitating seamless library operations. Respondents emphasized that digital tools such as institutional repositories, multimedia equipment, and online databases are essential in modernizing library services and increasing user engagement. The responses were highly consistent, indicating a general consensus that digital resources play a crucial role in encouraging patronage. This is consistent with Ayoade and Adeyemi (2018), who highlighted that integrating ICT into library operations significantly improves accessibility and user satisfaction. The consensus among library staff suggests that investing in ICT-driven solutions can address the issue of low patronage and transform the library into a more user-friendly learning environment.

Research Question 3: What are the type of available information and communication technologies that can encourage library patronage among staff and students?

The results reveal significant gaps in the availability of ICT resources in the library. While basic ICT hardware such as computers, printers, scanners, and photocopiers are readily available, essential digital infrastructure like library software, OPAC, and library management systems are lacking. Furthermore, networking components such as servers and routers exist but are not fully functional, and internet access remains limited. The lack of these essential digital tools likely contributes to the low utilization of e-library services. These gaps hinder the efficient delivery of library services. According to Agwu and Ifeanyi (2019), the availability of ICT resources in libraries directly influences the effectiveness of service delivery and user engagement. Without critical digital infrastructure, libraries may struggle to provide efficient and responsive services that meet the needs of modern users.

Research Question 4: What are the challenges associated with the use of available information and communication technology facilities that can encourage library patronage among staff and students?

ICT facilities significantly improve library services by facilitating access to information, automating processes, and enhancing overall efficiency. Several challenges hinder their effective utilization in enhancing library patronage. The major issues identified include the absence of advanced digital infrastructure, limited internet access, and inadequate technical support. The lack of an institutional repository, library web portal, OPAC, and online databases prevents the library from offering comprehensive digital services. This finding supports the argument by Okoro and Nwankwo (2017), who asserted that poor ICT adoption in academic library is often due to funding constraints, inadequate staff training, and infrastructural deficiencies.

Conclusion

The study revealed that traditional library services, such as book loans, reference services, and photocopying, are widely patronized among staff and students. However, digital services, including e-library and inter-library loans, are underutilized. This suggests a strong preference for traditional services while highlighting the need to improve the accessibility and functionality of digital offerings.

Library staff perceptions strongly support integrating ICT tools into library services to improve patronage. ICT facilities such as computers, printers, scanners, and multimedia equipment are seen as essential for enhancing service delivery. However, key digital tools such as library management software, online public access catalogues, and institutional repositories, library web portal are perceived as unavailable, indicating a significant gap in infrastructure.

A variety of ICT tools, such as computers, printers, and scanning machines, are readily available to encourage library use. However, critical digital resources, including a functional library website, social media platforms, and library management systems, are entirely absent. Limited availability of internet services and online databases further limits the library's ability to meet modern demands. Several challenges hinder the effective use of ICT in library services. These include inadequate internet connectivity, power supply issues, outdated hardware and software, and the absence of critical digital tools. High subscription costs for online databases also pose a significant barrier. These challenges need to be addressed to foster greater library patronage and improve service delivery.

Recommendation

Arising from the findings to this study, the following recommendations are made.

1. The library should vigorously sensitize the polytechnic community on the available information services, especially in compliance with the current trends integration on users information needs.
2. By improving access to information and facilitating seamless library operations, the library should lobby the Management to seriously invest in ICT driven academic library, especially to install institutional repository, Koha library management software and online database subscription.
3. The library should be thoroughly funded, enhanced capacity building, and improved internet connectivity in order to optimizing ICT integration in library services.

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Change Management Strategies for University Librarians: Navigating Career Mobility

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Abstract

Change is inevitable in today's dynamic workplace, particularly in librarianship. This article explores change management tactics that support career mobility and professional development, helping library professionals remain competitive. The researchers looked at how accepting change may help librarians develop in their profession. It also examined how librarians in South-West, Nigeria can adapt to changing job roles, take advantage of new technology, and advance their careers. The study employed a survey design. The population for the study consisted of 430 academic librarians in universities in South-West, Nigeria. A structured and validated questionnaire was used to collect data. The Cronbach's alpha reliability coefficients for the constructs ranged from 0.78 to 0.87. The response rate was 88.4% and the data were analyzed using descriptive and inferential (simple and multiple regression) statistics at a 5% significance level. The findings showed that there was a significant influence of career mobility on change management strategies of university librarians (Adj.R^2 = 0.81, F (1, 378), p < 0.05). The study concluded that careers are all about being flexible, creative, and willing to make bold professional moves. It was recommended that the management and library administration should make sure that all parties involved understand the rationale behind the change, the anticipated results, and the necessary steps. Staff members' comprehension and support of one another will be enhanced by this in the university.

Keywords: Career, Career Mobility, Change, Change Management, University Librarians, Professional Identity, and Professional Development

Introduction

Change has become a topic discussed by library and information professionals over the past few years. The world is dynamic and ever-changing; thus, change is widely understood to be life's constant and enduring feature. Changes are of different dimensions, types, and levels. The drivers of changes are internal and external operations and processes. There are organizational, technological, and cultural changes. Thus, changes are incremental and transformational change**,** however, is not a simple task; it usually influences the internal and then reflects on all external operations and processes. Institutional management policies and instructions for operations, strategies, and structures are frequently revised to reflect potential future developments. Changes occasionally occur due to environmental adjustments, administration, tactics, or some processes. Oketunji (2017) opined that the impact of change, on the other hand, is more significant due to its intermittent and unpredictable nature.

Change is essential for growth in all areas of life and it reduces the likelihood of disaster and increases the prospects of sustainability and survival (Shan & Shaheen, 2013). Globalization and rapid technological advancements have contributed significantly to this shift in libraries. Recently, changes have been made quickly due to modifications in the media landscape and user behaviors. There are nearly always changes in the way things happen as a result of both internal and external causes. Enright (2023) noted it is difficult to alter any institution. It is easy to become disoriented when adapting. Change is the process of moving from one state to another, and managing that transition is change management. For every firm to thrive and grow; managing change is essential. The rapid advancement of technology has altered the paradigm of the library profession and services. Additionally, change management significantly determines library patrons' expectations, preferences, and actions. Smoothly implementing changes for library patrons is one of the most crucial jobs of managers.

Strategic change management therefore is a collective term for all approaches to prepare, support, and help individuals, teams, and organizations in making organizational change. Appiah, Adams, and Adu (2016) stated that any procedure or activity used to help people or groups move seamlessly from one desirable condition to another is known as change management. In the contemporary global world, institutions that can adapt more successfully enhance their chances and competitive advantage, which makes global change management strategy imperative. Change management is the strategy used to go from the current situation to the one that is preferred. Without change management strategies, institutions would not grow, advance, and achieve their goals.

Technology has been the key to the successful implementation of updated information services offered in academic libraries. However, Miller (2020) noted that about 50% of organizational transformation initiatives fail. Although university libraries are under constant pressure to undergo various transformations, from traditional systems to virtual ones, there are challenges encountered by academic librarians operating in a constantly changing technology environment. To continue their employment in the libraries, library employees must also overcome the obstacle of obtaining ICT training and education. For this reason, it's critical that university libraries carefully implement institutional changes to guarantee that all of their goals are realized. All these have completely changed academic libraries and the information services they offer globally. A few of the difficulties facing libraries have been brought to light by research on change management, including librarians' poor global adaptation and resistance to change (Dadzie and Mensah, 2022).

RESEARCH QUESTIONS

- What change management strategies are embarked on university libraries in South-West Nigeria?
- What is the influence of career mobility on change management in university libraries in South-West Nigeria.

Literature Review

University Libraries and Changes Management Strategies

University libraries must constantly update their services, and strategies to assess their needs and those of their target audiences (Otike, Barat & Kiszl, 2022). Library heads need to address the important questions of why, what, who, when, and how to understand the different types of changes including the planned, unplanned, incremental, marginal, transitional, or transformational. Hence, to avoid setbacks in the growth of the institutions and the get the expected productivity of staff, it is crucial to consider the change management strategies employed by the different university librarians. Public sector library heads emphasize continuing education, training, and development of their staff to produce a positive impact on operations and the overall performance of libraries. Change management strategies in the context of university libraries of the twenty-first century therefore, refers to the systematic approach and processes involved in the planning, implementation, and management of changes within the library's structure, services, and operations (Gunapala, Montague, Reynolds, & Vo-Tran, 2020; Oketunji, 2017).

Academic libraries need to use technology advancement pertinent to new trends of specific technologies to interact and build alliances across institutions. Numerous researchers and scholars all over the world have investigated change management in academic libraries. As indicated in these studies, however, few studies have investigated change management strategies for enhanced efficient, effective, and profitable services. In the United States, Otike, Barat, and Kiszl (2022) study revealed that the application and use of entrepreneurial theories and principles are slowly invading the library space. They observed that the majority of American Library Association (ALA) accredited university library and information studies departments have included business courses in their curricula. Business jargon and tactics are not new; marketing ideas were used to launch the library's business model. As a result, academic libraries now compete with partners and markets outside of their community. If they must survive the market, they have to thrive to remain competitive and strategic.

At its libraries and throughout its campus, Michigan State University (MSU) has adopted sustainable reforms. The MSU Libraries' Library Environmental Committee serves as a leader in sustainability at the university and collaborates with several other departments, including MSU Sustainability. The MSU Libraries have carried out and taken the lead on several initiatives, such as staff training seminars, active recycling programs that encourage student participation, energy conservation, and waste reduction. By lowering food waste at landfills thanks to a compost collection program started by the library, Oregon State University Libraries, and Press have tried to reduce their greenhouse gas emissions. To prepare students to become aware, well-organized leaders with the capacity to make complicated decisions, the University of Calgary in Canada has introduced sustainable information literacy teaching as a first-year course (Stoeckle & Campbell, 2019). The development of a clear vision based on the demands and input of stakeholders is essential for leadership (Tribelhorn, 2023). Hence, libraries are strategically positioning themselves to be change agents in their environments.

Several libraries in China have prioritized economic and social development while giving little thought to environmental sustainability this has harmed practical long-term solutions and underlined the importance of libraries in Chinese colleges and universities. Arguably, this inequality will harm the neighborhood (Huang et al 2022; Kang, 2018). In addition, certain Chinese colleges have adopted various smaller projects as well as several larger ones to improve resource conservation and lower energy usage, including sustainable building

designs for their libraries. Further study by Huang et al (2022) on the investigation and analysis of the university library organizational climate in China revealed that university librarians in China had low job satisfaction. The management's weaknesses are found primarily in the two areas of climate for management justice and climate for staff support; while the leadership of libraries has started to value climate for innovation, it still lacks effective policies and support systems; the two aspects that perform well are interpersonal harmony and employees' sense of responsibility. However, Zhao, Zhang, and Wang (2019) stated in recent development that the administration of library resources is receiving increasing attention from Chinese governments. China's level of scientific and technological development is likewise progressively rising. With the aid of science and technology, an increasing number of library resources and literature data have realized the production and storage of diversified scientific knowledge.

In developing countries, like Kenya, many academic libraries are facing additional challenges hindering long-term sustainability. These challenges include no commitment from leadership, no established standard practices, policies, or procedures, limited resources, limited skills, and training, no funding, limited collaboration, and antiquated technology, as described for digital collections (Masenya, 2020), but could be applied to all aspects of sustainability. These are dysfunctional systems unable to address inequities effectively in any area of sustainability, ultimately resulting in these academic libraries being unable to support their communities. Typically, these challenges can occur in all academic libraries to different degrees, not just those from impoverished countries. Makanga (2019) observed that the Technical University of Kenya Library management should strategize to meet the expectations of the university community. This study investigated the challenge of how the Technical University of Kenya Library managers embrace change to meet the expectations of the university community.

Appiah, Adams and Adu (2016) observed that most academic libraries in Ghana had problems with the implementation of change initiatives thus many failed at the implementation stage. The resistance of employees, inadequate planning periods, lack of adequate communication, an attempt to change everything at once, and half-hearted management commitment coupled with financial constraints account for the failure of most change initiatives in academic libraries in Ghana. At the Balme Library, the researchers revealed that the most frequent problems that affect change implementation in academic libraries include the absence of a highly visible leader to take ownership of projects, a longer than planned time frame to complete the change process, major unanticipated problems, and ineffective coordination of activities (Dadzie, & Mensah, 2022). Furthermore, researchers observed that most academic libraries in Ghana had problems with the implementation of change initiatives, thus many failed at the implementation stage. (Appiah, Adams, & Adu, 2016; Dadzie, & Mensah, M., 2022).

In Nigeria, many researchers observed that maintaining the university's e-library comes at a high expense, doing nothing is riskier. Librarians cannot afford to stay in their current position; they must change with the times or perish. The researchers stated that funding is the biggest issue for libraries. In the face of declining financing, it is not possible to provide enhanced, successful, efficient, and sustainable information services, as well as access to a wide range of knowledge and information sources (Enweani, 2018; Ifijeh & Yusuf 2020; Okere & Olorunfemi, 2018). In the same vein, other studies' findings revealed that institutions had installed the most modern technology in teaching, registration, admissions, and internet access, among other areas, because of technological advancements (Archibong & Ibrahim 2021). In addition, the sudden global epidemic known as COVID-19, which at one point resulted in movement restrictions and a general state of lockdown around the globe quickly enhanced the technology options available to change management strategies to lighten the workload and improve competence in the profession.

Change Management Strategies from the Leadership Perspective.

Change management strategies are a collection of best practices and experiences that are applied to both internal and external changes to achieve a long-term goal. They include the methods, procedures, and equipment used to guarantee that adjustments are effectively implemented and integrated into the operations of the library (Otike, Barat & Kiszl, 2022; Tribelhorn, 2023). The leadership and academic librarians; therefore, need strategies to manage changes (Seeman, 2021 & Waterhouse, 2019). To tackle impending problems, library directors need a clear vision and a well-thought-out strategy. They also need to be self-assured and able to collaborate with a diverse team. For the heads of libraries to achieve the institution's goal of change management, they must play leadership and human resource management roles to adopt some strategies that will enhance changes.

The ALA examined all procedures to ensure that leadership is consistent with the principles to control reluctance to change. They observed that in essence, librarians should reaffirm their commitment to the fundamental principles (Martin, 2018). Therefore, leadership should highlight the significance of sustainable projects in academic libraries for success, transparency, and inclusiveness in governance. Research results by

Abrigo and Torres (2022) showed that, despite the small number of responses, few libraries had a holistic approach to sustainability, with minimal leadership guidance and little review of sustainability programs. Yet, for long-term benefits for their communities, library leadership must recommit to their ideals and promote a culture of sustainability through ongoing evaluation. However, this occurs because of the sudden worldwide COVID-19 outbreak, which at one point resulted in mobility restrictions and a general state of lockdown has rapidly improved technology, reduced workload, and improved proficiency in the workplace (Ifijeh & Yusuf, 2020; Archibong & Ibrahim 2021).

Based on the above reflections, a considerable case is made for this research on change management strategies in university libraries on the basis that only a few studies have been conducted to provide strategies for change management about the introduction of new technologies and the provision of library services among university libraries. Hence, leaders and managers need to be the change agents. At Islamabad and Rawalpindi (Pakistan), Shan and Shaheen, (2013) study on the leadership role in change management noted that academic libraries are improving much more compared to any other type of libraries because of the change of new information technologies. In these academic libraries, the library heads work in bureaucratic structural organizations where centralized decision-making and strict hierarchy encourage standards and dogmatic rules. Archibong and Ibrahim's (2021) research study results demonstrate that the institution whose leadership supports and has installed the most contemporary technology in a variety of areas, including teaching, registration, admissions, and internet access thrives better.

Concept of Career Mobility

A career is a person's "representational journey" through their educational background, place of employment, and other aspects of their lives. Depending on where the word is used, a career can be defined in many ways: it's a job that requires a lot of time and offers room for growth. Mobility is usually defined as the capacity to move swiftly and easily, as well as the desire or propensity to shift to a better place or circumstance. The term "career mobility" refers to an employee's transition across positions, levels, and even institutions. It served as a benchmark for measuring people's development and output. Kennedy and Antúnez (2017) pointed out that employment transfers or mobility are becoming the norm, particularly for librarians who are career-focused. Because of the discontent with their jobs, librarians may use it as a platform for changes in leadership, reorganizations of job responsibilities, and retirement rates. Workers are becoming more mobile and quitting positions without security in pursuit of better opportunities and reorganization, as many have concluded that long-term employment is no longer a realistic aim. Individuals often pick up all the abilities required in various workplace segments and move to different career levels, roles, and organizations.

Employees' experience and career possibilities are enhanced by career mobility inside the organization. It follows that migration and job mobility are influenced by the distance to be moved. Thus, it can be concluded that early-career workers typically have an easier time migrating than mid- and late-career workers, or that male workers typically have an easier time than female workers. On the other hand, an experiment shown by Grunau and Pecoraro (2017) indicates that highly educated workers affect the effectiveness of the organization, whereas employees with less education do not, in any case, lower production. According to Latzke et al. (2016), the labor market, organizational growth, and economic development have all led to a rigorous examination of career shifts and stability in recent years. Due to outsourcing and delays, several firms are hesitant to enter into long-term agreements with their employees. In terms of professions in general and job mobility in particular, Germany, however, has a unique viewpoint. Each country in the world has its own unique set of regulations regarding employment, layoffs, work councils, trade unions, and working hours and conditions. Still, when it comes to positive role models and employment regulations, Germany is among the largest economies in the world. According to the studies (Grunau & Pecoraro, 2017; Latzke et al, 2016), earnings grow after voluntary job moves, while job levels remain similar or fall for those who stay on the job.

Other researchers have found that upward mobility is possible because job-to-job movement is to higher-paying jobs (Javdani, 2020; Lohr, 2020). One possible explanation for the observed salary disparities is that visible minority native-born have slower income growth because of their inability to keep up with their white counterparts in terms of job mobility. Investigating employment mobility between Canadian visible minorities and white native-born people helps to enhance a better understanding of salary disparities (Javdani, 2020). Thus, with the change in the work environment, technology, and working tools, there is a need for changes in workers' attitudes. In the past, people in Nigeria and other parts of the world would stay on a job for their entire lives, but in recent years, individuals have become more open to the possibility of changing jobs and moving from one region to another when the employment conditions are not favorable or when they are not promoted. In addition, switching jobs and professions was the exception rather than the norm in the past, but today it is widespread.

Changes Management Strategies and Career Mobility

Huinink, Vidal and Kley (2014) averred that employees consider factors based on heterogeneity (age, employment, family, education, wages, or salary) in search of jobs. They concluded that the decision to migrate enhances several openings and the likelihood of getting a better job. There is correspondingly adequate provision for such mobility, as many institutions and organizations are changing policies and downsizing. Employees, who plan and strategize, therefore determine their lots thereby leading to fulfillment in their jobs and careers (Career Research, Igbokwe, 2011, Giulioni, 2017). In some countries, especially in developed countries, there are jobs for all categories of people whether you are a certified professional or not, while in some other countries, jobs are not easy to get, hence, people who plan their career paths are better equipped to get the best in their profession and lives.

Researchers estimate differences in the probability of inter-firm mobility, the probability of intra-firm mobility (i.e. promotion), the number of times promoted, as well as wage returns associated with inter-firm and intra-firm mobility. Indeed, the effects of mobility are difficult to measure, since it is difficult to determine if the individual internal wage direction is higher than that of the intermediary wage (i.e. mobility). Javdani (2020) noted that job mobility experts cannot discover any indication of the differences in hierarchy, professional paths, or immigration history. Different family roles influence societal values or family dynamics, which also play a role in career mobility. However, the employers determine promotion decisions while the decision to change jobs is determined by the employee, also labor market discrimination between males and females remains a possible contributor to these differences. When there is a change of job, sometimes individuals experience increases in wages, while at some other times, individuals experience wage reduction (Javdani, & McGee, 2013; Schneck, 2010).

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Methodology

The study employed survey design. The population consists of all 430 librarians working in public and private university libraries in the South-West, Nigeria. A total of 380 respondents responded and completed the survey questionnaire and they were analyzable giving a response rate of 88.4%. The geographical region chosen for this study is South-West **zone**. This is because the South-West geopolitical region is considered to have the highest number of both public and private universities in Nigeria.

Table 1
Frequency Distribution of Demographic Information of Respondents

Demographic Information	**Labels**	**Frequency**	Percentage (%)
Gender	Female	210	**55**
	Male	170	**45**
Age Range	20 years and below	44	**12**
	21-30	58	**15**
	31-40	118	**31**
	41-50	98	**26**
	51 - 60	45	**12**
	61 years and above	17	**5**
Job Status/Rank	University Librarian	22	**6**
	Deputy librarian	47	**12**
	Principal librarian	68	**18**
	Senior Librarian	46	**12**

	Librarian I	112	**29**
	Librarian II	18	**5**
	Assistant Librarian	85	**22**
Years of Work Experience	10 years and below	45	**20**
	11-20	100	**20**
	21-30	125	**33**
	31-40	74	**20**
	41-50	26	**7**
	51 years and above	10	**3**
Demographic Information	**Labels**	**Frequency**	Percentage (%)
Highest Academic Qualification	PhD	84	**22**
	MLIS/MSc/MA	180	**47**
	BSc/BA/BLS	76	**20**
	HND	15	**4**
	OND	25	**7**
Category of Employee	Permanent employee	355	**93**
	Volunteer employee Temporary employee	5	**1**

Source: Researcher's Field Survey, 2024

Table 1 reveals the demographic information of the respondents. The result shows that out of 380 respondents, 210 (55.3%) respondents were female, and 170 (44.7%) respondents were male. This implies that there was almost an equal representation of the two genders in this study; however, female librarians are more than male librarians. The result shows that 118 (39.2%) respondents were between the age range of 31 and 40 years while only 17 (4.5%) respondents were 61 years and above. The finding shows that the majority of the respondents 112 (29.5%) were Librarian I, while assistant Librarians were next at 22 (5.8%) respondents. The result shows that 125 (32.9%) of the respondents had 21-30 years of work experience while only 10 (2.6%) respondents had 51 years and above work experience. The result shows that 180 (47.4%) respondents had a Master's degree while only 15 (3.9%) respondents had OND.

Table 2
Change Management Strategies Change Management Strategies Embarked on in University Libraries in South-West, Nigeria

Change Management Strategies	**Yes (%)**	**No%**
Change of the leadership	230 (60.5)	150 (39.5)
Change of the corporate structures	195 (51.3)	215 (56.6)
Organizational structure change	226 (59.5)	235 (61.8)
Task change	165 (43.4)	154 (40.5)
Organizational culture change	173 (45.5)	207 (54.5)
Change of the library practice	168 (44.2)	150 (36.5)
Change of the library environment	183 (48.2)	212 (55.8)
Change of the learning environment	152 (40.0)	197 (51.8)
Staff training	145 (38.2)	228 (60)

Capacity development	162 (42.6)	185 (48.7)
Job rotation	230 (60.5)	218 (57.4)

Source: Researcher's Field Survey, 2024

Table 2 presents the frequency distribution of change management strategies embarked on in university libraries in South-West, Nigeria. The result shows that 230 (60.5%) respondents indicated that their university libraries embarked on a change of leadership. The result shows that 195 (51.3%) respondents indicated that their university libraries embarked on a change of the corporate structures. The result shows that 226 (59.5%) respondents indicated that their university libraries embarked on organizational structure change. The result shows that 165 (43.4%) respondents indicated that their university libraries embarked on task change. The result shows that 173 (45.5%) respondents indicated that their university libraries embarked on a change in organizational culture. The result shows that 168 (44.2%) respondents indicated that their university libraries embarked on a change of library practice. The result shows that 183 (48.2%) respondents indicated that their university libraries embarked on a change in the library environment. The result shows that 152 (40.0%) respondents indicated that their university libraries embarked on a change in the learning environment. The result shows that 145 (38.2%) respondents indicated that their university libraries embarked on staff training. The result shows that 162 (42.6%) respondents indicated that their university libraries embarked on capacity development. The result shows that 230 (60.5%) respondents indicated that their university libraries embarked on job rotation.

Table 3
Unfreeze, Change, and Refreeze as Change Management Strategies Carried Out in University Libraries in South-West, Nigeria

Statements **REFREEZE**	**Strongly Agree** **(%)**	**Agree** **(%)**	**Disagree** **(%)**	**Strongly Disagree** **(%)**	**Mean**	**SD**
(Weighted Mean: 3.43)					**3.43**	**7.83**
Librarians gain new knowledge because of change management strategies	220 (57.9)	148 (38.9)	12 (3.2)	0 (0)	3.55	0.56
Change management strategies have introduced new library policies	218 (60.5)	150 (31.4)	12 (6.3)	0 (0)	3.54	0.56
Librarians gain new knowledge because of the new library infrastructure	203 (53.4)	169 (44.5)	8 (2.1)	0 (0)	3.51	0.54
Change management strategies have increased my self-development on the job.	220 (57.9)	132 (34.7)	26 (6.8)	2 (0.5)	3.50	0.65
Change management strategies encourage delegation of authority on the job.	230 (60.5)	122 (28.8)	10 (2.6)	18 (4.7)	3.48	0.77
Change management strategies have increased my job experiences.	191 (50.3)	171 (45.0)	18 (4.7)	0 (0)	3.46	0.59
Change management strategies have introduced relatively new job responsibilities.	199 (52.4)	149 (39.2)	32 (8.4)	0 (0)	3.44	0.65
Librarians are exposed to new library practices because of change management strategies.	183 (48.2)	173 (45.5)	22 (5.8)	2 (0.5)	3.41	0.63

Statements **REFREEZE**	**Strongly Agree** **(%)**	**Agree** **(%)**	**Disagree** **(%)**	**Strongly Disagree** **(%)**	**Mean**	**SD**
The university library acquires sufficient library resources for the university patrons because of change management strategies	187 (49.2)	160 (42.1)	25 (6.6)	8 (2.1)	3.38	0.70
Change management strategies encourage mentoring/guidance on the job	183 (48.2)	156 (41.1)	35 (9.2)	6 (1.6)	3.36	0.71
University library IT infrastructure is adequate for patrons because of constant change management strategies	159 (41.8)	166 (43.7)	53 (13.9)	2 (0.5)	3.27	0.71
Change management strategies have improved my relationship with my boss (es).	155 (40.8)	173 (45.5)	40 (10.5)	12 (3.2)	3.24	0.76
Weighted Mean					**3.38**	**10.49**
The library policy is amended periodically by library management	231 (60.8)	129 (33.9)	20 (5.3)	0 (0)	3.56	0.59
The university management always gives the necessary support to the actualization of the library policy	226 (59.5)	124 (32.6)	30 (7.9)	0 (0)	3.52	0.64
The library management implements the library policy	230 (60.5)	120 (31.4)	24 (6.3)	6 (1.6)	3.51	0.69
IT infrastructure is acquired at regular intervals in the library	215 (56.6)	145 (38.2)	20 (5.3)	0 (0)	3.51	0.60
The library environment is conducive for the university patrons	215 (56.6)	129 (33.9)	34 (8.9)	2 (0.5)	3.47	0.68
Periodically, there is an upward review of the work condition	214 (56.3)	132 (34.7)	28 (7.4)	6 (1.6)	3.46	0.70
Information resources are acquired at regular intervals in the library	200 (52.6)	152 (40.0)	24 (6.3)	4 (1.1)	3.44	0.66
Change in the university library is infrequent	203 (53.4)	139 (36.6)	38 (10.0)	0 (0)	3.43	0.67
The university management changes the work conditions intermittently.	180 (47.4)	183 (48.2)	11 (2.9)	6 (1.6)	3.41	0.63
Change in the university library is not usually a planned activity	165 (43.4)	195 (51.3)	18 (4.7)	2 (0.5)	3.38	0.60
The work condition is changed intermittently by the library management	170 (44.7)	162 (42.6)	40 (10.5)	8 (2.1)	3.30	0.74

The work environment is altered periodically for the university librarians	168 (44.2)	162 (42.6)	36 (9.5)	14 (3.7)	3.27	0.78
The policy is known to all the library staff	168 (44.2)	139 (36.6)	61 (16.1)	12 (3.2)	3.22	0.83
The work environment is conducive for the university librarians	149 (39.2)	173 (45.5)	45 (11.8)	13 (3.4)	3.21	0.78
My university has a library policy for change management strategies	148 (38.9)	144 (37.9)	64 (16.8)	24 (6.3)	3.09	0.90
UNFREEZE	**Strongly Agree (%)**	**Agree (%)**	**Disagree (%)**	**Strongly Disagree (%)**	**Mean**	**SD**
Weighted Mean					**3.08**	**8.13**
The changing learning environment	160 (37.8)	164 (38.8)	18 ()	38 (0)	3.17	0.92
Organizational structure change	154 (40.5)	161 (42.4)	39 (10.3)	26 (6.8)	3.17	0.87
Change in the library environment	152 (40.0)	148 (38.9)	59 (15.5)	21 (5.5)	3.13	0.87
Change in library management software	152 (40.0)	144 (37.9)	61 (16.1)	23 (6.1)	3.12	0.89
Organizational culture change	118 (31.1)	195 (51.3)	55 (14.5)	12 (3.2)	3.10	0.75
Change in leadership	170 (44.7)	109 (28.7)	63 (16.6)	38 (10.0)	3.08	1.00
Developments in information technology	141 (37.1)	160 (42.1)	49 (12.9)	30 (7.9)	3.08	0.90
The changing economy	107 (28.2)	193 (50.8)	44 (11.6)	36 (9.5)	2.98	0.88
Changes as a result of natural disaster	143 (37.6)	112 (29.5)	75 (19.7)	50 (13.2)	2.92	1.05
Grand mean					**3.30**	**0.73**

Source: Researcher's Field Survey, 2024

Table 3

Table 3 reveals the descriptive analysis of change as one of the change management strategies carried out in the university libraries in South-West, Nigeria. The result shows that the Weighted Mean of change as one of the change management strategies carried out in the university libraries in South-West, Nigeria is $\bar{x} = 3.38$. This implies that librarians in university libraries in South-West, Nigeria agreed that change is one of the change management strategies carried out in the university libraries in South-West, Nigeria. The descriptive analysis of refreeze reveals change management strategies as one of the carried out in the university libraries in South-West, Nigeria. The result shows that the Weighted Mean of refreeze as one of the change management strategies carried out in the university libraries in South-West, Nigeria is $\bar{x} = 3.43$. This implies that librarians in university libraries in South-West, Nigeria agreed that refreezing is one of the change management strategies carried out in university libraries in South-West, Nigeria.

Table 4

Influence of Career Mobility on Change Management in University Libraries

Variables	*B*	Std. Error	Beta (*β*)	T	P	R^2	F	*D(residual)*	*p*
(Constant)	14.37	2.53		7.68	.00	0.81	1637.35	1(378)	0.00
Career Mobility	2.02	0.05	0.90	40.46	.00				
Dependent	**Variable:**	**Change**	**Management**	**Strategies**					

Source: Researcher's Field Survey, 2024, ***β*** = Standardized Coefficient, significant at 0.05

Table 4 indicates that career mobility significantly influences change management strategies in university libraries ($\beta = 0.90$, t=40.46, R^2=0.81, p<0.05). The result shows that the t-value is noted to be 40.46. The R-Square is 0.81; this means that 81% of the variation in career mobility can be explained by change management strategies in university libraries. The result also showed a positive slope of ($\beta = 0.90$). The result further showed a positive relationship between career mobility and change management strategies in university libraries with (Beta = 0.90). This means that a unit increase in career mobility results in a 90% increase in change management strategies. However, the significant value of 0.00 is the calculated value and it is used to compare the t-tabulated value of 0.05 (5% standard value). Since 0.00 < 0.05, the null hypothesis is rejected. Therefore, the result concluded that career mobility significantly influences change management strategies in university libraries in South-West, Nigeria.

Table 5

Influence of Career Mobility (Indicators) on Change Management Strategies of University Librarians

Variables	*B*	Std. Error	Beta (*β*)	T	P	Adj. R^2	F	*df (residual)*	*P*
(Constant)	14.37	3.57		4.02	0.00	0.70	443.15	2(377)	.0.00
Intrafirm mobility	3.08	0.21	0.61	14.45	0.00				
Inter-firm mobility	1.19	0.18	0.28	6.75	0.00				
Dependent	**Variable:**	**Change**	**Management**	**Strategies**					

Source: Researcher's Field Survey, 2024

Table 5 shows that career mobility significantly influences the change management strategies of university librarians in South-West, Nigeria (Adj R^2=0.70, F2(377) = 443.15, P<0.05). The R-Square of career mobility is 0.70; this means that a 70% variation in career mobility can be explained by the change management strategies of university librarians in South-West, Nigeria. The table shows that the regression yielded an F-value of 443.15 (p = 0.00). This implies that the significant value of 0.00 is the calculated value and it is used to compare the t-tabulated value of 0.05 (5% standard value). Since the p-value = 0.00, the null hypothesis is rejected. Therefore, career mobility significantly influences the change management strategies of university librarians in South-West, Nigeria. However, table 4.8 further shows that the two indicators of career mobility which are: intra-firm career mobility with ($\beta = 0.61$; $p < 0.05$) and inter-firm career mobility with ($\beta = 0.28$; $p < 0.05$) had an individual significant influence of change management strategies of university librarians in South-West, Nigeria.

Discussion of Findings

The results of the data analysis are further discussed in this section. This is to give a more thorough explanation of the variables in the study. Following the order in which they were presented in the analysis, the study's goals and questions were examined in the same order that they were examined. The following approach is used to analyze the study's findings:

The study supports Dadzie, and Mensah (2022) observation that there is a lack of literature on change management in libraries, particularly in Africa. Most of the other studies on the subject have focused on changes to the technologies, resources, and services that libraries provide. This study therefore was directed toward improving the change management strategies of university libraries. However, there seems to be a low awareness of the changes to be made in many university libraries and a low awareness of library policies on change management in university libraries. The results presented by Du Plessis and Mabunda (2016) support the major findings that participants said they adapted to change because of self-motivation and when the new technology showed great benefit to the service they delivered. Adeyoyin, Abayomi, and Bello's (2012) findings further supported the study that organizational structure change that all change management and programs need to be contextual and comprehensive.

The results agreed with Moonasar (2024) findinds which indicated that librarians who strongly identify with their profession may be more inclined to adopt changes that align with their professional values and standards. This finding also supports Glusker, Emmelhainz, Estrada, and Dyess (2022) that librarians who see prospects for mobility inside or outside the library profession or for career promotion may be more adaptable because they view change as an opportunity to grow their expertise and experience. In contrast, people with low expectations for their careers could be less amenable to change, particularly if they think it will compromise their stability. However, change management strategies open many doors to those who desire career advancement and personal growth. The result of this study shows that career mobility significantly influences the change management strategies of university librarians in the South-West geopolitical zone of Nigeria.

The findings of this study agree with Duncan (2018) result that career mobility is suitable for every employee who wants to be satisfied with their jobs and live a fulfilled life. Furthermore, the findings of the study are consistent with those of Huinink, Vidal, and Kley (2014), who conducted a study on people's willingness to change jobs and move, find a favorable salary, and pay increases. Afterward, concluding that career mobility significantly influenced change management strategies. The results also corroborate According to Lam, Ng, and Feldman (2012), the favorable impacts of external job mobility on compensation are stronger for early-career workers than for mid- and late-career workers, and career mobility has a considerable impact on worker satisfaction. In the same vein, Dadzie, and Mensah (2022) supported the rotation of staff at the University of Ghana Library System (UGLS) in its main library and the satellite libraries. Furthermore, Goossen & Carnabuci (2020) concur with this study when they stress the relevance of employee change management strategies and it's the consequences on interfirm mobility.

Conclusion

The study was directed toward improving the change management strategies of academic libraries. The research established indicators of professional identity and change management strategies of university librarians in South-West, Nigeria. The result of this study shows that the librarians in university libraries agreed that unfreeze, change, and refreeze are change management strategies that are carried out in the university libraries. The study concluded that professional identity and career mobility jointly influenced the change management strategies of university librarians in South-West, Nigeria. And there is a positive relationship between career mobility and the change management strategies of university librarians. The gap for this study provided cases for changes for individuals, especially women who might opt for career mobility and job rotation, instead of outright migration, which is possibly due to household responsibility. The result of this study therefore shows that career mobility significantly influences change management strategies in university libraries in South-West, Nigeria.

Recommendations

The study's findings have an impact on the government, LIS schools, university administrations, professional librarians, and the Librarians Registration Council of Nigeria (LRCN). Based on the study's findings, the following suggestions were offered to deal with these issues:

1. The university management and library administration should understand the rationale behind the change, the anticipated results, and the necessary steps. Staff members' comprehension and support of the change management strategies and one another are enhanced by this.
2. Engage important parties in the transformation process, such as professors, staff, students, and librarians. By using their opinions and suggestions, change projects can be better implemented and possible problems can be found.
3. There should be a uniform standard for all Library and Information Science programs in public and private universities and the salary of university librarians should also be at par with other professionals because many academic librarians disagree that their pay is comparable with other professions.
4. University librarians should understand that change is a dynamic process and be ready to modify their plans of action when necessary. Therefore, being adaptive and flexible can help deal with unforeseen

problems and guarantee the success of change projects.

5. The university librarians agreed that inter-firm career mobility has more prospect of enhancing change management strategies of academic librarians in South-West, Nigeria, therefore, the university management should provide off-the-job training to ensure more opportunities are available to reduce career migration of librarians.

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Competencies Required by Library and Information Science (LIS) Professionals for the 5th Industrial Revolution

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Abstract

The paper examined the key competencies required by LIS professionals for Fifth Industrial Revolution (5IR) which represents a transformative stage in technological evolution, characterized by the fusion of human intelligence with advanced technologies such as artificial intelligence, robotics, and big data. The paper argued that unlike the 4th Industrial Revolution, which focused primarily on automation and machine intelligence, the 5IR prioritizes collaboration between humans and machines to create more inclusive and socially responsible advancements. This shift presents both challenges and opportunities for Library and Information Science (LIS) professionals, who must adapt to an evolving information ecosystem shaped by intelligent technologies and user-centric services. The study adopted a survey design and used a structured questionnaire to collect data from LIS professionals in Nigeria's South-South region, who served as the population of the study. Questionnaires were distributed via Google Forms on professional WhatsApp platforms, The collected data were analyzed using simple percentages, mean, and standard deviation to address the research questions. The study revealed that to thrive in this era, LIS professionals require a blend of advanced digital literacy, AI and automation knowledge, critical thinking, data analytics skills, and essential soft skills like adaptability and collaboration skills equally as crucial as technical expertise. However, the research also uncovered significant gaps in LIS education and training that hinder graduates' readiness for active participation in 5IR. Challenges such as limited funding and inadequate access to technological infrastructure were among the most pressing concerns. To bridge these gaps, the study recommends implementing collaborative learning initiatives with tech companies, mandatory 5IR competency certifications, flexible online and blended learning models, and robust mentorship programs. With these strategies in place, libraries can transform into innovative and inclusive knowledge hubs, and LIS professionals will be better equipped to stay relevant and uphold the core values of their field in a rapidly evolving digital landscape.

Key Words: *LIS Professionals, 5th Industrial Revolution, Artificial Intelligence, Big Data, Blended learning*

1. INTRODUCTION

The global landscape of knowledge creation, dissemination, and utilization is rapidly evolving as the world moves towards the **5th Industrial Revolution (5IR)** an era characterized by **human-centric innovation, collaborative synergy between humans and advanced technologies,** and a strong focus on **personalization, sustainability, and ethical use of technology**. Unlike the preceding Fourth Industrial Revolution, which emphasized automation, artificial intelligence (AI), and data-driven systems, the 5IR envisions a **harmonious integration of human intelligence with cutting-edge technologies** to address complex societal challenges and enhance the human experience. (Ayinde et al., 2024). In this emerging context, **Library and Information Science (LIS) professionals** are at a pivotal juncture. Libraries, as traditional custodians of knowledge and information, are no longer limited to physical repositories but have evolved into dynamic centers for **knowledge curation, digital inclusion, innovation, and lifelong learning**. As the 5IR unfolds, LIS professionals are expected to play critical roles in **bridging technological advancements and human needs,** ensuring equitable access to information while upholding ethical standards and social responsibilities. (Adigun et al., 2024)

To remain relevant and effective, **LIS professionals must be equipped with new competencies and mindsets** that transcend conventional librarianship. This includes **proficiency in emerging technologies** such as AI, machine learning, blockchain, Internet of Things (IoT), and data analytics, alongside **strong**

human-centered skills like critical thinking, creativity, digital ethics, emotional intelligence, and interdisciplinary collaboration. Additionally, understanding concepts such as **personalized information services, sustainable knowledge ecosystems, and inclusive digital transformation** is essential to meet the diverse and evolving needs of the communities they serve. Furthermore, as **guardians of information integrity and promoters of intellectual freedom,** LIS professionals have a responsibility to **navigate challenges** such as misinformation, digital divides, data privacy, and algorithmic biases, which are likely to intensify in the 5IR era. (Adeleke & Ajakaye, 2023, Nwobu et al, 2024).

Despite the significant opportunities offered by the 5IR, the preparedness of Library and Information Science (LIS) professionals in Nigeria remains limited. While there is strong awareness of emerging technologies such as artificial intelligence, big data, and robotics, many LIS professionals have not received adequate training or exposure to these tools. The traditional curriculum in most LIS schools is still largely focused on conventional library practices, with minimal integration of 5IR-related competencies. As a result, professionals often lack the digital literacy, data analytics, and technological adaptability needed to function effectively in this evolving landscape. Although a few professionals have taken personal initiatives to upskill through online courses or international collaboration, this progress is not yet widespread or institutionalized. (Tella et al., 2022)

However, there are encouraging signs of readiness in some quarters. The increasing use of digital library systems, open access repositories, and user-focused service models shows a shift toward modern practices. Additionally, recent recruitment of qualified librarians and gradual inclusion of technology-based training in LIS education indicate a move in the right direction. Professional associations and academic institutions are also beginning to organize workshops and conferences that emphasize the importance of 5IR skills. (Moonasar, 2024).

Nonetheless, to fully prepare for the 5IR, Nigeria's LIS sector needs stronger policy support, targeted funding, and comprehensive curriculum reform to close the gap between potential and practice. Without these systemic changes, the promise of the 5IR will remain largely untapped for LIS professionals in the country. It becomes very important to ascertain if LIS professionals in Nigeria have adequately been prepared to face this new era. Thus, **continuous professional development, adaptive leadership, and a proactive embrace of innovation** are indispensable for enabling LIS professionals to thrive in this transformative period. Hence, this background underscores the urgent need for **strategic initiatives, educational reforms, and capacity-building programs** aimed at **empowering LIS professionals for the 5th Industrial Revolution**, ensuring they are well-prepared to lead and contribute meaningfully to the advancement of knowledge societies in a human-centered, ethically driven, and technologically advanced world.

1.2. STATEMENT OF PROBLEM

As the world advances into the Fifth Industrial Revolution (5IR), Library and Information Science (LIS) professionals face significant challenges in aligning their skills with emerging technological and human-centered trends. While libraries continue to play a crucial role in knowledge access and innovation, many professionals remain underprepared for this new era as they struggle to acquire the required key competencies to navigate this 5IR. Other challenges such as limited awareness of 5IR concepts, inadequate funding, inadequate training in emerging technologies like AI, blockchain, and IoT, and a lack of integration of these topics into LIS education and professional development. Additionally, current LIS training often overlooks the soft skills such as emotional intelligence, creativity, and interdisciplinary collaboration needed for ethical and personalized service delivery. These gaps hinder LIS professionals' ability to remain relevant and lead in technology driven, inclusive environments. Addressing these problems requires strategic reforms in curriculum, targeted training initiatives, and supportive policies that prioritize both technological and human-centric competencies.

OBJECTIVES OF THE STUDY

The study is meant to look at equipping library and information science professionals for the 5th industrial revolution. However, the study specifically sought to:

1. Identify the key competencies required for LIS professionals in 5IR
2. examine the influence of the competencies required by the LIS professionals on 5IR
3. assess the current state of LIS education and training
4. evaluate the challenges associated with the acquisition of competences required by LIS professionals for 5IR
5. propose strategies for effective LIS professional development

RESEARCH QUESTIONS

The following research questions will be used to guide the study

1. What are the key competencies required for LIS professionals in 5IR?
2. What is the influence of competencies required by LIS professionals on 5IR?
3. What is the current state of LIS education and training?
4. What are the challenges associate with the acquisition of competencies required by LIS professionals for 5IR?
5. What strategies are employed for effective LIS professional development?

KEY COMPETENCIES REQUIRED FOR LIS PROFESSIONALS IN 5TH INDUSTRIAL REVOLUTION

According to Villar et al. (2023), the Fifth Industrial Revolution (5IR) involves the integration of advanced technologies such as artificial intelligence, big data analytics, and the Internet of Things into educational institutions and libraries. Librarians play a vital role in this transformation by adapting to technology advancements and ensuring that all users have access to efficient services. One of the fundamental skills for LIS professionals in the 5IR is digital literacy, or the ability to use digital tools and technologies for information management and service delivery (Jyotsna & Madhu 2021). LIS personnel need to be skilled at using databases, information systems, and digital resources to meet the needs of patrons in libraries and information centers. Librarians should also be proficient in data management, which involves data collection, analysis, and visualization, in order to support evidence-based decision making and enhance services (Thiruppathi, 2024). Similarly, another crucial ability for librarians in the 5IR is technological expertise. According to Tella et al. (2023), librarians need to be proficient with a variety of technologies, such as library management systems, digital asset management platforms, and online research tools, since libraries are depending more and more on digital tools and resources to assist their patrons. Librarians should also be skilled in information retrieval so they can access and disseminate content from a range of sources, such as digital repository and online databases, to meet a range of learning needs (Bokoh et al., 2023). Librarians must include online learning platforms, e-books, and digital catalogues into their services to increase accessibility. Librarians must possess good networking and cooperation skills in order to work with other people and organizations to share resources and expertise. (Chisita and others, 2019). To keep up with the newest technological advancements and the evolving demands of their patrons, librarians must be adaptable and committed to lifelong learning.

To adjust to the requirements of the 5IR and satisfy the evolving needs of users, LIS professionals must develop STEM competencies, such as creativity, critical analysis, teamwork, and problem-solving abilities (Kenga & Sijide, 2024). Ziatdinov et al. (2024) claim that the Fifth Industrial Revolution (5th IR) is defined by the incorporation of cutting-edge technology like artificial intelligence, big data analytics, and the Internet of Things into a variety of sectors, including education and libraries. By adjusting to technological developments and making sure that all of their users receive efficient services, LIS professionals play a critical part in this transformation (Ekwueme, Oluwaseun, Ajie, , Ofodu, . & Ambrose, 2024).

Nwobu, Dumbiri, Ibia, and Oladokun (2024) added that in order for LIS professionals to stay relevant in the 5IR, they need to acquire critical skills such as:

- **Data literacy:** This includes knowing data structures, analysis methods, and how to extract valuable insights from large datasets.
- **Knowledge of AI and machine learning:** Familiarity with AI principles and their application to library services, including chatbot development and recommendation systems.
- **User experience design:** Understanding user behavior and creating user-friendly interfaces to improve engagement and information availability.
- **Information curation:** This is the process of choosing, assessing, and arranging data from many sources, including both digital and physical media.
- **Ethical considerations:** Navigating the ethical implications of emerging technologies like data privacy and algorithmic bias in library services.

These key competencies will enable LIS professionals to thrive in the 5th Industrial Revolution and provide innovative, user-centered services and systems.

THE IMPACT OF 5TH INDUSTRIAL REVOLUTION ON LIS PROFESSIONALS

In the Fifth Industrial Revolution (5th IR), conventional automation gives way to cutting-edge technologies that improve speed, connectivity, and creative problem-solving, increasing productivity and opening new economic prospects. In order to provide services, LIS personnel must embrace 5th IR technology. To improve user experiences and increase access to information, LIS experts are urged to incorporate technologies such as 3D printing, cloud computing, robots, artificial intelligence, and the Internet of Things

(IoT). By enabling flexible, remote access to digital materials, these technologies help libraries expand the range of services they offer and make it easier for people, particularly students, to access the internet.

Additionally, navigating 5th IR advancements especially during crises like epidemics requires updating librarian training programs and integrating data science into library services. According to Ekwueme et al (2024), human-technology collaboration enables automation and process efficiency, resulting in individualized services, increased productivity, and increased job satisfaction.

The 5th Industrial Revolution, which is defined by the convergence of technologies like artificial intelligence (AI), robotics, and the Internet of Things, is expected to have a significant impact on LIS professionals. It will automate repetitive tasks, enable advanced data analysis, and require them to acquire new skills in data management, information curation, and user experience design in order to stay relevant in a rapidly changing landscape (Oladokun, Ayinde & Enakrire, 2024). Key impacts on LIS professionals:

- **Enhanced automation:** LIS professionals could concentrate on higher-level services like research support, data analysis, and user engagement by largely automating routine tasks like cataloging, circulation management, and basic reference queries.
- **Personalized user experiences:** AI-powered systems can tailor recommendations and search results to individual user needs, necessitating that LIS professionals comprehend user behavior and curate content effectively.
- **Advanced data analysis:** With access to powerful AI tools, LIS professionals can analyze large datasets to identify trends, user behavior patterns, and insights that inform library services and collection development.
- **New information formats:** As new digital formats like virtual reality and augmented reality become more prevalent, new skills may be needed to manage and make these new information sources accessible.
- **Collaboration with other disciplines:** To create creative information solutions, LIS professionals may need to work more closely with subject matter experts, computer scientists, and data scientists.

CHALLENGES IN EQUIPPING LIS PROFESSIONALS FOR 5TH INDUSTRIAL REVOLUTION

Despite the many advantages of the 5IR, there are drawbacks as well, particularly for LIS professionals attempting to prepare for the fifth industrial revolution. A major change is anticipated in the 5IR age, where machines will work alongside people to do tasks. Given that many human professions were displaced by computers in the 4IR, this poses a significant difficulty, especially in libraries where people were still adjusting. The most cutting-edge technology is now available as the 5IR ushers in a new era of human-machine cooperation (Sajidan et al 2021).

Ajani et al. (2022) assert that the 5IR will eliminate the distinction between the physical and digital world. These developments will impact librarians' professional lives as well as their current practices. Humans will probably be replaced by robots, which will raise the unemployment rate. The majority of librarians are concerned about this. The high expense of acquiring and maintaining these cutting-edge technologies is another significant obstacle. The cost of educating competent and effective staff to provide the library services connected with the 5IR era will be beyond the means of some libraries and information centers (Ekwueme et al 2024).

It can be difficult for librarians to stay up to date with new tools, platforms, and trends due to the quick speed of technology innovation. For this reason, Tella et al. (2023) suggest that in order for librarians to remain relevant in the digital age, they should constantly acquire new skills and expertise. This entails keeping up with cutting-edge technology like augmented reality, machine learning, and artificial intelligence and comprehending how these might be used to improve library services.

Libraries always struggle with budgetary restrictions, and the 5IR is no different. According to Bradley (2021), librarians use technology to optimize resources, increase productivity, and streamline processes in order to accomplish more with less. This could entail embracing open-source software, putting in place affordable digitalization initiatives, or looking toward joint ventures with other organizations (Nwobu et al 2024).

Additionally, the 5IR also presents several challenges for LIS professionals, including:

- **Changing user needs and expectations:** The 5IR creates new user needs and expectations, requiring LIS professionals to adapt their services and programs.
- **Rapidly changing technology landscape:** The 5IR is characterized by rapid technological advancements, making it challenging for LIS professionals to keep up-to-date.
- **Limited access to emerging technologies:** Many libraries, especially in developing countries, lack access to emerging technologies, hindering the ability of LIS professionals to develop relevant skills.
- **Digital divide and inequality:** The 5IR may exacerbate existing digital divides and inequalities, requiring LIS professionals to develop strategies to address these issues.

- **Limited LIS education and training programs:** Many LIS education and training programs may not be adequately preparing professionals for the 5IR.
- **Lack of continuing professional development (CPD) opportunities:** LIS professionals may not have access to CPD opportunities, making it challenging to develop new skills and competencies.
- **Limited resources and funding:** Many libraries and information organizations may not have the necessary resources and funding to invest in emerging technologies and staff development.
- **Resistance to change:** Some LIS professionals may resist changes brought about by the 5IR, making it challenging to implement new technologies and services.

By understanding these challenges, libraries, information centers and LIS education and training programs can develop strategies to equip LIS professionals with the necessary skills and competencies to thrive in the 5IR.

STRATEGIES FOR EFFECTIVE LIS PROFESSIONAL DEVELOPMENT

The 5IR has the potential to transform library operations through work automation, increased productivity, and real-time usage statistics, all of which would increase cost-effectiveness (Rushan et al 2024). Apriliyanti (2022) suggests that curricula be updated on a regular basis to accommodate current and future library services. Creativity, critical thinking, and life skills must also change with the times. According to Sajidan et al (2021), in order for institutions to trust librarians, they need to possess the fifth IR competencies and abilities. For LIS professionals to be successful in the 5IR era, several requirements such as curriculum, competency, training, and skill acquisition re essential.

Other strategies Library and Information Science (LIS) professionals need to adopt to thrive in the 5th Industrial Revolution (5IR) include:

- **Data analysis and interpretation:** Ability to collect, analyze, and interpret data to inform decision-making.
- **Artificial intelligence and Blockchain:** Understanding of AI and knowledge of blockchain and its potential applications in LIS.
- **Emotional intelligence and empathy:** Ability to understand and respond to the needs of diverse users.
- **Critical thinking and problem-solving:** Ability to analyze complex problems and develop innovative solutions.
- **Adaptability and flexibility:** Ability to adapt to digital tools, rapidly changing technologies, platforms, and methodologies to support research and learning.
- **Information literacy and instruction:** Ability to teach information literacy skills and design effective instructional programs.
- **Collection development and management:** Ability to select, acquire, and manage physical and digital collections.

By adopting these strategies, LIS professionals can thrive in the 5IR, providing innovative services and systems that meet the evolving needs of users.

METHODOLOGY

The study adopted a survey design using a structured questionnaire as data collection instrument to collect data from LIS professionals in Nigeria's South-South region, who served as the population for the study. Questionnaires were distributed via Google Forms on LIS professional WhatsApp platforms within the South South geo-political zone of Nigeria, leveraging online forums as effective tools for idea sharing and data collection. Over a one-month period, the survey link was shared multiple times, resulting in 26 valid responses. The collected data were analyzed using simple percentages, mean, and standard deviation to address the research questions.

FINDINGS AND DISCUSSION

Table 1: Demographic characteristics of the respondents

Professional Designation	**Frequency**	**Percentage %**
Librarian	24	92.3
Archivist	0	0
Information Scientist	3	11.5
Educator/Trainer	4	15.4
Student	1	3.8
Years of Working Experience	**Frequency**	**Percentage %**
Less than 5 years	4	15.4
5–10 years	6	23.1
10–20 years	12	46.2
More than 20 years	4	15.4

Type of Organization	Frequency	Percentage %
Academic library	22	84.6
Public library	**0**	0
Special library	0	0
LIS School	3	15.4
Corporate or private sector	1	3.8

The demographic profile shows that most respondents are Librarians (92.3%) with extensive professional experience, particularly between 10–20 years (46.2%), indicating a mature and knowledgeable participant base. Representation from other designations like Information Scientists and Educators was minimal, with no Archivists and few Students (3.8%).

Additionally, the majority (84.6%) work in academic libraries, while public, special, and corporate libraries were virtually unrepresented. This suggests the study's findings are largely reflective of the academic library sector with limited insight into other sectors of the LIS profession.

Table 2: Key Competencies for LIS Professionals in 5IR

Key Competencies for LIS Professionals in 5IR	STRONGLY AGREED	AGREED	DISAGREED	STRONGLY DISAGREED	MEAN	STANDARD DEVIATION
LIS professionals need advanced digital literacy skills to thrive in the 5IR.	24 (92.3%)	2 (7.7%)	-	-	3.923	0.266
Knowledge of artificial intelligence and automation is essential for modern LIS professionals.	22 (84.6%)	4 (15.4%)	-	-	3.846	0.361
Critical thinking and problem-solving skills are crucial in adapting to technological changes in the LIS field.	21 (80.8%)	5 (19.2%)	-	-	3.808	0.393
LIS professionals should possess strong data management and analytics skills	20 (76.9%)	6 (23.1%)	-	-	3.769	0.421
Soft skills such as adaptability and collaboration are as important as technical skills in the 5IR.	21 (80.8%)	5 (19.2%)	-	-	3.808	0.393

The table presents the perceived key competencies for Library and Information Science (LIS) professionals in the era of the Fifth Industrial Revolution (5IR), based on participant responses. Across all competencies, the mean scores are very high, ranging from 3.769 to 3.923 out of a maximum of 4. This indicates an overwhelmingly strong agreement among respondents on the critical importance of these skills. Specifically, the highest mean (3.923) was recorded for "advanced digital literacy skills", suggesting that LIS professionals consider digital proficiency as the most vital competency to thrive in 5IR environments. This finding aligns with the increasing integration of advanced technologies like AI, big data, and digital systems in library services.

Regarding standard deviations, all values are low (ranging from 0.266 to 0.421), suggesting a high level of consensus among respondents. The lowest variability (SD = 0.266) is seen for advanced digital literacy, reinforcing the idea that this competency is near-universally acknowledged as critical.

Table 3: Impact of Competencies on LIS Professionals

Impact of Competencies on LIS Professionals	STRONGLY AGREED	AGREED	DISAGREED	STRONGLY DISAGREED	MEAN	STANDARD DEVIATION
Developing 5IR -related competencies has improved my job efficiency	15 (57.7%)	11(42.3%)	-	-	3.58	0.51
Lack of digital and technical skills limits career growth opportunities in the LIS field.	16 (61.5%)	9 (34.6%)	1 (3.8%)	-	3.58	0.58
LIS professionals who adapt to emerging technologies provide better information services.	21 (80.8%)	5 (19.2%)	-	-	3.81	0.39
The integration of 5IR skills enhances the relevance of LIS professionals in modern libraries.	19 (73.1)	7 (26.9%)	-	-	3.73	0.44
Continuous professional development in 5IR competencies increases job satisfaction.	17 (65.4%)	9 (34.6%)	-	-	3.65	0.48

The data shows a strong consensus that LIS professionals who adapt to emerging technologies provide better information services, with a high mean score of 3.81 and the lowest standard deviation of 0.39. A notable 80.8% of respondents strongly agreed, highlighting the widespread belief in the importance of tech-savviness for delivering quality library services. This underscores the critical role of technological competencies in supporting the digital transformation of library environments. More broadly, the findings consistently affirm the value of digital and emerging technology skills in enhancing professional efficiency, relevance, career growth, and job satisfaction for LIS professionals. The low standard deviations across responses indicate a shared perspective among participants. These insights suggest that institutions should prioritize structured training and continuous skill development to help LIS professionals remain effective and adaptable in a rapidly changing information landscape.

Table 4: Current State of LIS Education and Training

Current State of LIS Education and Training	STRONGLY AGREED	AGREED	DISAGREED	STRONGLY DISAGREED	MEAN	STANDARD DEVIATION
My LIS education provided adequate training on emerging technologies relevant to 5IR.	5 (19.2%)	13 (50%)	7 (26.9%)	1 (3.8%)	2.85	1.14
LIS curricula should include more courses on artificial intelligence, data science, and automation.	15 (57.7%)	10 (38.5%)	1 (3.8%)	-	3.54	1.30
On-the-job training and workshops have been effective in equipping LIS professionals with 5IR skills.	14 (53.8%)	11(42.3%)	1 (3.8%)	-	3.50	1.33
There are enough professional development opportunities available to help LIS professionals upskill for 5IR.	10 (38.5%)	10 (38.5%)	5 (19.2%)	1 (3.8%)	3.12	1.78
Universities and LIS training institutions are proactive in integrating 5IR concepts into their programs.	5 (19.2%)	11(42.3%)	10 (38.5%)	-	2.81	2.11

In examining the current state of LIS training and education, the results suggest a moderate perception of preparedness among LIS professionals regarding 5IR competencies. While most respondents agree that LIS curricula should expand to include AI, data science, and automation (mean = 3.54), and that on-the-job training is helpful (mean = 3.50), there is less confidence in the proactivity of institutions (mean = 2.81) and the adequacy of formal LIS education (mean = 2.85). The high standard deviations, especially for institutional support (2.11), highlight significant variability in experiences. This points to the need for more consistent and comprehensive integration of 5IR concepts in both academic and professional training frameworks.

Table 5: Challenges in Equipping LIS Professionals

Challenges in Equipping LIS Professionals	STRONGLY AGREED	AGREED	DISAGREED	STRONGLY DISAGREED	MEAN	STANDARD DEVIATION
There is a lack of institutional support for LIS professionals to develop 5IR-related skills.	12 (46.2%)	13 (50%)	1 (3.8%)	-	3.42	0.57
Financial constraints hinder LIS professionals from accessing training programs.	16 (61.5%)	10 (38.5%)	-	-	3.62	0.49
Many LIS professionals are resistant to adopting emerging technologies in their work.	6 (23.1%)	10 (38.5%)	9 (34.6%)	1(3.8%)	2.81	0.87
The fast pace of technological advancements makes it difficult for LIS professionals to stay updated	5 (19.2%)	12 (46.2%)	6 (23.1%)	3 (11.5%)	2.73	0.91
Limited access to technological infrastructure affects the implementation of 5IR-related training.	16 (61.5%)	10 (38.5%)	-	-	3.62	0.49

Highest Mean Scores: Financial constraints and limited infrastructure access (mean ≈ 3.62) — strongly agreed by most respondents, suggesting these are perceived as the most serious challenges. Lowest Mean Scores: Pace of technological advancements (2.73) and resistance to technology (2.81) indicating more divided opinions. Standard Deviation: Challenges like financial constraints and infrastructure access have lower SD (~0.49), meaning responses were tightly clustered (more agreement). Resistance to technology and pace of advancements have higher SD (~0.87–0.91), meaning opinions varied more widely across respondents.

Table 6: Strategies for Effective LIS Professional Development

Strategies for Effective LIS Professional Development	STRONGLY AGREED	AGREED	DISAGREED	STRONGLY DISAGREED	MEAN	STANDARD DEVIATION
Organizations should provide more funding for LIS professional development in 5IR.	18 (69.2%)	8 (30.8%)	-	-	3.69	1.43
Collaborative learning programs (e.g., partnerships with tech companies) should be encouraged in LIS training.	22 (84.6%)	4 (15.4%)	-	-	3.85	0.77
Professional associations should introduce mandatory 5IR competency certifications for LIS professionals.	14 (53.8%)	8 (30.8%)	4 (15.4%)	-	3.38	1.50
Online and blended learning models should be prioritized for LIS upskilling.	15 (57.7%)	11(42.3%)	-	-	3.58	1.37
Mentorship programs should be implemented to help LIS professionals transition into 5IR roles.	19 (73.1%)	7 (26.9%)	-	-	3.73	1.06

The findings indicate strong support for a variety of professional development strategies aimed at equipping LIS professionals for the 5IR era. The highest-rated strategy was encouraging collaborative learning programs (mean = 3.85), with the lowest variation (SD = 0.77), suggesting broad consensus on the value of partnerships, especially with tech organizations. Similarly, mentorship programs (mean = 3.73) and increased funding (mean = 3.69) were strongly supported, indicating a recognized need for both structured guidance and financial investment.

Though the idea of mandatory 5IR competency certification had slightly lower support (mean = 3.38) and the highest variation (SD = 1.50), it still shows overall agreement. The relatively high mean scores across all strategies demonstrate that respondents view a multi-pronged approach such as funding, partnerships, flexible learning, mentorship, and formal recognition of skills as key to effective professional development in the LIS field.

CONCLUSION AND RECOMMENDATIONS

This study examined the preparedness of Library and Information Science (LIS) professionals for the demands of the Fifth Industrial Revolution (5IR). The findings highlight a strong consensus on the importance of developing competencies in emerging technologies, digital literacy, and continuous professional development to remain relevant and effective in a rapidly evolving information landscape. While professionals acknowledge the value of 5IR-related skills in enhancing service delivery, efficiency, and job satisfaction, there are noticeable gaps in current LIS education and training, especially in areas such as artificial intelligence, data science, and automation. Furthermore, while some professional development opportunities exist, more structured and accessible avenues are needed.

Recommendations

1. Advanced digital literacy skills be prioritized as a foundational component in both LIS education and professional development programs.
2. LIS Institutions and Libraries should prioritize structured training and continuous skill development to help LIS professionals remain effective and adaptable in a rapidly changing information landscape.
3. LIS institutions and Libraries should proactively integrate 5IR competencies such as AI, data science, and automation into both academic curricula and professional training, ensuring consistent and comprehensive preparation for emerging challenges in the field.
4. LIS institutions and stakeholders should prioritize addressing financial constraints and improving infrastructure, as these are widely recognized and consistently reported as the most critical barriers to effective technology adoption.
5. LIS institutions and Libraries should adopt a multi-pronged professional development strategy that includes collaborative learning with tech partners, mentorship programs, and increased funding support.

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Competency-Based Assessment of Librarians Readiness for Emerging Technologies in the 5th Industrial Revolution

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Abstract

This study investigated the readiness of librarians in utilizing emerging technologies, a crucial aspect of preparing for the Fifth Industrial Revolution in library services delivery. A quantitative approach was employed, surveying a sample of 90 librarians using an online questionnaire (Google form) as the data collection instrument. Three research questions guided the study. Standard multiple regression analysis was used to examine the relationship between the variables. The findings of the study provide valuable insights into the competency levels of librarians in emerging technologies, highlighting areas for improvement and informing strategies for enhancing their readiness for the Fifth Industrial Revolution. The outcome of the study has significant implications for library management, training institutions, and policymakers seeking to enhance the capacity of librarians to effectively leverage emerging technologies in delivering library services.

Keywords: *Emerging Technologies; Fifth Industrial Revolution; Librarians' Readiness; Librarians' Competency; Professional Development; Library Services*

Introduction

The fifth industrial revolution has brought about rapid technological advancements, transforming various professions, including librarianship. In this era, librarians' competency in emerging technologies is crucial for providing quality services to patrons (Omehia, Okwu, & Nsirim, 2021). Emerging technologies, such as artificial intelligence, blockchain, and the Internet of Things (IoT), are revolutionizing library operations, and librarians must acquire new skills to remain relevant.

As librarians navigate this technological landscape, their familiarity with emerging technologies plays a vital role in developing their competency. When librarians are familiar with emerging technologies, they are more likely to feel confident in adopting and effectively utilizing them. However, this raises a critical question: how familiar are librarians with emerging technologies in the first place? A lack of exposure to these technologies could hinder their ability to develop the required competency. The integration of new technologies into libraries has revolutionized the way information is acquired and disseminated, enabling librarians to provide competent and sufficient library services across all academic disciplines (Ehoniyotan & Amzat, 2023). This transformation underscores the necessity for librarians to continually assess and adapt to technological advancements to meet users' evolving needs.

Furthermore, even when librarians are familiar with emerging technologies, they may still require training on professional development to enhance their competency. Professional development opportunities, such as workshops, conferences, and online courses, can equip librarians with the necessary knowledge and skills to effectively utilize emerging technologies. The availability and accessibility of these opportunities are therefore crucial in supporting librarians' competency development. As Akinola (2023) emphasizes, it is crucial for academic libraries to keep up with technological innovations in higher education and be at the forefront of utilizing these technologies. This highlights the need for continuous investment in both technological infrastructure and professional development to ensure librarians remain proficient in emerging technologies.

The importance of librarians' competency in emerging technologies is further emphasized by the changing information needs of library users. As technology continues to evolve, library professionals must engage in continuous learning to stay relevant. According to Opele (2023), the rapid pace of technological advancements necessitates lifelong learning and professional development among librarians. Library education programs provide ongoing training through workshops, conferences, and online courses, ensuring that librarians remain competent and adaptable in the face of emerging technologies.

Ultimately, the development of librarians' competency in emerging technologies is also influenced by the technological infrastructure available to them. A well-developed technological infrastructure can provide

librarians with the necessary tools and resources to effectively utilize emerging technologies. As Agboke and Oladokun (2024) note, automation and ICT have transformed library services, enabling the shift from conventional to hybrid and digital models that enhance efficiency and accessibility.
In conclusion, librarians' competency in emerging technologies is critical for providing quality services in the fifth industrial revolution. By examining the interplay between librarians' familiarity with emerging technologies, training on professional development, and technological infrastructure, we can better understand the factors that influence their competency.

Problem of the Study
The emergence of the Fifth Industrial Revolution marks a shift toward human-centered technological integration, blending advanced innovations such as artificial intelligence, robotics, and smart systems with human values and creativity. For libraries, this transformation demands that librarians not only adopt new technologies but also develop the competencies necessary to use them effectively in service delivery. However, many librarians face challenges in keeping pace with these rapid technological changes due to limited familiarity, insufficient training, inadequate infrastructure, or a lack of strategic institutional support. This raises concerns about their readiness to meet the expectations of modern library users and to remain relevant in a technology-driven information environment. Despite growing discourse on emerging technologies in librarianship, there is insufficient research assessing librarians' competencies and preparedness within the context of the Fifth Industrial Revolution. This study, therefore, seeks to fill this gap by evaluating the readiness of librarians through a competency-based assessment framework, with the aim of informing policy and professional development initiatives.

Research Objectives
The study aimed to achieve the following research objectives:
1. To ascertain the librarians' familiarity with emerging technologies in the fifth industrial revolution.
2. To investigate the level of training on professional development on how it influence the librarian's competencies with emerging technologies in the fifth industrial revolution.
3. To investigate the impact of technological infrastructure on librarian's competency in the use of emerging technologies in the fifth industrial revolution.

Research Questions
The following research questions guided the study:
1. To what extent do librarians are familiar with the emerging technologies in the fifth industrial revolution?
2. How does training on professional development influence librarians' competencies with emerging technologies in the 5th industrial revolution?
3. How does technological infrastructure influence librarians' competency in using emerging technologies?

Hypotheses
The study tested the following hypotheses:
H_1a: There is a significant level of librarians' familiarity with emerging technologies in the Fifth Industrial Revolution that relates to their competency in using these technologies.
H_1b: Training on professional development significantly influences librarians' competencies with emerging technologies in the Fifth Industrial Revolution.
H_1c: Technological infrastructure significantly influences librarians' competency in using emerging technologies in the Fifth Industrial Revolution.

Literature Review
Emerging Technologies and the Fifth Industrial Revolution in Libraries
The evolution of emerging technologies continues to reshape the global information landscape, and libraries are at the forefront of this transformation. Technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Virtual Reality (VR), blockchain, robotics, and cloud computing are increasingly integrated into library systems to enhance user services, streamline operations, and support knowledge creation (Ganesamoorthy & Selvakamal, 2025; Racheal, 2020; Chari, 2023). These innovations facilitate personalized services, predictive analytics, and intelligent automation, turning libraries into dynamic, interactive knowledge ecosystems.
In the context of these advancements, the Fifth Industrial Revolution (5IR) introduces a paradigm shift; one that emphasizes the fusion of technological innovation with human-centric values such as empathy, ethics, creativity, and sustainability (Lee et al., 2021). Unlike the Fourth Industrial Revolution, which prioritized digital automation and efficiency, the 5IR focuses on the collaboration between humans and intelligent machines to deliver more meaningful, personalized experiences (Xu et al., 2021; Bousquet, 2022). This shift

has profound implications for libraries, requiring them not only to adopt advanced technologies but to do so in ways that prioritize user empowerment, inclusivity, and adaptability.

For instance, AI-powered chatbots and virtual assistants can offer 24/7 reference services tailored to user needs, while immersive technologies like AR/VR support experiential learning and virtual exhibitions (Asim et al., 2022; Taher & Ahmed, 2023). Meanwhile, IoT-enabled systems improve inventory control and energy efficiency, and blockchain provides secure, transparent record-keeping for digital archives (Asif & Singh, 2019; Echezona & Ugwuanyi, 2023).

Despite these opportunities, libraries, especially in developing contexts, face significant challenges such as limited funding, inadequate technological infrastructure, and gaps in professional competencies (Shashikumar et al., 2019; Gaikwad & Bilawar, 2023). The rapid pace of technological change also demands continual staff development and institutional readiness. Strategic investment in infrastructure, continuous professional development, and policy support are therefore critical to ensure librarians are equipped to navigate this new era.

As agents of knowledge access and digital equity, libraries must align themselves with the human-centered vision of the Fifth Industrial Revolution. Doing so not only ensures relevance but positions libraries as inclusive platforms where technology enhances—not replaces—the human touch in information service delivery (Sandhu, 2018; Bousquet, 2022).

Librarians' Familiarity with Emerging Technologies in the Fifth Industrial Revolution

The Fifth Industrial Revolution (5IR) introduces a people-focused approach to technological innovation, emphasizing the synergy between advanced technologies and human creativity. In the context of libraries, this shift requires librarians to be aware of and engage with a growing range of emerging technologies—including Artificial Intelligence (AI), Internet of Things (IoT), Extended Reality (XR), Quantum Computing, Blockchain, 5G/6G Networks, Synthetic Data, Digital Twins, 3D Printing, Cloud Computing, and Data Analytics (Schwab & Zahidi, 2020; Ganesamoorthy & Selvakamal, 2025). Familiarity with these technologies is often seen as a foundational step toward readiness and competency in delivering technology-driven library services.

Librarians across different types of libraries (public, academic, and special) show varying levels of awareness and familiarity with these technologies. Commonly adopted tools include cloud-based services, RFID, and basic AI applications such as chatbots or recommendation systems (Oyelude, 2020; Abayomi et al., 2021). However, familiarity often remains superficial, especially with more complex or emerging innovations like synthetic data, quantum computing, and digital twins (Onyancha, 2022; Aina & Okunade, 2023).

Interestingly, recent empirical evidence suggests that familiarity alone does not guarantee effective application. While many librarians report knowing about certain technologies, this awareness does not necessarily translate into practical competency (Rotimi et al., 2022). This finding challenges assumptions in previous literature that posit familiarity as a critical stepping stone to professional competence (Gaikwad & Bilawar, 2023).

Several factors may explain this disconnect. First, librarians may be passively aware of technologies through professional discourse or observation but lack the structured exposure needed to translate that familiarity into skill. Second, institutions may not provide opportunities to experiment or apply these technologies, limiting librarians' capacity to develop practical expertise (Chukwuemeka & Bakare, 2023). Furthermore, the speed of technological advancement makes it difficult for familiarity alone to keep pace with functional proficiency.

Given the rapid and complex evolution of emerging technologies under the 5IR, libraries must go beyond raising awareness and invest in strategic pathways that build practical competencies. This includes hands-on training, mentorship, and collaborative learning models that move librarians from knowing about a technology to confidently using it.

Training on Professional Development for Librarians in the Fifth Industrial Revolution

The demands of the Fifth Industrial Revolution (5IR)—a phase characterized by human-centered integration of emerging technologies such as artificial intelligence (AI), extended reality (XR), and quantum computing—require librarians to continuously update their competencies through structured professional development (Schwab & Zahidi, 2020; Ziatdinov, Atteraya, & Nabiyev, 2024; Ganesamoorthy & Selvakamal, 2025). Professional development programs including workshops, certifications, and collaborative learning initiatives are crucial for building both technological and soft skills essential in this evolving landscape (Ebong, Ogwo, & Nwachukwu, 2022; Derek, 2020; Ogundipe, 2023).

Numerous studies emphasize that targeted training enhances librarians' abilities in areas such as data analytics, AI tools, research data management, and digital service delivery—skills increasingly vital to meet user expectations in smart library environments (Oyelude, 2020; Gaikwad & Bilawar, 2023; Shashikumar et al., 2019). In the Global South, particularly in Nigeria, librarians actively engage in training to improve their ICT

literacy and digital service competencies, although gaps persist in advanced fields like AI and blockchain (Adjei, 2023; Aina & Okunade, 2023).

Despite this engagement, challenges such as insufficient institutional support, inconsistent access to funding, and self-sponsored participation remain barriers to professional development (Jan & Jan, 2022; Chukwuemeka & Bakare, 2023; Rotimi et al., 2022). Financial limitations and lack of structured learning pathways affect equitable skill acquisition. Nonetheless, ongoing learning remains a key enabler of technological adaptability in libraries, suggesting that professional development may play a pivotal role in building competency for the 5IR.

Technological Infrastructure and 5IR Integration in Libraries

The successful integration of emerging technologies in the era of the Fifth Industrial Revolution (5IR) hinges on the availability and strength of technological infrastructure within libraries. The 5IR emphasizes the convergence of advanced digital technologies—such as artificial intelligence (AI), the Internet of Things (IoT), augmented reality (AR), and blockchain—with human-centered services. This evolution is transforming libraries into dynamic, technology-driven environments (Chari, 2023).

However, significant disparities in infrastructure readiness persist, particularly between Western nations and developing countries (Gaikwad & Bilawar, 2023). In many libraries across developing regions, the lack of stable electricity, high-speed internet, and updated hardware creates a barrier to innovation and digital transformation (Poluru et al., 2018). As a result, the potential of 5IR technologies remains underutilized in these contexts.

To effectively implement 5IR tools in library services, strong infrastructural support is critical. This includes not only reliable internet connectivity but also robust data storage systems and secure digital environments (Ekwueme et al., 2024). Shashikumar et al. (2019) noted that the integration of technologies such as AI, IoT, AR, and blockchain can greatly enhance user experience, access to information, and automation of routine tasks.

Despite these prospects, financial constraints and infrastructural limitations continue to hinder widespread adoption. Asif and Singh (2019) highlighted how budget limitations and technological gaps delay progress, especially in resource-constrained institutions. Furthermore, even when infrastructure is in place, the absence of skilled personnel capable of utilizing these tools effectively remains a concern. This underscores the need for continuous professional development programs aimed at equipping librarians with the competencies needed to thrive in a 5IR-aligned library system (Nepali & Tamang, 2022; Asif & Singh, 2019).

Thus, for libraries to fully integrate into the 5IR landscape, investments in both infrastructure and human capacity are indispensable. Only then can libraries reposition themselves as proactive participants in the human-technology synergy that defines the Fifth Industrial Revolution.

Librarians' Competency in Emerging Technologies in the Fifth Industrial Revolution

In the Fifth Industrial Revolution, marked by the convergence of human capabilities and intelligent technologies, librarians are required to go beyond basic digital literacy and develop competencies in advanced tools like artificial intelligence (AI), extended reality (XR), and blockchain (Oladokun, Adebayo, & Ajayi, 2023). These technologies are redefining information services, demanding that librarians possess both technical proficiency and the strategic ability to apply them in user-centered contexts.

Key competencies now extend beyond operating traditional ICT tools to include managing data analytics platforms, cloud computing services, and immersive content systems that support interactive learning and decision-making (Sarfo, Nti, & Asante, 2016; Onuoha, Akidi, & Chukwueke, 2019). These tools are essential in facilitating smarter, more responsive library services aligned with user expectations in a digitally connected society. Despite growing interest and awareness among professionals, many librarians still lack the hands-on experience needed to confidently deploy these technologies. Institutional limitations—such as funding constraints, policy gaps, and inadequate infrastructure—further restrict opportunities for skill development (Ademodi & Adepoju, 2019; Ebong, Ogwo, & Nwachukwu, 2022; Ziatdinov, Atteraya, & Nabiyev, 2024).

Ongoing professional development remains a critical pathway for bridging these skill gaps and ensuring that librarians can thrive in increasingly digital, user-driven information ecosystems. Without continuous capacity building and intentional support structures, the profession risks falling behind in an era that demands agility, innovation, and a deep understanding of emerging technological landscapes.

Methodology

This study adopted a quantitative, cross-sectional research design using a structured online survey to evaluate librarians' readiness for emerging technologies in the context of the Fifth Industrial Revolution (5IR). The instrument used for data collection was a self-developed questionnaire titled *Librarians' Readiness for Emerging Technologies Survey*, comprising 23 items focused on four core areas: familiarity with emerging technologies, professional development and training, technological infrastructure, and competency in

emerging technologies. Items were rated on a 4-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree." The questionnaire was distributed via Google Forms through professional networks and social platforms, and 90 valid responses were obtained through voluntary participation. Though no formal sampling frame was used, this non-probability, convenience-based sampling allowed the researcher to reach librarians actively engaged in professional practice. The instrument was reviewed by experts in the field to ensure content relevance and clarity. Data were analyzed using Microsoft Excel, selected for its accessibility and the researcher's familiarity with the tool. Descriptive statistics were used to summarize responses, while standard multiple regression analysis was conducted to examine the relationship between the three independent variables: familiarity with emerging technologies, training on professional development, and technological infrastructure and the dependent variable, librarians' competency in emerging technologies. The hypotheses were tested using standard multiple regression, with statistical significance determined at a threshold of $\mathbf{p \leq 0.05}$. Ethical considerations were observed through voluntary participation, confidentiality of responses, and an informed consent statement embedded in the survey introduction.

Results

Table 1: Familiarity with Emerging Technologies

S/N	Items	SA	A	D	SD	Mean	Familiarity Level
1.	Artificial Intelligence (AI)	65	13	5	7	3.51	High Familiarity
2.	Internet of Things (IoT)	59	10	17	4	3.38	High Familiarity
3.	Extended Reality (XR)	26	20	9	35	2.41	Moderate Familiarity
4.	Quantum Computing	26	13	13	38	2.3	Moderate Familiarity
5.	Digital Twins	29	13	13	35	2.4	Moderate Familiarity
6.	Synthetic Data	27	15	13	35	2.38	Moderate Familiarity
7.	Blockchain	58	15	11	6	3.39	High Familiarity
8.	5G and 6G Networks	61	19	6	4	3.52	High Familiarity
9.	3D printing	35	40	8	7	3.14	High Familiarity
10.	Cloud computing and storage systems	63	12	7	8	3.44	High Familiarity
11.	Data Analytics and Visualization tools	60	18	6	6	3.47	High Familiarity
					Grand mean	**3.03**	

The results presented in Table 1 show that librarians have a significant level of familiarity with emerging technologies, with an overall average mean score of 3.03. This score indicates a high level of familiarity, with 5G network standing out as the emerging technology with which librarians are most familiar.

Table 2: Librarians' level of training on professional development in the use of emerging technologies

S/N	Items	SA	A	D	SD	Mean	Training Level
1.	I have received adequate training and professional development opportunities to prepare me for the use of emerging technologies in my work as a librarian.	27	19	35	9	2.71	Moderate Training
2.	The training programs I have attended have been effective in improving my understanding and use of emerging technologies.	30	18	38	4	2.82	Moderate Training
3.	My organization provides sufficient resources and support for me to pursue ongoing training and professional development in emerging technologies.	23	16	41	10	2.58	Moderate Training
4.	I am confident that I can apply the skills and knowledge I have gained from training programs to my work as a librarian.	26	18	40	6	2.71	Moderate Training
					Grand mean	**2.71**	

The results presented in Table 2 show the extent of librarians' training on professional development in the use of emerging technologies. The average mean score of 2.71 indicates that librarians have received moderate training in this area

Table 3: Technological infrastructure for emerging technologies.

S/N	Items	SA	A	D	SD	Mean	Infrastructure Level
1.	My library has adequate technological infrastructure (e.g., hardware, software, internet connectivity) to support the use of emerging technologies.	27	46	10	7	3.03	High Infrastructure
2.	The technological infrastructure in my library is up-to-date and regularly maintained.	26	15	40	9	2.64	Moderate Infrastructure
3.	I have access to the necessary technological tools and resources to effectively use emerging technologies in my work	23	19	38	10	2.61	Moderate Infrastructure
4.	The technological infrastructure in my library is sufficient to support the integration of emerging technologies into our services and programs.	24	37	22	7	2.87	Moderate Infrastructure
					Grand mean	**2.79**	

The results show that librarians' assessments of their library's technological infrastructure are generally moderate, with an overall average mean score of 2.79. The mean scores indicate that librarians agree that their library has adequate technological infrastructure (3.03), while ratings for up-to-date maintenance (2.64), access to necessary tools and resources (2.61), and sufficient infrastructure for integrating emerging technologies (2.87) were moderate.

Table 4: Librarians' Competency in Emerging Technologies

S/N		SA	A	D	SD	Mean	Competency Level
1.	I am comfortable using emerging technologies (e.g., AI, blockchain, IoT) in my work as a librarian.	28	17	42	3	2.78	Moderate Competency
2.	I am able to effectively integrate emerging technologies into my library's services and programs.	30	16	41	3	2.81	Moderate Competency
3.	I am knowledgeable about the current trends and developments in emerging technologies.	29	21	34	6	2.81	Moderate Competency
4.	I am able to troubleshoot and resolve technical issues related to emerging technologies.	28	17	35	10	2.7	Moderate Competency
				Grand mean	**2.78**		

The results indicate that librarians have moderate levels of competency in emerging technologies, with an overall average mean score of 2.78. Specifically, librarians reported moderate comfort in using emerging technologies in their work (2.78), integrating them into library services and programs (2.81), and staying knowledgeable about current trends and developments (2.81). Additionally, librarians reported moderate ability to troubleshoot and resolve technical issues related to emerging technologies (2.70).

Hypotheses Testing

H_1a: *There is a significant level of librarians' familiarity with emerging technologies in the Fifth Industrial Revolution that relates to their competency in using these technologies.*

H_1b: *Training on professional development significantly influences librarians' competencies with emerging technologies in the Fifth Industrial Revolution.*

H1c: *Technological infrastructure significantly influences librarians' competency in using emerging technologies in the Fifth Industrial Revolution.*

A standard multiple regression was conducted to determine the extent to which these independent variables: familiarity with emerging technologies, training on professional development, and technological infrastructure—predict librarians' competency in using emerging technologies. The results are presented in Table 4 below.

Table 5: Multiple Regression Results

Predictor Variable	Coefficient (β)	t-value	p-value	Interpretation
Familiarity with emerging technologies	-0.0083	-0.04	0.969	Not significant
Training on professional development	0.561	2.363	0.05	Significant
Technological infrastructure	0.0945	0.411	0.693	Not significant
Intercept (β_0)	1.020			
R^2	**0.539**			Model explained 53.9% of the variance

Interpretation of Results

Training on Professional Development (p=0.05) is the only significant predictor of librarians' competency in emerging technologies. This indicates that training plays a crucial role in enhancing librarians' ability to use emerging technologies effectively.

Familiarity with Emerging Technologies (p=0.969*)* is not a significant predictor, suggesting that simply being familiar with new technologies does not necessarily translate into competency.

Technological Infrastructure (p=0.693) is also not significant, indicating that infrastructure alone is insufficient in improving librarians' competency.

The value implies that 53.9% of the variation in competency can be explained by the three independent variables, while the remaining 46.1% is influenced by other factors not included in the model.

Hypotheses Testing Results

Based on the regression results: Training on Professional Development (p=0.05) has a significant influence on competency. Familiarity with Emerging Technologies (p=0.969) and Technological Infrastructure (p=0.693) do not significantly influence competency.

Since only one independent variable (Training on Professional Development) is significant, the hypothesis is partially accepted. This means that while training significantly contributes to competency, familiarity and infrastructure do not have a significant direct impact.

Discussion of Findings

The findings revealed that although librarians demonstrated moderate familiarity with emerging technologies—such as AI, 5G, and cloud computing—this familiarity did not significantly predict their overall competency in using them (p = 0.969). This suggests that awareness or exposure to such technologies, which are central to the Fifth Industrial Revolution (5IR), does not automatically translate into functional skills. This result challenges prior assumptions in the literature that regard familiarity as a foundational step toward competency (Gaikwad & Bilawar, 2023; Schwab & Zahidi, 2020). While studies like Oyelude (2020) and Abayomi et al. (2021) noted increasing awareness of tools such as cloud services and basic AI applications among librarians, this awareness may be passive or superficial, particularly regarding advanced technologies like digital twins or quantum computing (Onyancha, 2022; Aina & Okunade, 2023). In line with findings by Rotimi et al. (2022) and Chukwuemeka & Bakare (2023), this study reinforces the notion that many librarians know of these technologies in theory but lack the structured exposure and institutional support required to develop practical competence. Thus, in the context of the 5IR, awareness alone is insufficient, librarians require targeted capacity-building opportunities to effectively apply these tools in library practice.

By contrast, training on professional development emerged as the only statistically significant predictor of librarians' competency in using emerging technologies. This underscores the centrality of continuous, structured learning opportunities in cultivating technological proficiency, especially in a 5IR context that emphasizes the integration of human expertise with advanced technologies such as AI, XR, and quantum computing (Schwab & Zahidi, 2020; Ziatdinov, Atteraya, & Nabiyev, 2024). The finding aligns with the work of Ebong, Ogwo, and Nwachukwu (2022), Derek (2020), and Ogundipe (2023), who highlighted the transformative potential of workshops, certifications, and collaborative learning in equipping librarians with both digital and soft skills.

Additionally, the findings support those of Oyelude (2020) and Gaikwad & Bilawar (2023), who emphasized that focused training enhances librarians' abilities in areas such as data analytics, research data management, and AI integration—skills that are increasingly vital in smart, user-centric library environments. Although barriers such as limited funding, inconsistent institutional backing, and self-sponsored training remain prevalent (Jan & Jan, 2022;

Rotimi et al., 2022; Chukwuemeka & Bakare, 2023), the present study confirms that training still plays the most critical role in developing technological competency. Moreover, consistent with observations by Adjei (2023) and Aina & Okunade (2023), this study affirms that while many librarians in Nigeria and similar contexts are actively pursuing professional development, strategic and sustained institutional support is necessary to bridge existing gaps, particularly in advanced fields like AI and blockchain.

In terms of technological infrastructure, although respondents generally rated their libraries' infrastructure as moderately available and functional, this factor did not significantly predict their competency with emerging technologies. This finding challenges positions such as that of Chari (2023), who argued that robust infrastructure is a cornerstone for the transformation of libraries into technology-driven environments in alignment with 5IR principles. The result highlights a critical distinction: having physical infrastructure—such as internet connectivity, networked systems, and digital tools—does not guarantee effective use or competency.

The 5IR, with its emphasis on human-technology synergy through tools like AI, IoT, AR, and blockchain, requires not just availability but effective integration of infrastructure, supported by capable and trained personnel. The study's findings echo concerns raised by Gaikwad & Bilawar (2023) and Poluru et al. (2018) about persistent infrastructural disparities in developing regions, particularly related to unreliable electricity, outdated hardware, and limited broadband access. However, the current data suggest that even where infrastructure exists, it may not be optimally utilized—often due to inadequate training, unclear policy direction, or lack of strategic implementation.

Furthermore, as Ekwueme et al. (2024) highlighted, the effective adoption of 5IR technologies in libraries also depends on robust digital ecosystems—including secure data management systems and scalable platforms. Yet, as noted by Asif & Singh (2019) and Nepali & Tamang (2022), the existence of infrastructure alone is insufficient if librarians are not adequately trained or empowered to leverage these tools meaningfully. This reflects a dual challenge: addressing both infrastructural limitations and human capacity gaps to ensure full participation in the 5IR transformation.

In summary, the study demonstrates that while familiarity with emerging technologies and the availability of infrastructure are important elements of technological readiness, they do not significantly influence librarians' competency unless reinforced through structured professional development. Training stands out as the most critical driver of competency, reinforcing the idea that librarians must be equipped with practical, actionable knowledge—not just access or exposure—to effectively integrate 5IR technologies into their work. These findings carry important implications for library leadership and policymakers, who must prioritize sustained staff development initiatives as a cornerstone for building future-ready, innovation-driven library systems.

Recommendation

Based on the findings of this study, it is recommended that library management and relevant stakeholders prioritize continuous professional development for librarians. Regular workshops, seminars, and hands-on training programs should be organized to equip librarians with practical skills in emerging technologies. While technological infrastructure is important, efforts should focus more on ensuring that staff are adequately trained to utilize available tools effectively. Institutions should also evaluate the impact of training programs to ensure they are aligned with current technological trends and the evolving needs of library services.

Conclusion

This study assessed the readiness of librarians to use emerging technologies by examining their familiarity, access to infrastructure, and participation in professional development. The results revealed that among the three variables, only training on professional development significantly influenced librarians' competency. Familiarity with technologies and access to infrastructure, though present, did not translate into practical competence. The study concludes that professional development remains a critical pathway for librarians to stay relevant and effective in a rapidly evolving digital landscape. These findings emphasize the need for targeted interventions that build skills rather than relying solely on exposure or resource availability.

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Cultural heritage in Virtual Space in the 5th industrial revolution and the Role of Libraries: A Case of Tiv Intangible Cultural Heritage Preservation Project, Using Dspace Software in University Libraries in North central Nigeria

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Abstract

The study investigates Cultural heritage In Virtual Space in the 5th industrial revolution, The Role of Libraries: A Case of Tiv intangible Cultural Heritage Preservation Project, Using Dspace Software inUniversity Libraries in North central Nigeria. The study was guided by 4 objectives and 4 research question, significance and scope of the study. Methodology The study adopted explanatory sequential mixed methods design. The population of the study two hundred and forty-five respondents, comprising the library staff, system analysts, and Tiv traditional rulers. The sample size is one hundred and twenty-six, Library Staff, System Librarians, and Tiv traditional rulers in Benue and Nasarawa state, while the sampling technique was multistage sampling procedure, to arrive at the sample size. Two sets of instruments were used for data collection, focus group discussion, and questionnaire. Data collected from the respondents were collated and analyzed to answer the research questions and the statistical method used in analyzing the descriptive data was descriptive statistics mean and standard deviation for the questionnaire with a rating scale of 4, 3, 2, 1=2.50 was the criteria mean.The findings of the study showed that the use of brochures, posters, staging exhibitions, and daily Newspapers among others were the methods of creating awareness for the digitally preserved Tiv intangible cultural heritage resources in university libraries in North Central Nigeria ($\overline{x}$ = 3.12, SD = 0.50). Dspace promotes open access,Dspace enhances visibility using IP address, Dspace is Dublin core based and others are the ways in which libraries can create visibility using Internet protocol addresses for the digitalized Tiv intangible cultural heritage collection in university libraries in North Central Nigeria ($\overline{x}$ = 3.18, SD = 0.52). To a high extent,Dspace is flexible and adjusts to the user's needs, it has a Level of visibility through the Dspace handle, large data acceptance, and others are the extent to which Dspace software can enhance digitally preserved Tiv intangible cultural heritage for enhanced visibility in university libraries in North central Nigeria ($\overline{x}$ = 3.32, SD = 0.41). The study recommends that adequate plan for the preservation of digital resources by the Tiv traditional council and Tiv states council for arts and culture should ascertain that at each point where there is a notice of an extinction of cultural heritage, digital preservation should be applied.

Introduction

Cultural sensitivity in the virtual space of libraries is crucial for fostering an inclusive and welcoming environment for all patrons especially those who seeks cultural collections, there are some key considerations to cultural sensitivity which includes Multilingual Support, and were librariesstrive to provide resources and services in multiple languages to accommodate patrons from diverse linguistic backgrounds. This includes offering multilingual websites, catalog interfaces, and digital resources.Another aspect is the culturally relevant collections were libraries strive to curate collections that reflect the diversity of their communities, including materials representing various cultures, perspectives, and experiences. This can involve collaborating with community groups to identify relevant materials and ensure they are accessible in the virtual space, taking note of accessibility since it is key role of the libraries to its communities, having to pay attention to accessibility standards to ensure that digital resources and platforms are usable by individuals and those with disabilities. This includes features like screen reader compatibility, alternative text for images, and adjustable font sizes, this canin return give rise to cultural awareness and training, receiving training on cultural competence and sensitivity to better serve patrons from different cultural backgrounds becomes very vital. This training can help staff understand and respect cultural differences, avoid stereotypes, andprovide

culturally appropriate assistance to patrons who seek cultural heritage collections.However cultural collection needs to be handled with utmost respect, privacy and confidentiality. Libraries should prioritize the privacy and confidentiality of communities' indigenous knowledge as well as patrons request in virtual interactions. This includes safeguarding patron data and respecting cultural norms regarding privacy.This will increase user feedback and engagements, patrons will continuously improve virtual services and ensure they meet the needs of diverse cultural groups, they will actively engage with the community to solicit input and involve them in decision-making processes, at the end of the effective inclusion of cultural collection promotion of diversity and inclusion would be achieved, using the virtual space to promote diversity and inclusion through online events, exhibitions, and educational programs. Highlighting diverse voices and perspectives can help foster a sense of belonging for all patrons. By implementing these strategies, libraries can create a virtual space that is inclusive, welcoming, and responsive to the cultural needs of all patrons in the 5th industrial revolution era.

The Industrial Revolutions have been instrumental in driving technological and societal transformations. According to Petcuetal (2020),The Industrial Revolution, spanning from Industry1.0 to Industry5.0, has revolutionized the way we work and live. The revolution has introduced mechanization, mass production, and the rise of e-commerce. The 4th Industrial Revolution integrated advanced technologies like Internet of Things and Artificial Intelligence, transforming production into a decentralized model. The 5th Industrial Revolution, Industry5.0, aims to optimize resource efficiency and production output by reshaping human-machine interactions (Golić, 2019). This era of Industry5.0aimstoredefineindustrialprocessesandhuman- 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, Purwanto & Sudarno, 2024) libraries have integrated machine learning to its operations and have also diversify into several needs of patrons looking into cultural heritage and community engagement in order to satisfy the needs of various patrons.

Diversity and inclusive in library services involve creating an environment where individuals from diverse backgrounds (regardless of gender, race, ability, religion, etc.) have access to a variety of information resources to meet their needs (Zaid & Nduka,2023). Diversity in the library context pertains to heterogeneous differences, encompassing the workforce, collections, and community. Inclusivity, on the other hand, focuses on establishing and maintaining an organization and community where every member is treated fairly and respectfully (Kauffman & Anderson, 2020). In the context of the 5th Industrial Revolution (IR), diversity and inclusion entail recognizing differences and perspectives in development, deployment, addressing potential biases, and promoting equitable outcomes for all Integrating diversity and inclusion principles into artificial intelligence (AI) can enhance technology's responsiveness to diverse user needs, thereby improving our understanding and implementation of diversity and inclusion in library services (Noble, et.al 2022). Thevisionofthe cultural heritage preservation project at Benue state university was to create a cultural sensitivity society in the virtual space using Benue state university library is to provide equitable access to cultural heritage collection and for all individuals seeking knowledge concerning cultural heritage. The university library aims to achieve this objective by granting access to patrons regardless of their remote locations through the use of the library website for digital information resources about the different cultures in Benue state Nigeria.

The Benue StateUniversitywas founded in 1992 by Rev Fr Moses Orshio Adasu, and the university library as well. According to Igbudu, Asen, and Ver (2020), Benue State University Library and Information Services (BSULIS) Nigeria, supports the university mission by facilitating access and use of information resources and services in support of the instructional, research, and community service activities of the university community. The library system commenced operation from make-shift quarters at the inception of Benue State University, Nigeria in 1992. With a sitting capacity of approximately 3,000 this building currently houses about forty-five books in monographs and three thousand journal titles in addition to subscribed databases, open access resources, and an e-books database. The library adopted Koha open-source c software as its Integrated Library Management (ILM) software and DSpace software in 2019 for the institutional repository with five hundred thesis titles in stock. (website survey @ www.bsum.edu.ng) with the digital preservation project for cultural sensitivity in the virtual space using Dspace software.

The preservation was targeted at the Tiv people of Benue State on the first phase of the project, with the inclusion of other languages at the second and third phase.Digital preservation of Tiv intangible cultural heritage is imperative to the world to ensure that knowledge and information creation shared by Tiv indigenous communities be collected, preserved and made accessible to the future generations globally and creating awareness for theTiv culture in the virtual space, Promoting Diversity and Inclusion Using the virtual space through online events, exhibitions, and educational programs.

Culturally relevant collections and those going into extinction, of the Tiv people was collected in the course of the project and digitized using Dspace software, the region is faced with increasing number of urban migration due to crisis on the border areas this necessitate the digital preservation of Tiv intangible cultural heritage collection using Dspace software in Benue state university library.

Statement of the Problem

A significant number of Tiv intangible cultural heritage have been lost due to urban migration, it has also been observed that some sons and daughters of the Tiv people in the Diaspora have lost touch with their culture because of distance, some have never experienced it at all, and others who are American and British citizens have no platform to view their cultural heritage resources.

A more worrisome situation is that only a few of the present generation read what is on paper, as such those at home where the culture is practiced have also lost grip on it due to over-reliance on technology,in an environment wherethe role of libraries in the preservation of the Tiv intangible cultural heritage resources is neglected or short-changed, thereby making the library faced with the challenge of losing its patronage and the fulfillment of its obligation as an information preservation warehouse for the future generation.The problem of the study centers on establishing the types of Tiv intangible cultural heritage collections still in existence, determining ways of collecting the intangible cultural heritage resource for digital preservation, creating awareness for the digitally preserved intangible cultural heritage, also creating visibility for the intangible cultural heritage collection using the IP address in DSpace. The researcher customizes the existing DSpace software to digitize Tiv intangible cultural heritage collection for enhanced visibility in university libraries in North-central Nigeria.

Research in this area of digital preservation of Tiv intangible cultural heritage collection using DSpace software for enhanced visibility in university libraries in north central Nigeria is few and scarce. Thus, there is a lacuna because of the non-availability of studies in this area. This gap forms the critical motivation that prompted the study.

Objectives of the Study

1. Identify the methods of collecting intangible cultural heritage resources available for the Tiv people in North-Central Nigeria.
2. Determine methods of creating awareness of the digitally preserved Tiv cultural heritage resources in North Central.
3. Determine ways in which libraries can make digitized intangible cultural heritage collections visible using Internet protocol for Tiv people irrespective of place.
4. Examine the extent to which Dspace software can enhance visibility of the digitally preserved Tiv intangible cultural heritage collection in university libraries in North-Central Nigeria.

Research Questions

The following research questions were formulated to guide the study;

1. What are the methods of collecting intangible cultural heritage resources of the Tiv people of North-Central Nigeria?
2. What are the methods of creating awareness for the digitally preserved Tiv intangible cultural heritage resources in university libraries in North Central Nigeria?
3. What are the ways in which libraries can create visibility using Internet protocol addresses for the digitalized Tiv intangible cultural heritage collection in university libraries in North Central Nigeria?
4. What is the extent to which Dspace software can enhance digitally preserved Tiv intangible cultural heritage for enhanced visibility in university libraries in north central Nigeria?

Significance of the Study

The findings of this work are expected to be of immense benefit to the following group of people: students, library staff, library administrators, and Tiv people. The findings of this work is expected to serve as a vital information resource and a reference material to students and researchers especially in the area of software development and digital preservation of cultural heritage collection, as it is expected to widening their horizon in this area. Above all, the findings of this work is expected to contribute to building a body of literature on the theme in the field of library and information science,as it will articulate Seminar papers, Conference papers, and Journal publications both in print and electronic all for learning and consultation.

Scope of the Study

The study focused onthe Digital Preservation of Tiv Intangible Cultural Heritage resources using Dspace Software for enhanced visibility in University Libraries in North Central Nigeria. Geographically, the study covered public university libraries in North-central Nigeria. North central region and their university libraries were chosen based on the presence of the Tiv-speaking people within the region as indigenous people.

Literature Review

Preservation is the action taken to reduce or prevent damage to extend the life expectancy of the collections. Ntui and Ottong (2009) maintain that a library is a repository of the wisdom of great thinkers of the past and present. Therefore, a library must ensure that its resources, in all formats, are preserved in an accessible form for as long as possible. Oyeniyi (2015) defined preservation as all efforts and actions taken to elongate the lifespan of the information material. The efforts for preservation may include planning, following principles and practices directed at preventing deterioration or restoring damaged materials to a usable condition. Harvey as cited in Oluwaseun, Ottong, and Ottong, (2017) a more detailed definition of preservation: "all the managerial and financial consideration including storage, and accommodation provision, staffing levels, policies, techniques and methods involved in preserving library and archival materials and the information contained in them". Oyeniyi (2015) opines that libraries and archives should preserve their materials to ensure their accessibility and longevity, foster research, and prevent spending on replacement costs of old materials, this preservation comes in the long term and short term. Short-term preservation ensures replication of the resources in other formats other than the original format, while the long term employs more sophisticated technologies like the hardware and software for the preservation process and this type of preservation is known as digital preservation. According to Brown et al as cited in Moseti (2016), the term digital preservation is used to refer to the overall approach to preserving information and appraisal of digital information over its entire cycle. Digital preservation activities aim to keep valuable and useful digital materials available for the future generation of scholars, researchers, and other users. The goal of any preservation programme is to ensure adequate protection, long term and ready access to the information and cultural heritage resources of any institution.

Culture as a way of life of a people is a common identity by a group of people, most of the practices are passed from one generation to another to preserve it, and most communities hold their cultural life and beliefs very high. Kaddu (2015) defines Cultural Heritage as an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions, and values. Therefore, digital heritage consists of unique resources of human knowledge and expression. It embraces cultural, educational, scientific, and administrative resources, as well as technical, legal, medical, and other kinds of information created digitally or converted into digital form from existing analog resources.

Crofts (2010) defines intangible cultural heritage as the practices, representations, expressions, knowledge, and skills – as well as the instruments, objects, artifacts, and cultural spaces associated therewith that communities, groups, and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature, and their history, and provides them with a sense of identity and continuity.

Similarly, Shimray and Somipam(2019) also refer to Intangible Cultural Heritage (ICH) as very delicate and vital in sustaining cultural diversity in the fast-changing modern era, ICH consists ofart expressions, drama, acting, literature, language, martial arts, livelihood cultures, food habits, Traditional practices, folktale, folksong, folklore, folkdance, oral records, etc.

The Tiv people shared values, beliefs and behavior are embedded in intangible cultural heritage as Ajekwe and Ibiamke (2017), Tiv is the fourth largest of the over 200 ethnic groups in Nigeria; with an estimated population of twelve million. The Tiv, like the other Nigerian ethnic groups, have distinct cultural values, beliefs, and practices. They speak a common language and claim a common ancestral origin. They inhabit Central Nigeria in the states of Benue (where they are the majority ethnic group), Nasarawa, Taraba, Plateau, Cross River, and Kogi, including the Federal Capital Territory, Abuja, and the Republic of Cameroon.

According to Walker (2010), Dspace is a digital repository software platform with broad functionality for the capture, management, preservation and redistribution of digital scholarly research materials in a variety of formats, for a variety of purposes. Pennock as cited in Abdulkadir (2011) views Dspace as a digital repository system design to capture, store, index, preserve, and provide access to institutional digital research materials. Morris (2009) argues that it is an out-of-the-box repository software package for creating open repositories focused on delivering digital content to end users and providing a full set of tools for managing and preserving content within the application. Dspace, however, is open-source software designed to capture, manage, preserve, and disseminate digital scholarly research material in all forms. Hamill (2019) asserts that Dspace captures, distributes, and preserves digital research products. Here you can find articles, working papers, preprints, technical reports, conference papers, and data sets in various digital formats.

Content grows daily as new communities and collections are added to DSpace. Dspace developer (2017) asserts that Dspace was developed to solve the problem of providing a long-term home for digital materials,

thus Dspace focused on open knowledge sharing and long term preservation concept. Dspace was originally designed and developed by Hewlett-Packard (HP) and Massachusetts Institute of Technology (MIT). The software development started in November 2000, as part of the HP and MIT alliance and in November 2002, they released Dspace version 1.0. In July 2007, the Dspace foundation was formed. The foundation merged with Fedora Commons to create the Dura space Organization in July 2009. The design supports community participation and customization to serve the content and intellectual property of each user community. Dspace is written in Java and runs on Linux or UNIX systems and Windows

Methodology

The study adopted explanatory sequential mixed methods design. The population of the study two hundred and forty-five respondents, comprising the library staff, system analysts, and Tiv traditional rulers. The sample size was derived by total enumeration sampling technique as the population was a manageable one. The sample size was one hundred and twenty-six, Library Staff, System Librarians, and Tiv traditional rulers in Benue and Nasarawa state.

Two sets of instruments were used for data collection, focus group discussion, and questionnaire. Data collected from the respondents were collated and analyzed to answer the research questions and the statistical method used in analyzing the descriptive data was descriptive statistics mean and standard deviation for the questionnaire with a rating scale of 4, 3, 2, 1=2.50 was the criteria mean.

Results and Findings

Research Question One - Methods of collecting Tiv intangible cultural heritage resources

Result for the focus group discussion shows the frequency and percentages of the methods of collecting intangible cultural heritage resources of the Tiv people of North Central Nigeria. Concerning Tiv songs, dance, and music, the result showed that all respondents (15, 100%) agreed on the Tiv songs artist in their community and the type of dance the community perform very well. However, while some respondents (10, 66.7%) agreed on the type of dance still in existence for preservation, others, (5,33.3%) disagreed. On the contrary, all respondents (15, 100%) agreed on the time ideal for song, music, and dance, and whether a dance is preferred by a particular gender and a preferred time to dance it. In the area of Tiv oral literature and folklore, all the respondents (15, 100%) agreed on the myth about the history and origin of Tiv (green snake story), preferred time for folklore and if it is specific to an age group (Moonlight at night), time the oratory last (1hour), whether the present generation knows about any of the oral literature (Audio recording and oral literature are available and can be preserved) and the ways of ensuring that the future has access to this folklore (Audio broadcast and audio recording) respectively.

Concerning Tiv ceremonies, all the respondents (15, 100%) agreed on the activities the Tiv traditional council has to preserve Tiv ceremonies and festivals (Archive and documentation center by government), specific seasons and times to perform these ceremonies and festivals (Burial ceremonies and kwaghir festival for competition), methods for ensuring ceremonies and festivals are preserved (Recording on DVD tape) and the ways to ensure that these ceremonies do not go extinct (Teaching children) respectively. In the aspect of Tiv traditional rites and religion, all the respondents (15, 100%) agreed on the channels most appropriate for documenting Tiv traditional rites (Imborvungu, azoov), the preferred method of recording traditional rites, whether tourists come around to inquire about this cultural attribute and if Yes, the ways of collecting data, and otherways of preserving the deities that can be preserved for posterity respectively. In the area of Tiv traditional craftsmanship and technology, all the respondents agreed on the preferred time to visit the shrine or atewai (Permission by chief priest), preferred gender, and restriction on physical appearance (Men are preferred), how they came about traditional craftsmanship (Through inheritance), and the preferred way do the custodians of the shrine see appropriate documentation-say pictures, short films, and videos (Pictures) respectively. However, while some respondents (7, 46.7%) agreed on how they intend to pass the knowledge to the younger generation (Learning based on interest) others (8, 53.3%) disagreed. The implication for the finding is that there is urgent need for the preservation of the Tiv intangible cultural heritage collection to avoid going into extinction.

Research Question Two

What are the methods of creating awareness for the digitally preserved Tiv intangible cultural heritage resources in university libraries in North Central Nigeria?

Table1: *Mean and Standard deviation of respondents on the methods of creating awareness for the digitally preserved Tiv intangible cultural heritage resources in university libraries in North Central.*

	Awareness of the digitally preserved Tiv intangible cultural heritage (N = 100)			
S/N	**Item Statement**	□	□□	**Dec**
1	Use of Brochure	3.33	0.73	**A**
2	Posters are strategic in the creation of awareness	3.21	0.57	A
3	Staging exhibition	3.17	0.87	A
4	Using daily Newspaper	3.13	0.77	A
5	Making an announcement on Radio	3.17	0.74	A
6	Buying time on Television to display products	3.11	0.78	A
7	Creation of a Website to increase visibility	3.18	0.76	A
8	Internet-based tools	3.17	0.68	A
9	Information related Blogs	3.02	0.77	A
10	Creating pages with ads on Facebook	3.10	0.84	A
11	Maintaining a lively Instagram page	3.21	0.80	A
12	Creating Flickr pages for a picture from products	2.92	0.75	A
13	Downloading and using Telegram with friends	3.06	0.80	A
14	Sharing available information on Twitter	3.13	0.61	A
15	Using Pinterest	2.93	0.78	A
16	Creating Social tagging for mentions	2.97	0.78	A
17	Downloading and enlightening friends on Whatsapp	3.33	0.70	A
18	Displaying videos on the YouTube page	3.17	0.78	A
	Grand Mean	**3.12**	**0.50**	**A**

Key: N = Number of respondents, x= mean, SD = Standard Deviation, Dec. = Decision.

Result presented in Table 2 showed the mean and standard deviations of respondents on the methods of creating awareness for the digitally preserved Tiv intangible cultural heritage resources in university libraries in North Central, Nigeria. In summarythe grand mean of 3.12 is also above the criterion level of 2.50 set as a benchmark for accepting an item. The grand mean of 3.12 with a standard deviation of 0.50 showed that respondents agreed that all the item statements in Table 3 above are methods of creating awareness for the digitally preserved Tiv intangible cultural heritage resources in university libraries in North Central, Nigeria.

Research Question three

What are the ways in which libraries can create visibility using Internet protocol addresses for the digitalized Tiv intangible cultural heritage collection in university libraries in North Central Nigeria?

Table2: *Mean and Standard deviation of respondents on the ways in which libraries can create visibility using Internet protocol addresses for the digitalized Tiv intangible cultural heritage collection in university libraries in North Central Nigeria.*

	Ways in which libraries can create visibility using Internet protocol address (N = 100)			
S/N	**Item Statement**	□	□□	**Dec**
1	Dspace promotes open access	3.46	0.67	**A**
2	Dspace enhances visibility using IP address	3.21	0.66	A
3	Dspace is Dublin core based	3.05	0.77	A
4	Dspace has descriptive metadata for interoperability	3.10	0.80	A
5	Dspace out-of-the-box digital asset management	3.10	0.70	A
6	Dspace has management and curation of digital objects	3.12	0.77	A
7	Metadata full-text files are indexed for facet browsing and searching the web	3.16	0.76	A
8	Digital adds for image viewer for audio and video stream module creates visibility	3.13	0.79	A
9	Dspace create links to social media platform to enhance visibility	3.36	0.66	A
10	Collections are open and interoperable.	3.13	0.76	A
	Grand Mean	**3.18**	**0.52**	**A**

Key: N = Number of respondents, x= mean, SD = Standard Deviation, Dec. = Decision.

Result presented in Table 4 showed the mean and standard deviations of respondents on the ways in which libraries can create visibility using Internet protocol addresses for the digitalized Tiv intangible cultural heritage collection in university libraries in North Central Nigeria. In summary thegrand mean of 3.18 is also above the criterion level of 2.50 set as the benchmark for accepting an item. The grand mean of 3.18 with a standard deviation of 0.52 showed that respondents agreed that all the item statements in Table 4 are ways in which libraries can create visibility using Internet protocol addresses for the digitalized Tiv intangible cultural heritage collection in university libraries in North Central Nig

Research Question Four

What is the extent to which Dspace software can enhance visibility for the digitally preserved Tiv intangible cultural heritage in university libraries in north central Nigeria?

Table 4: *Mean and Standard deviation of respondents on the extent to which Dspace software can enhance visibility for digitally preserved Tiv intangible cultural heritage in university libraries in north central Nigeria.*

	Extent to which Dspace software can enhance visibility for digitally preserved Tiv intangible cultural heritage (N = 100)			
S/N	**Item Statement**	□	□□	**Dec**
1	Dspace is Flexible and adjusts to the user's needs	3.45	0.66	HE
2	It has a Level of visibility through the Dspace handle	3.22	0.60	HE
3	Large data acceptance	3.41	0.67	HE
4	It is User friendly and allows its user to customize	3.16	0.81	HE
5	Its Visual display module allows the visualization of items that are upload	3.52	0.60	HE
6	Dspace module has API for enhanced function as desired	3.27	0.80	HE

S/N	Extent to which Dspace software can enhance visibility for digitally preserved Tiv intangible cultural heritage (N = 100) Item Statement	□	□□	Dec
7	Has optimal webpage browser structured for information retrieval in search engines	3.33	0.68	HE
8	Gives room for expansion and improvement for enhanced visibility of digital content	3.43	0.61	HE
9	Enhanced interoperability between cultural heritage and output	3.12	0.72	HE
10	Dspace uses CSV and XML data for enhanced visibility	3.31	0.58	HE
	Grand Mean	**3.32**	**0.41**	**HE**

Key: N = Number of respondents, x = mean, SD = Standard Deviation, Dec. = Decision.

Result presented in Table 4 showed the mean and standard deviations of respondents on the extent to which Dspace software can enhance digitally preserved Tiv intangible cultural heritagefor enhanced visibility in university libraries in north-central Nigeria. In summarythe grand mean of 3.32 is also above the criterion level of 2.50 set as benchmark for accepting an item. The grand mean of 3.32 with a standard deviation of 0.41 showed that to a high extentall the item statements in Table 5 are the extent to which Dspace software can enhance digitally preserved Tiv intangible cultural heritage for enhanced visibility in university libraries in North central Nigeria.

Discussion of Findings

This subheading discusses the findings of the study. The findings are discussed drawing inference from the authors' views in literature and relating them to the views of the researcher. The discussion is presented under twelve(12) subheadings following the purpose of the study and hypotheses.

Methods of collecting intangible cultural heritage collection Digital Preservation

The findings of this study revealed that the respondents agreed that the following constitute the methods of collecting intangible cultural heritage collection for digital preservation. The methods were explored using focus group discussions among the Tiv traditional rulers and their subordinates who agreed to the methods as recordings on audio and video tape but teaching their children was more appropriate for them. Pictures were also agreed and making of short films.

The findings of the study agree with Perare and Chandra (2020) that the advent of technology has enabled support and saved the cultural memories of the communities. The study also confirms with Ikyer (2017) finding which asserts that the Tiv folklore could be combined in linking text audio, video, animation, and graphics through hyperlinked multimedia, this integrative and supportive hypermedia could relive narratives and performances, enrich texts in time past, in ancient and modern confluences, and recreate history in a connective chain such that oral histories and culture could bounce back to a cultural and modern reckoning for digital preservation.

The Tiv traditional council on the focus group discussion participates with maximum cooperation which is in line with Chaudhuri (2012) that community involvement in strengthening audio-visual recording collection in Langas Manganiars and Mandolin traditional music. For the performing arts so many communities have attempted ways in the past to document their cultural heritage, among the Tiv people, festivals and dance which have been in existence have recordings on video, tape, and photographs as confirmed by Shija (2016) in a speech said “I also had the distinguished honor and privilege of leading a Tiv Kwagh-hir theatre troupe to perform at Ghana and France in 1999 and 2001 respectively.

Ways in which libraries can create awareness for the digitally preserved cultural heritage

Awareness creation for the digitally preserved cultural heritage is an internet and network aspect, it is a technique adopted by systems librarians and institutions to deliver an automated package to its audience.

The findings of this study showed that the respondents agreed that the following are ways of creating awareness for the digitally preserved Tiv intangible cultural heritage collection using DSpace software. Some of the identified methods are: the use of brochures, posters, exhibitions, daily newspapers, radio announcements, television broadcasts, website creation, internet-based tools, blogs, Facebook, Instagram, Flickr, Telegram, Twitter, Pinterest, social tagging, WhatsApp, and YouTube.

The above findings agreed with the findings of Tupja et al (2016), the essential objective of making an accessible virtual archive serves the purpose of raising awareness among field specialists at an institutional level. Even though communities are regarded as crucial actors in the safeguarding process, they are nevertheless kept at a certain distance and the current state of the virtual collection is evidence of a bureaucratic expert-friendly content arrangement.

In addition, Graitan (2014) asserts that, Twitter, Facebook, Pinterest, Instagram, and Flickr are some examples of social media that numerous cultural institutions around the world are using to engage with their community, by sharing with them day-to-day updates of an excavation, information about restoration projects, or the staging of an exhibition this is also the case with the results arising from North-central Nigeria. This study has brought to limelight the possible ways of using social media to raise awareness of cultural heritage preservation with links to Dspace software.

Ways in which libraries can create visibility for the digitally preserved cultural heritage collection using IP address in Dspace

The results of this study revealed that the respondents agreed that libraries can create visibility for the digitally preserved Tiv intangible cultural heritage collection using internet protocol and other modules as: the open access software is readily available, visibility is enhanced using IP address, DSpace is Dublin core based, descriptive metadata for interoperability, out of the box digital asset management, curation of objects, indexed for facet browsing and web searching, digital adds for viewers for audio and video, stream module for visibility, social media platforms and open collections with interoperable

The findings of this study are in line with the findings of Nicholas (2013) describes digital visibility as how visible or accessible content is as a result of navigational signposting, menu, and hotspot prominence. More so, digital visibility can be achieved better with a platform that can accept all formats of multimedia collections, easy to navigate with simple menus like Dspace software.

Similarly, Bollini etal (2017) findings confirms, Dspace as an open-source, out-of-the-box Digital Asset Management System that allows capturing, storing, indexing, preservation, and distribution of many kinds of digital objects, including texts, images videos, audio, and data. The researcher further affirms that Dspace provides a way to manage materials and publications in a professionally maintained repository to give them greater visibility and accessibility over time. Dspace is specifically appreciated for its effectiveness and the simplicity of its installation and management procedures.

Extent to which Dspace can enhance digital preservation of the Tiv intangible cultural heritage collection

The results of this study revealed that the respondents agreed to the extent to which Dspace software enhances digital preservation in university libraries, the extent agreed to were thus: Dspace is flexible and adjusts to users' needs, the level of visibility is high using its handle, it accepts large data, user friendly, visualization of items upload is allowed, optimal web browsers to function as desired, optimal web browser to structure for information retrieval in search engines, gives room for expansion and improvement for enhanced visibility of digital content, enhanced interoperability between cultural heritage and output at very high extent. The findings of this study are in line with the findings of Williams (2021).

The extent of visibility of Tiv Cultural Heritage Collections digitized through Dspace depends on the IP (Internet Protocol) address assigned to the Dspace computer server. Williams (2021) asserts that an IP address is a numerical label assigned to the devices connected to a computer network that uses the IP for communication. The researcher further explains that IP addresses act as an identifier for a specific machine on a particular network. It also helps you to develop a virtual connection between a destination and a source.

CONCLUSION

Methods of collecting Tiv intangible cultural heritage was audio recording, photographs, film, DVDs among others except for the Tiv traditional religion and other sacred practices, as such this can encourage more digital preservation practices among the Tiv people, systems librarian affirms to the methods in which libraries can create awareness of the digitally preserved Tiv intangible cultural heritage resources as seminar,workshop,training and using social media handle,for the visibility creation for the digitally preserved

Tiv in tangible cultural heritage collection, IP address are key to Dspace visibility and the Dspace handle,as the extent to which DSpace software can enhanced digital preservation is based on how professionals are able to customized the software,

RECOMMENDATIONS

1. Since technological gadgets can now be used in collecting intangible cultural heritage collections on displays, cultural centers and librarians can also digitally document this cultural heritage during the festive periods when they are commonly displayed for proper documentation on the DSpace software for global visibility and posterity.
2. University libraries should create awareness for digitally preserved cultural heritage using the Dspace software social media links.
3. University libraries should use IP address and subscription handle for enhanced visibility.
4. It is recommended that amongst the library software, DSpace is ascertained to be flexible and user-friendly and can be tailored to meet any need of a user therefore other tribes cultural heritage within North Central and Nigeria can also digitized.

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Cybersecurity Management Skills as Determinant to Effective Digital Library Services Provision in Nigerian Public University Libraries

By

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Abstract

This study examined cybersecurity management skills as determinant to effective digital library services provision in Nigerian public university libraries. It adopted a correlational research design, with a population of 401 academic/professional librarians from eight (8) public university libraries in four (4) states in South-East and South-South, Nigeria. The proportionate stratified random sampling technique was used to select 180 academic/professional librarians as the sample size for the study. Data were collected using the researchers' structured questionnaire and unstructured interview. The data collection process yielded 93% response rate, while the data collected were analysed using descriptive statistics of frequency counts, mean scores, standard deviations and Pearson Product Moment Correlation (PPMC), with the simple linear regression to test the single null hypothesis at 0.05 level of significance. The study revealed that librarians' level of awareness of cybersecurity management issues was relatively high on basic issues such as managing cybersecurity budgets and projects, etc., and low on issues of technical nature such as designing and developing cybersecurity architecture for digital library systems, etc. It indicated that the cybersecurity management skills required by librarians for effective digital library services provision are categorized into technical skills (such as knowledge in identifying and mitigating an attempt to hack library server to secure digital library services, ability to install and update computer virus for digital library services provision, etc.); managerial skills (like the ability to lead highly motivated teams in dealing with cybersecurity threats for digital library services provision; knowledge in effective collaboration with various departments and stakeholders in cybersecurity situation for digital library services, etc.); and soft skills (such as ability to make proactive decisions about cybersecurity issues, learn new skills about cybersecurity, and think critically in evaluating cybersecurity information for digital library services, among others). It identified rapid pace of technological evolution, general low level of librarians' skills in digital technologies, lack of cybersecurity courses in LIS curriculum, lack of tailor-made training programmes for librarians on cybersecurity issues, etc., as the major factors militating against the acquisition of cybersecurity management skills by librarians for effective digital library services provision. The study concluded that cybersecurity management skills of librarians have a strong significant relationship with effective digital library services provision in Nigerian public university libraries. It therefore, recommended, among other measures, that management of universities in collaboration with LIS schools should introduce cybersecurity management courses into the curriculum of Library and Information Science to provide the background for acquiring cybersecurity management knowledge and skills by LIS graduates, while the training and retraining of librarians in cybersecurity management incidents and trends should be prioritized by management of university libraries, library associations and professional bodies.

Keywords: ***Cybersecurity, Cybersecurity Management Skills, Digital Library Services Provision, Nigerian Public University Libraries.***

Introduction

Cybersecurity threats have become one of the major issues with severe effects on organizational and individual activities across the globe. Cybersecurity threats and other Internet related criminal activities are posing serious challenges to policy and decision makers in business, health, education, finance and other sectors. In the university libraries, cybersecurity threats have been reported as the most palpable challenge of modern times, affecting information services delivery, generally, and the provision of digital library services, in particular. It is said to result in severe consequences such as intellectual property theft, reputational damage, and financial losses (Oladokun et al., 2024); as well as breach of confidentiality and integrity, with compromising trust and reputation of libraries (Akor et al., 2024; Bouaamri et al., 2022). University libraries, as digital information and knowledge hubs (Arua & Udoh, 2019; Sheikh et al., 2021), increasingly and unequivocally depend on emerging interconnected digital technologies for services delivery and by so doing, are exposed to cyberthreats (Pratama et al. 2022). They often face malicious actors who target the library systems and networks in order to gain unauthorised access and compromise data integrity and privacy. Particularly, users of the university libraries are exposed to phishing attacks, identity theft, cyberbullying, cyberstalking, revenge pornography, cybersex, cybersquatting, espionage, copyright infringement, spamming, software theft, digital plagiarism, etc. (Aderibigbe et al., 2021; Akwang et al, 2024; Al-Hawamleh, 2023; Dunmade, 2022; Essien & Ekaiko, 2022). This escalating situation demands urgent attention in cybersecurity management, which in turn, requires effective cybersecurity management skills. This will facilitate the provision of trustworthy, authentic, reliable, and quality digital library services to the teem crops of library users. It will also help in keeping the integrity and organizational reputation of the university libraries intact.

Cybersecurity management refers to the practical and conscious techniques, including planning, organization and coordination of securing the cyberspace, computer systems and other electronic gadgets in the libraries from unauthorized persons and malicious access. According to Fadehan and Okiki (2023), cybersecurity is defined as the practice of safeguarding computers, servers, mobile devices, electronic systems, networks and data from unauthorised access, theft and damage. It is the practice of preventing and protecting the online or computer assisted technologies from cyberattacks and the measures to recover from the incidents of cyberattacks when it occurs (Obim & Akpokurerie, 2023). Cybersecurity also embeds a set of technologies, practices, processes and policies designed to guard networks, programmes, computers and data from damage, attack or unauthorized access by individual or group of individuals who are called cybercriminals (Ajie, 2019; Udoh, 2024). Cybersecurity management is a vital process of network administration, involving the provision of planned protection of data, systems, and networks from unauthorized access, attacks, or damage. It encompasses education, practices, risk mitigation, and provision of equitable access to digital resources for all library users. Cybersecurity management is of utmost importance in university libraries due to their fundamental role in supporting teaching, learning, and research activities through the acquisition, storage and provision of access to valuable intellectual assets such as scholarly publications, research data, and proprietary information to all members of the university communities. Cybersecurity management helps in safeguarding sensitive information from criminally-minded individuals and systems who seek to undermine the digital information systems of the university libraries. Effective cybersecurity management depends largely on the level or degree of the cybersecurity management skills and competencies possess by the librarians.

Cybersecurity management skills of librarians could be construed as the most critical requirement for cybersecurity vis-à-vis effective provision of digital library services in university libraries. Cybersecurity management skills embed the competencies, capabilities, knowledge, expertise, abilities, and aptitude necessary in dealing with cybersecurity threats in all ramifications. Cybersecurity management skills are indispensable skillsets in the present age of interconnectivity, cyber presence and digital essence. Obim and Akpokurerie (2023) defined cybersecurity management competencies as 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. Cybersecurity management skills are considered as a combination of technical, managerial and soft skills (Commonwealth of Australia, 2025; EC-Council University, 2025; Udoh, 2024) or simply, as a combination of hard and soft skills (Fortra, 2022). They are crucial in cybersecurity management, playing vital roles in ensuring effective response and mitigation of cybersecurity threats. These crucial skillsets include knowledge of network security and security technologies, including operating systems and databases; ability to know emerging threats and attack vectors, including vulnerabilities; ability to identify and respond to security incidents; ability to guide or lead cybersecurity teams and make strategic decisions; ability to plan and implement cybersecurity projects, including risk assessments and security audits. Others include the ability to communicate clearly to both technical and non-technical

audiences; ability to build good interpersonal relationships, while effectively collaborating with various departments and stakeholders, as well as think critically and analytically for effective solutions to cybersecurity challenges. Cybersecurity management skills equally involve the ability to monitor unauthorized access to digital information resources, prevent hackers, install and update computer virus, identify and mitigate an attempt to hack a system, as well as archive the content of university library website. Possessing cybersecurity management skills is fundamental for librarians to adequately combat cybersecurity issues in order to effectively provide digital library services in university libraries.

However, digital library services are the offshoot or product of information and communication technologies (ICTs), with numerous advantages over traditional library services. According to Olubiyo and Olubiyo (2023), digital libraries, also called online libraries, internet libraries, digital repositories, or digital collections are online databases of digital objects that may include text, still images, audio, video, digital documents, other digital media formats or libraries accessible through the internet. Digital library services provision refers to the delivery of library services using digital platforms so that users can consult the services of the library from the comfort of their homes, offices, hotels, gyms, business locations or anywhere else without physical contact with the librarians at any time of the day (Fagbemi et al., 2024). The provision of digital library services ensure that users can access and consult the library services from remote places using mobile, digital or electronic devices. Digital library services are provided by librarians via the use computers and digital technologies, with such services including digital collection, online internet search services, e-mail services, online reference services, customer care services (Ekere et al., 2016; Udoh et al. 2020). They are not limited by space, time or geographical location. The provision of digital library services also assures of better quality, accuracy, reliability, convenience and satisfaction. The provision of digital library services requires digital technologies such as computer networks, iPad, iPhone, Tablets, and other internet-related tools like web-based OPACs, web-based databases, electronic document delivery, virtual library assistant tools, library websites, library portals, web forms, electronic bulletin boards, discussion forums, electronic mailing lists, video conferencing or webcam, voice over Internet protocol (VoIP), etc. (Bhattacharya et al., as cited in Igbo, 2017; Igbo et al., 2022; Mensa et al., 2023). Digital library services are highly prone to cybersecurity attacks and other threats.

From the perspectives, therefore, to provide effective digital library services, librarians are expected to acquire adequate cybersecurity management skills and competencies. These new skillsets are needed to deal with digital collections, online databases, electronic services, and most importantly harness various digital tools which are integral components of digital library systems. Cybersecurity management skills help librarians as knowledge experts, digital literacy trainers, information scientists, data analysts, research advisors and information mangers to work with necessary cybersecurity tools, including cloud technologies, augmented reality, data science and analytic tools, artificial intelligence (AI), Internet of Things (IoT), Robots, drones and other emerging Hi-Tech tools (Butler-Adam, 2018; Mensa et al., 2023; Penprase, 2018; Ukwandu, et al., 2023; Udoh et al., 2024). Cybersecurity management skills empower librarians to effectively integrate people, process and technology toward proactively identifying, investigating and mitigating cybersecurity risks in order to ensure the confidentiality, integrity and availability of information assets of university libraries. They enhance the performance of the tasks of vulnerability assessment, threat intelligence, incident response, penetration testing, and security awareness training. The skills also shape librarians' potentials in coordinating stakeholders to ensure that cybersecurity goals and standards are in accordance with organizational requirements, while ensuring that other necessary cybersecurity protocols, policies, and best practices are regularly finetuned for optimum results. Meanwhile, the acquisition of cybersecurity management skills by librarians for effective provision of digital library services in university libraries is significantly hampered. This is due to a myriad of issues, including poor level of skills and desire to learn new skills by librarians, lack of clear legal guidelines and policies for effective cybersecurity issues, lack of cybersecurity courses in LIS curriculum, lack of tailor-made training programmes for librarians on cybersecurity, resistance to change, high rate of technological evolution, organisational inertia, among other issues (Akor et al., 2024; Haque et al., 2022; Obim & Akpokurerie, 2023). Thus, based on the above background, this study investigated cybersecurity management skills as determinant to effective digital library services provision in Nigerian public university libraries using eight (8) public university libraries in four (4) states from South-East and South-South, Nigeria.

Statement of the Problem

Cybersecurity threats are increasing astronomically in digital library systems due to massive integration of emerging digital technologies. They constitute the most severe challenges hampering the provision of effective digital library services by librarians in university libraries. Cybersecurity threats result in disruption of the functionality of digital library server, unauthorized access to digital information, as well as

exposure of sensitive organizational or personal data, among other consequences. However, in spite of the dangerous effects of cybersecurity situations, it seems that the required cybersecurity management skills among librarians as the most critical cybersecurity counter measures are lacking in most public university libraries. In fact, studies indicated that university libraries are exposed to various cybersecurity threats but librarians are not taught cybersecurity issues since majority of library schools in Nigeria do not teach cybersecurity courses as a result of dearth in skilled manpower (Igbinovia & Clifford, 2023; Ukwandu et al., 2023). Particularly, Khan et al. (2021) in their study on university libraries in Pakistan (which is outside the peculiar situations in Nigeria), reported that majority of university libraries are lagging in standardized measures to secure digital resources because of the challenges of inadequate skills of librarians to secure digital resources. Okike and Adetoro (2018) in another study on securing cyber information systems of libraries and the influence of tech-skills of librarians in university libraries in South-West, reported low skills among librarians. The above positions were further confirmed by these researchers' preliminary observations, which revealed a lack of preparedness and readiness of university libraries and librarians in cybersecurity management skills for digital library services provision due to lack of training of librarians on cybersecurity management issues. Therefore, in view of the above worrisome scenarios, it pricked these researchers' interest to investigate cybersecurity management skills as determinant to effective digital library services provision in Nigerian public university libraries in order to proffer solutions to the hitherto disturbing reality.

Objectives of the Study

The study examined cybersecurity management skills as determinant to effective digital library services provision in Nigerian public university libraries. The specific objectives of the study were:

i. To determine librarians' awareness level of cybersecurity management issues for effective digital library services provision in Nigerian public university libraries.
ii. To identify cybersecurity management skills required by librarians for effective digital library services provision in Nigerian public university libraries.
iii. To find out possible factors that militate against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries.
iv. To examine the relationship between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries.

Research Questions

The following research questions guided the study:

i. What is the level of librarians' awareness of cybersecurity management issues for effective digital library services provision in Nigerian public university libraries?
ii. What are the cybersecurity management skills required by librarians for effective digital library services provision in Nigerian public university libraries?
iii. What are the possible factors that militate against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries?
iv. What relationship exists between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries?

Hypotheses

A single null hypothesis was formulated and tested at 0.05 level of significance.

H0: Cybersecurity management skills of librarians have no significance relationship with effective digital library services provision in Nigerian public university libraries

Literature Review

Cybersecurity refers to a wide range of conscious practices aimed at preventing and/or protecting the online and computer mediated technologies from cyberattacks as well as measures to recover from the cybersecurity incidents or attacks when they occur (Obim & Akpokurerie, 2023). Similarly, Ajie (2019) conceived cybersecurity as a set of technologies, practices, policies and processes designed to guard networks, programmes, computers and data from damage, attack or unauthorized access by individual or group of individuals who are called cybercriminals. In the same vein, Technopedia, as cited in Jenab and Moslehpour (2016) opined that cybersecurity involves preventative methods used to protect digital information and digital technologies from being stolen, compromised or attacked. It requires effective understanding of potential cyberthreats such as viruses and other malicious codes to digital information and associated digital tools. According to Ahmad and Ulrahman (2023); Nilsen (2017), cybersecurity attacks are increasingly prevalent, with severe threats to compromise sensitive information of individuals, organizations, and even entire nations. This necessitates effective cybersecurity management strategies in order to ensure effective cybersecurity identity management, cybersecurity risk management and cybersecurity incident management. It implies that cybersecurity management is a herculean task that requires strong skillsets, including innovative, creative,

critical and analytical skills in identifying and mitigating cyberthreats, while making efforts to prevent such threats from damaging the online technologies and network of interconnected computers in university libraries. Cybersecurity management for effective digital library services provision in university libraries, require adequate cybersecurity management skills.

Accordingly, Obim and Akpokurerie (2023) defined cybersecurity management skills as the totality of abilities, competencies, capabilities and technological know-how required by an individual to effectively, proactively and adequately protect, prevent and secure online technological infrastructures as well as professionally handle the incidents of cyberattacks within the institutions to prevent further attacks or damage. Ahmad and Ulrahman (2023) opined that cybersecurity management skills can be broadly categorized into technical and soft skills. These skillsets are further dissected to include the ability to assess an organisation's cybersecurity posture; analyse and implement cybersecurity policies and frameworks; analyse and comply with cybersecurity-related laws, regulations and legislations; implement cybersecurity recommendations and best practices; manage cybersecurity resources; develop and lead the execution of a cybersecurity strategies; influence an organisation's cybersecurity culture; identify and solve cybersecurity-related issues; establish a cybersecurity plans; communicate, coordinate and cooperate with internal and external stakeholders, etc. This position corroborated Commonwealth of Australia (2025); as well as EC-Council University (2025), which reported that cybersecurity management skills can be considered as a combination of technical, managerial and soft skills, or simply, as a combination of hard and soft skills (Fortra, 2022). Possessing these skillsets is very essential in achieving a safe and well-protected online environment for effective provision of digital library services in university libraries. It ensures that cybersecurity threats, attacks, malicious attempts, damages and unauthorized access are identified and prevented from digital library systems and information.

However, Akor et al. (2024) investigated cybersecurity awareness with attention on leveraging emerging technologies in the security and management of libraries in higher education institutions. The study, which adopted a qualitative research approach revealed that malware infections, phishing attacks, data breaches, and ransomware incidents are some of the cybersecurity threats facing libraries. It indicated breach of confidentiality, integrity, and availability of library resources and patron information, compromising the trust and reputation of libraries as some significant risks posed by cybersecurity threats in the libraries. It showed that Artificial Intelligence (AI), Machine Learning (ML), Blockchain, Biometric Authentication, and Internet of Things (IoT) security are emerging technologies for mitigating cybersecurity threats and enhancing library security management. It also identified interoperability issues, data privacy concerns, and budget constraints as barriers to their effective implementation of cybersecurity in libraries.

Oladokun et al. (2024) also studied cybersecurity risks as a sine qua non for university libraries in Africa. The study discovered that cybersecurity risks encompass issues of malware attacks, phishing, ransomware, and identity theft, which if not addressed, can lead to severe consequences such intellectual property theft, reputational damage, and financial losses. It recommended that African university libraries should prioritise cybersecurity education for both staff and users, develop and regularly update comprehensive cyberethics and policies that address the unique challenges faced in the African context, and explore avenues for improving technological infrastructure. It harps on the need for investments in advanced security systems, regular software updates, and the adoption of emerging technologies to strengthen African university libraries' resilience against cyberthreats.

Obim and Akpokurerie (2023) investigated the awareness of cybersecurity and its impact on information storage in the university libraries in South-East, Nigeria. The study revealed that the major cybersecurity threats in university libraries were hacking, impersonation, interception of electronic message, unauthorized access to information resources, computer virus, among others. It showed that the cybersecurity competency among librarians for effective information storage is low, attributing it to inadequate training of librarians on cybersecurity measures, substandard technological infrastructures, lack of cybersecurity policy framework in university libraries, etc. The study recommended that librarians should be trained and re-trained on cybersecurity measures, most especially in the areas of detection and prevention of cybersecurity threats while university library management should formulate cybersecurity policy framework.

In another study, Igbinovia and Clifford (2023) examined cyber security in university libraries and implication for library and information science education in Nigeria. The study adopted a descriptive research design, and revealed that the perceived knowledge of cyber security among the librarians was moderately low. It showed that majority of library schools do not offer cyber security course due to dearth in skilled manpower. The study indicated that university libraries are exposed to various cyber threats, and that the librarians were not taught cyber security in library school, even though they have serious interest and enthusiasm in learning more about it. It revealed that librarians displayed high level of adherence to cyber ethics, while the disposition of library management towards cyber security issues and poor password management are the main challenges to the deployment of cyber security measures in university libraries. It showed that cyber security guidelines is one of the critical measures to combat cybercrimes in university libraries.

Ukwandu et al. (2023) also assessed cyber-security readiness of Nigeria to industry 4.0. The study adopted a quantitative research approach, and revealed that 60% of the respondents indicated that Nigeria is not yet ready to adopt 4IR as evidenced by the lack of basic prerequisites, such as 4IR-relevant laws, strong institutional frameworks and policies. It showed that the country lacks essential facilities to mitigate risks associated with 4IR. It discovered that at the university level, 72% of the academics are of the opinion that they have not taught, not teaching, or may have taught any subject relevant to the emerging 4IR world. The study concluded that there are increasing awareness and training over the last five (5) years by the academic stakeholders in these directions. It recommended that academic community should focus more attention in conducting deep-rooted scientific research around the emerging new field as a way of developing capacities to impact relevant skillsets, influence policy directions, while strengthening the development of legal and policy frameworks needed to protect intellectual properties, copyrights, and conducive environment.

Igbo et al. (2022) examined the provision of digital information resources in Nigerian university libraries. The study revealed that access to digital information resources in libraries is low due to non-implementation of real-time provision of information resources to users. This was reportedly attributed to lack of library management software to drive the process, professionals' lack of skills in implementing digital information services, as well as lack of relevant formal institutional digital information provision policies. It concluded that embracing real-time digital library services is essential to ensure effective provision of access to digital information for users. The study recommended subscription to library management software and development of the capacity of the librarians for effective implementation.

In the work of Chisita and Chiparausha (2021) on cyberthreats experienced at the Bindura University of Science Education, Zimbabwe, the interconnected nature of cybersecurity risks was emphasised. It indicated that a breach in one university library could reverberate across the broader academic community. The study recommended an urgent need for a collaborative approach in fortifying digital defences to protect the wealth of knowledge stored in academic institutions. This was also as Owusu-Ansah (2021) investigated the digital library readiness of distance learners with a focus on access and skills imperative in public multi-mode university in Ghana. The study showed that distance learners generally lacked advanced ICT skills to effectively use digital libraries. It indicated that though most of the respondents indicated that they possessed above average ICT skills, this did not translate into skills in formation of search queries and the use of electronic library tools. It showed that basic ICT skills constitute a solid ground to consolidate digital library readiness. The study recommended that libraries in multi-mode universities should design tailor-made training programmes for all classes of students including distance learners to enhance their use of digital library resources.

Khan et al. (2021) in their study on university libraries in Pakistan reported that majority of university libraries are lagging in standardized measures to secure digital resources due to challenges of inadequate skills of librarians to secure digital resources, as well as lack of policy on securing digital information resources in libraries, inadequate funding, ineffective information technologies in university libraries. This was corroborated by Okike and Adetoro (2018), who reported low skills among librarians in securing cyber information system and structures in the university libraries in South-West, Nigeria. Other studies by Mustafa and Kar (2019); Richardson et al. (2020) further reportedly agreed that human factor is the underlying reason for numerous attacks on computer systems and digital information resources because librarians have not acquired relevant cybersecurity management skills for effective and proactive cybersecurity.

From the above reviews, some insights have been made from various perspectives but the overall studies on the issues relating to cybersecurity management skills, and cybersecurity, generally, as well as their contributions to knowledge are far from been considered sufficient. In addition, the concept of cybersecurity is still very nascent thereby requiring more research towards expanding this emerging and very propelling research area. Thus, this study was conducted to add up to existing literature and specifically situate the imperatives of cybersecurity management skills of librarians as determinant of effective digital library services provision in Nigerian public university libraries.

Methodology

The study adopted a correlational research design, with a population of four hundred and one (401) librarians from eight (8) public university libraries, purposively selected from four (4) states in South-East and South-South, Nigeria. The population comprises 12 academic/professional librarians from Abia State University (ABSU) Library, Abia State; 43 from Michael Okpara University of Agriculture, Umudike (MOUAU) Library, Abia State; 15 from Imo State University (IMSU) Library, Imo State; 62 from Federal University of Technology (FUTO) Library, Imo State; 33 from Akwa Ibom State University (AKSU) Library, Akwa Ibom State; 80 from University of Uyo (UNIUYO) Library, Uyo, Akwa Ibom State; 22 from Cross River State University of Technology (CRUTECH) Library, Calabar, Cross River State; and 134 academic/professional librarians from University of Calabar (UNICAL) Library, Cross River State. The

population covered only those with a minimum of Bachelor of Science Degree in Library Science (BLS) or Library and Information Science (B.LIS), and those with higher academic qualifications (Masters and PhD), who are either progressing with the academic librarian cadre or working as non-academic staff in the university libraries. The choice of this population make-up was informed by the assumption that they have roles to play in cybersecurity management and should understand the importance of cybersecurity management skills in their involvement digital library services provision. The proportionate stratified random sampling technique was used in selecting 180 academic/professional librarians, representing 45% of the study population. The population distribution and sample size were further represented in the Table 1 below:

Table 1: Population Distribution and Sample Size of the Study

S/N	Institutions	University Status	State of Location	Academic/Professional librarians	Sample Size
1	ABSU	State	Abia	12	5
2	MOUAU	Federal	Abia	43	19
3	IMSU	State	Imo	15	7
4	FUTO	Federal	Imo	62	28
5	AKSU	State	Akwa Ibom	33	15
6	UNIUYO	Federal	Akwa Ibom	80	36
7	CRUTECH	State	Cross River	22	10
8	UNICAL	Federal	Cross River	134	60
	Total			***401***	***180***

Data for the study was collected using the researchers' structured questionnaire, with unstructured interview conducted on three university librarians to support the responses of the questionnaire. The questionnaire is titled, "**Cybersecurity Management Skills of Librarians for Effective Digital Library Services Provision Questionnaire - CSMSLEDLSPQ".** The questionnaire was designed in accordance with the modified Likert scale rating, under three (3) clusters, with a total of forty-six (46) item statements. It was subjected to content and face validated by three (3) research experts from Library and Information Science and Measurement and Evaluation disciplines from Akwa Ibom State University, Ikot Akpaden, who were expected to make necessary corrections and modifications to fit into the specific objectives of the study.

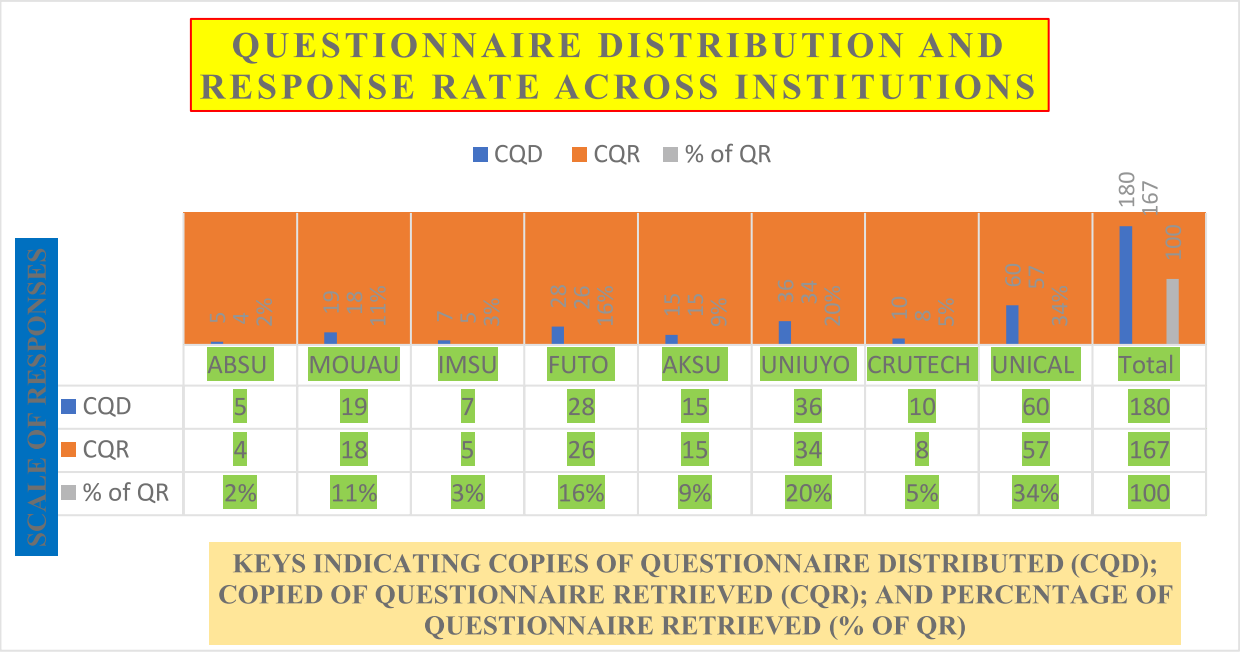
Consequently, 180 copies of the questionnaire were distributed physically to the respondents by the researchers and their research assistants recruited for the purpose of this study from each of the university libraries under investigation. At the end of the questionnaire distribution and retrieval, a total of 167 copies of the questionnaire, representing 92.78% (approximated to 93%) response rate were completed and retrieved with useful information, and were used for the data analysis. The data were analysed using descriptive statistics of percentage counts, mean scores, standard deviations to answer research questions 1 – 3, while Pearson Product Moment Correlation (PPMC) coefficient was used to answer research question 4, which examined the relationship between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries. The degree of the relationship for the correlation between the variables was determined and interpreted using Creswell's (2014) correlation coefficient scale of (r) ±0.00 - 0.20 = very low relationship; ±0.21 - 0.40 = low relationship; ±0.41 - 0.60 = moderate relationship; ±0.61 - 0.80 = high relationship, and ±0.81 - 1.00 = very high relationship. Again, the single null hypothesis was tested using simple linear regression at 0.05 level of significance. The decision rule suggested the rejection of the null hypothesis when the P-value is less than the Alpha value at 0.05 level of significance or otherwise invoke the acceptance principle of the null hypothesis.

Results

The results of the study were presented based on the total copies of questionnaire distributed and retrieval rate as shown in Table 2 and accompanying simple chart below:

Table 2: Questionnaire Distribution and Response Rate Across Institutions

S/N	Institution Libraries	CQD	CQR	% of QR
1	ABSU	5	4	2%
2	MOUAU	19	18	11%
3	IMSU	7	5	3%
4	FUTO	28	26	16%
5	AKSU	15	15	9%
6	UNIUYO	36	34	20%
7	CRUTECH	10	8	5%
8	UNICAL	60	57	34%
	Total	***180***	***167***	***100***



Data in Tabel 2 and accompanying chart above showed the copies of questionnaire distributed and rate of retrieval across the 8 university libraries in South-East and South-South zones of Nigeria. The results revealed that out of the 180 copies of the questionnaire distributed, a total of 167 were retrieved, with varying degree of responses. This retrieval rate was used throughout the data analyses to provide the basis for making generalizations.

Research Question 1: What is the level of librarians' awareness of cybersecurity management issues for effective digital library services provision in Nigerian public university libraries?

Table 3: Mean and standard deviation responses on librarians' awareness level of cybersecurity management issues for effective digital library services provision in Nigerian public university libraries (n = 167)

S/N	Item Statements **I am aware that the cybersecurity management issues for effective digital library services provision include:**	HA	A	FA	NA	Mean	Std. Dev.	Remark
1	Assessing and managing cybersecurity vulnerability in digital library system	69	74	21	3	3.25	0.74	Agreed
2	Planning response to cybersecurity incidents such as malware infections,	64	72	26	5	3.17	0.79	Agreed

S/N	Item Statements **I am aware that the cybersecurity management issues for effective digital library services provision include:**	HA	A	FA	NA	Mean	Std. Dev.	Remark
	phishing attacks, data breaches, and ransomware, etc., for digital library services provision							
3	Training of library staff on cybersecurity threats, incidents and trends	27	89	44	7	2.81	0.75	Agreed
4	Developing and updating cybersecurity policies, strategies and best practices for digital library services	55	71	29	12	3.01	0.89	Agreed
5	Managing cybersecurity budgets, resources and projects for digital library services provision	77	73	14	3	3.34	0.71	Agreed
6	Designing and developing cybersecurity architecture for digital library systems	12	44	90	21	2.28	0.78	Disagreed
7	Conducting cybersecurity risks analysis and audits to mitigate cybersecurity issues	16	35	91	25	2.25	0.83	Disagreed
8	Supervising and mentoring library staff on cybersecurity threats and incidents	32	62	62	11	2.69	0.69	Agreed
9	Reporting cybersecurity threats, incidents and status to management and other stakeholders	43	79	31	14	2.90	0.88	Agreed
10	Evaluating and implementing new cybersecurity tools and technologies	12	50	93	12	2.37	0.72	Disagreed
11	Following up latest cybersecurity threats, trends and regulations	16	64	59	28	2.41	0.88	Disagreed
	Grand mean					***2.77***	***0.79***	***Agreed***
	Criterion mean					***2.50***		

Source: Researchers' Field Survey, 2025

Data in Table 3 revealed the mean and standard deviation responses on librarians' awareness level of cybersecurity management issues for effective digital library services provision in Nigerian public university libraries. It indicated a relatively high level of awareness of cybersecurity management issues with a higher grand mean of 2.77 (0.79) against the 2.50 criterion mean. The results showed that the librarians' level of awareness of cybersecurity management issues was high on basic issues such as managing cybersecurity budgets, resources and projects with a mean score of 3.34 (0.71); assessing and managing cybersecurity vulnerability in digital library system (3.25, 0.74); planning response to cybersecurity incidents such as malware infections, phishing attacks, data breaches, and ransomware, etc., for digital library services (3.17, 0.79), etc. On the other hand, the result indicated a low level of awareness, with outright disagreement on issues of technical nature such as designing and developing cybersecurity architecture for digital library systems (2.28, 0.78); conducting cybersecurity risks analysis and audits to mitigate cybersecurity issues (2.25, 0.83); evaluating and implementing new cybersecurity tools and technologies (2.37, 0.72). This result was affirmed by the responses of the university librarians to the unstructured interview sessions, as they all agreed that cybersecurity is a new paradigm while effective cybersecurity management for digital library services provision will require deliberate cybersecurity training programmes by university libraries, library association and professional bodies or digital library services provision.

Research Question 2: What are the cybersecurity management skills required by librarians for effective digital library services provision in Nigerian public university libraries?

Table 4: Mean and standard deviation responses on the cybersecurity management skills required by librarians for effective digital library services provision in Nigerian

S/N	Item Statements **The cybersecurity management skills that I require for effective digital library services provision include:**	SA	A	D	SD	Mean	Std. Dev.	Remark
A	**Technical Skills**							
1	Ability to handle network infrastructure for dealing with cybersecurity issues in digital library services delivery	84	72	11	0	3.44	0.62	Agreed
2	Capability in handling and security control systems like server for effective delivery of digital library services	53	81	26	7	3.08	0.80	Agreed
3	Ability to work with security protocols and standards deliver digital library services	91	53	23	0	3.41	0.72	Agreed
4	Capability in dealing with security tools like firewalls, SIEM systems, and IDS/IPS for digital library services	82	79	3	3	3.44	0.63	Agreed
5	Ability to develop cybersecurity languages such as Python, C/C++, Go, Rust, PHP, JavaScript, SQL, HTML, etc., for digital library services	17	37	88	25	2.28	0.84	Disagreed
6	Ability to respond to security incidents for digital library services	85	56	26	0	3.35	0.74	Agreed
7	Ability to install and update computer virus for digital library services provision	91	67	9	0	3.49	0.60	Agreed
8	Knowledge in identifying and mitigating an attempt to hack library server to secure digital library services	101	50	16	0	3.51	0.67	Agreed
9	Ability to archive the content of university library website for effective digital library services provision	73	57	37	0	3.22	0.79	Agreed
B	**Managerial Skills**							
10	Ability to lead highly motivated teams in dealing with cybersecurity threats for digital library services provision	67	83	17	0	3.30	0.65	Agreed
11	Knowledge in identifying and mitigating security risks for digital library services	60	76	19	12	3.10	0.87	Agreed
12	Capability to manage cybersecurity projects from planning to implementation for digital library services	56	90	16	5	3.18	0.72	Agreed
13	Knowledge in effective collaboration with various departments and stakeholders in cybersecurity situation for digital library services	77	57	22	11	3.20	0.91	Agreed

C	**Soft Skills**							
14	Ability to learn new skills about cybersecurity for digital library services delivery	79	88	0	0	3.47	0.50	Agreed
15	Ability to adapt to changing cybersecurity situations for digital library services delivery	58	73	36	0	3.13	0.74	Agreed
16	Knowledge in analyzing cybersecurity issues for digital library services	63	83	18	3	3.23	0.71	Agreed
17	Ability to develop effective solutions for digital library services	59	95	13	0	3.28	0.60	Agreed
18	Ability to think critically in evaluating cybersecurity information for digital library services	92	61	7	7	3.43	0.76	Agreed
19	Ability in making proactive decisions about cybersecurity issues in delivering digital library services	98	59	9	1	3.52	0.63	Agreed
20	Analytical skills for making data-driven decisions about cybersecurity concerns	77	67	16	6	3.30	0.79	Agreed
21	Ability to pay attention to cybersecurity details	54	103	10	0	3.26	0.56	Agreed
	Grand mean					***3.27***	***0.71***	***Agreed***
	Criterion mean					***2.50***		

Source: Researchers' Field Survey, 2025

The data in Table 4 showed the mean and standard deviation responses on the cybersecurity management skills required by librarians for effective digital library services provision in Nigerian public university libraries. It indicated a very high degree of agreement with the items investigating librarians' required cybersecurity management skills for effective provision of digital literacy services with a higher grand mean of 3.17 against the criterion mean of 2.50. In the overall, a variety of cybersecurity management skills, which are broadly categorized into technical, managerial and soft skills are required by the librarians in dealing with cybersecurity systems, infrastructures and issues. Meanwhile, the highest required skills for managing cybersecurity related issues by the librarians, as indicated by their mean scores across the three broad skillsets include: knowledge in identifying and mitigating an attempt to hack library server to secure digital library services (3.51, 0.67); ability to install and update computer virus for digital library services provision (3.49, 0.60); ability to handle network infrastructure for dealing with cybersecurity issues in digital library services delivery (3.44, 0.62), etc. Skills from the managerial skills range include: ability to lead highly motivated teams in dealing with cybersecurity threats for digital library services provision (3.30, 0.65); knowledge in effective collaboration with various departments and stakeholders in cybersecurity situation for digital library services (3.20, 0.91), while the key skills from the soft skills spectrum include: ability to make proactive decisions about cybersecurity issues in delivering digital library services (3.52, 0.63); ability to learn new skills about cybersecurity for digital library services delivery (3.47, 0.50); ability to think critically in evaluating cybersecurity information for digital library services (3.43, 0.76), etc. On the contrary, the librarians disagreed with the option investigating the ability to develop cybersecurity languages such as Python, C/C++, Go, Rust, PHP, JavaScript, SQL, HTML, etc., for digital library services (2.28, 0.84). This result was further confirmed by the responses of the university librarians to the unstructured interviews, as they opined that librarians require a wide range of skillsets to survive in the digital world, but expressed their disappointment that librarians are not always exposed to relevant training to upskill themselves in line with new normals like cybersecurity threats, incidents, and trends. The heads of the university libraries also took time to clarify that most cybersecurity management skills are more technical and out of the core and regular practices of librarians in the university libraries.

Research Question 3: What are possible factors that militate against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries?

Table 5: Mean and standard deviation responses on the possible factors that militate against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries (n = 167)

S/N	Item Statements **The possible factors militating against my acquisition of cybersecurity management skills for effective digital library services provision include:**	SA	A	D	SD	Mean	Std. Dev.	Remark
1	Lack of tailor-made training programmes for librarians on cybersecurity issues	101	51	6	9	3.46	0.81	Agreed
2	Lack of funding for cybersecurity resources and tools like constant internet subscription for university libraries	66	92	9	0	3.34	0.58	Agreed
3	Substandard technological infrastructures for cybersecurity management	80	49	38	0	3.25	0.80	Agreed
4	Rapid pace of technological evolution	115	50	2	0	3.68	0.50	Agreed
5	Data privacy concerns	82	76	9	0	3.44	0.60	Agreed
6	Lack of cybersecurity policy framework and guidelines in university libraries	74	91	1	1	3.43	0.54	Agreed
7	Lack of adequate preparedness and readiness of university libraries to incorporate cybersecurity management systems	69	79	19	0	3.30	0.66	Agreed
8	Lack of cybersecurity courses in LIS curriculum	102	58	6	1	3.56	0.60	Agreed
9	General l ow level of librarians ' skills in digital technologies	99	68	0	0	3.59	0.50	Agreed
10	Lack of desire and interest of librarians in learning new skills like cybersecurity management skills	10	23	93	41	2.01	0.80	Disagreed
11	Technophobic disposition of librarians	17	60	70	20	2.44	0.83	Disagreed
12	Resistance to change	42	35	60	30	2.53	1.057	Agreed
13	Organisational inertia and lack of management support	67	74	20	6	3.21	0.80	Agreed
14	Complexity of integrating cybersecurity technologies and activities into existing university library workflows	79	88	0	0	3.47	0.50	Agreed
	Grand mean					***3.19***	***0.68***	***Agreed***
	Criterion mean					***2.50***		

Source: Researchers' Field Survey, 2025

Data on Table 5 showed the mean and standard deviation responses on the possible factors that militate against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries. It indicated that all the items of investigation, except lack of desire and interest of librarians in learning new skills like cybersecurity management skills (2.01, 0.80); and technophobic disposition of librarians (2.44, 0.83) were agreed upon by the librarians as the factors militating against the acquisition of cybersecurity management skills by librarians for effective digital library services provision. The result indicated a higher grand mean of 3.19 against the criterion mean of 2.50. It specifically identified rapid pace of technological evolution (3.68, 0.50); general low level of librarians' skills in digital technologies (3.59, 0.50); lack of cybersecurity courses in LIS curriculum (3.56, 0.60); complexity of integrating cybersecurity technologies and activities into existing university library workflows (3.47, 0.50);

lack of tailor-made training programmes for librarians on cybersecurity issues (3.46, 0.81), etc., as the major factors militating against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries. The result was validated by the responses of the university librarians to the unstructured interviews, since they pointed out lack of planned and systematic training opportunities for librarians in emerging technologies and systems, lack of adequate funding of university libraries, lack of state-of-the-art-facilities in the university libraries as the key hindrances to the acquisition of cybersecurity management skills in Nigerian public university libraries.

Research Question 4: What relationship exists between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries?

Table 6: PPMC coefficient of the relationship between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries

		CSMSLs	**EDLSP**
CSMSLs	Pearson's Correlation Sig. (2tailed)	1	0.155
	N	167	167
EDLSP	Pearson's Correlation Sig. (2tailed)	0.155	1
	R^2	0.024 (24%)	
	N	**167**	**167**

CSMSLs = Cybersecurity Management Skills of Librarians
EDLSP = Effective Digital Library Services Provision
N = Number of Observations
R = Correlation Coefficient
R^2 = Coefficient of Determination

Data in Table 6 revealed a very low degree of relationship between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries, as indicated by the correlation coefficient (r) of 0.155, which is positive and falls within the correlation coefficient limit range of ±0.00 - 0.20. The coefficient of determination (r^2) of 0.024 shows that 24% of the variance observed in effective digital library services provision in Nigerian public university libraries, could be accounted for by the cybersecurity management skills of librarians. Therefore, this implies that cybersecurity management skills of librarians to a very low extent but positively relates to effective digital library services provision in Nigerian public university libraries. This finding was validated using the result of the test of single null hypothesis as shown in Table 7 below.

Test of Hypothesis
The single hypothesis was tested at 0.05 level of significance

Hypothesis 1: Cybersecurity management skills of librarians have no significance relationship with effective digital library services provision in Nigerian public university libraries.

Table 7: Simple regression analysis of the relationship between cybersecurity management skills of librarians and effective digital library services provision in Nigerian public university libraries

Model	***Df***	***Sum of Square***	***Mean Square***	***F***	***Sig.***
Regression	1	25.167	25.167	2.687	0.103
Residual	166	1545.492	9.367		
Total	167	1570.659			

The data in Table 7 shows a P-value of 0.103, which is numerically greater than the Alpha value of 0.05, but not statistically strong enough to cause an acceptance of null hypothesis. Since the P-value of 0.103 is not statistically strong enough, the earlier postulated null hypothesis was rejected while the alternate hypothesis was accepted. Thus, cybersecurity management skills of librarians have strong significant relationship with effective digital library services provision in Nigerian public university libraries.

Discussion of the Findings

The study revealed that the librarians' level of awareness of cybersecurity management issues was relatively high on basic issues such as managing cybersecurity budgets, resources and projects; assessing and managing cybersecurity vulnerability in digital library system; planning response to cybersecurity incidents such as malware infections, phishing attacks, data breaches, and ransomware, etc., and low on issues of technical nature such as designing and developing cybersecurity architecture for digital library systems, etc. The reflects, in overall, that though the level of awareness of the librarians to cybersecurity management issues is relatively high, the reality is that the librarians are not well-familiar with cybersecurity management issues since the phenomenon is emerging and requires more training and sensitization. This was affirmed by the responses of the university librarians who pointed out that cybersecurity is a new paradigm while effective cybersecurity management for digital library services provision will require deliberate cybersecurity training programmes by the university libraries, library association and professional bodies. The finding aligns with Akor et al. (2024), as well as Obim and Akpokurerie (2023), which revealed that librarians are aware of malware infections, hacking, phishing attacks, data breaches, ransomware, unauthorized access to information resources, computer virus, etc., as some of the cybersecurity threats facing libraries. It disaffirms the position of Igbinovia and Clifford (2023), who discovered that the perceived knowledge of cybersecurity among librarians was moderately low, even as Ukwandu et al. (2023), reported an increasing awareness and training on cybersecurity related issues by academic stakeholders, including librarians.

The study indicated that the cybersecurity management skills required by librarians for effective digital library services provision are categorized into technical skills (such as knowledge in identifying and mitigating an attempt to hack library server to secure digital library services, ability to install and update computer virus for digital library services provision, etc.); managerial skills (like the ability to lead highly motivated teams in dealing with cybersecurity threats for digital library services provision; knowledge in effective collaboration with various departments and stakeholders in cybersecurity situation for digital library services, etc.); and soft skills (such as ability to make proactive decisions about cybersecurity issues, learn new skills about cybersecurity, and think critically in evaluating cybersecurity information for digital library services, among others). This result typifies the longing of librarians for more emerging skills like cybersecurity management skills as crucial for professional, intellectual and personal success in the Hi-Tech world. It was further confirmed by the responses of the university librarians who opined that librarians require a wide range of skillsets to survive in the digital world, but expressed their disappointment that librarians are not always exposed to relevant training to upskill themselves in line with new normals like cybersecurity threats, incidents, and trends. The heads of the university libraries also took time to clarify that most cybersecurity management skills are more technical and out of the core and regular practices of librarians in the university libraries. This finding agrees with Obim and Akpokurerie (2023), who reported that the cybersecurity competency among librarians for effective information storage is low, attributing it to inadequate training of librarians on cybersecurity measures and substandard technological infrastructures for training of librarians on cybersecurity issues. The finding, in a way, also corroborates Igbinovia and Clifford (2023), who revealed that librarians have high level of adherence to cyber ethics.

The study showed that rapid pace of technological evolution, general low level of librarians' skills in digital technologies, lack of cybersecurity courses in LIS curriculum, complexity of integrating cybersecurity technologies and activities into existing university library workflows, lack of tailor-made training programmes for librarians on cybersecurity issues, etc., as the major factors militating against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries. The result was validated by the responses of the university librarians who noted that lack of planned and systematic training opportunities for librarians in emerging technologies and systems, lack of adequate funding of university libraries, lack of state-of-the-art-facilities in the university libraries are the key hindrances to the acquisition of cybersecurity management skills in Nigerian public university libraries. This finding of the study is in agreement with the study conducted by Khan et al. (2021), which discovered that majority of university libraries are lagging in standardized measures to secure digital resources due to challenges of inadequate skills of librarians to secure digital resources, coupled with lack of policy on securing digital information resources in libraries and inadequate funding of university libraries. It aligns with Igbinovia and Clifford (2023) who found that majority of library schools do not offer cyber security course due

to dearth in skilled manpower. The finding also gives credence to Okike and Adetoro (2018); Mustafa and Kar (2019); as well as Richardson et al. (2020), who unanimously reportedly that human factor is the underlying reason for numerous attacks on computer systems and digital information resources because librarians have low skills and have not acquired relevant cybersecurity management skills for effective and proactive cybersecurity.

In summary, the study revealed that cybersecurity management skills have a strong significant relationship with effective digital library services provision in Nigerian public university libraries. This implies that the more skilled, competent and knowledgeable librarians are in managing cybersecurity threats, incidents and trends, the more they can effectively and efficiently provide digital library services in the university libraries.

Conclusion and Recommendations

Cybersecurity management skills are indispensable for effective provision of digital library services in university libraries. These emerging skillsets are of great essence for libraries and librarians since digital library services are constantly prone to various forms of attacks, including computer viruses, unauthorized access to digital information and databases, attack on server, as well as manipulation of official password to gain unauthorized entries into university library websites. These various forms of cybersecurity issues and incidents, if not prevented by skilled librarians can lead to loss of vital personal and organizational information, financial loss, attempt on the integrity and reputation of the libraries, among other severe consequences. In this study, it was discovered that librarians' level of awareness of cybersecurity management issues was relatively high on basic issues such as managing cybersecurity budgets and projects; planning response to cybersecurity incidents such as malware infections, phishing attacks, data breaches, etc., but low on issues of technical nature like designing and developing cybersecurity architecture for digital library systems; conducting cybersecurity risks analysis and audits to mitigate cybersecurity issues, etc. The study found that cybersecurity management skills required by librarians for effective digital library services provision are categorized into technical skills such as ability to identify and mitigate an attempt to hack library server, ability to install and update computer virus, etc.; managerial skills such as ability to lead highly motivated teams in dealing with cybersecurity threats, ability to collaborate with various departments and stakeholders in cybersecurity situations for digital library services, etc.; and soft skills like the ability to make proactive decisions about cybersecurity issues in providing digital library services, ability to learn new skills about cybersecurity for digital library services delivery, among others. The study also identified rapid pace of technological evolution, general low level of librarians' skills in digital technologies, lack of cybersecurity courses in LIS curriculum, complexity of integrating cybersecurity technologies and activities into existing university library workflows, lack of tailor-made training programmes for librarians on cybersecurity issues, etc., as the major factors militating against the acquisition of cybersecurity management skills by librarians for effective digital library services provision in Nigerian public university libraries. It however, concluded that cybersecurity management skills of librarians have a strong significant relationship with effective digital library services provision in Nigerian public university libraries.

Based on the findings of the study, the following recommendations were made:

i. Library and Information Science (LIS) curriculum should be expanded by those concern to include cybersecurity management courses in order to provide the background for acquiring cybersecurity management knowledge and skills by LIS graduates. This will equip them to become librarians with cybersecurity expertise and skills for their professional engagements and entire work life in whatever type of libraries they find themselves.

ii. Management of university libraries in collaboration with Librarians Registration of Nigeria (LRCN), library associations and professional bodies should prioritize the training and retraining of librarians in cybersecurity management issues, incidents and trends in order to enable them acquire these emerging skillsets for digital library services and day-to-day cybersecurity challenges in the university libraries.

iii. Management of the universities in collaboration with university libraries should provide state-of-the-art facilities including advanced security systems, Internet services and emerging digital technologies in order to enable librarians in Nigerian public university libraries to “learn by doing” and become skilled in cybersecurity issues and trends.

iv. University libraries should formulate cybersecurity policies and strategies in order to guide librarians in dealing with or responding to cybersecurity threats and issues in the university libraries.

v. Librarians should channel their energy, attention and interest to acquiring emerging new digital skills in order to be able to function effectively in the modern Hi-Tech age, especially in dealing with cybersecurity, AI and Machine Learning, as well as other Internet related issues that cropping into the services of the university libraries.

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Digital Literacy Skills and Attitude Towards Electronic Information Resource Utilisation among Students of Polytechnics in Ekiti State, Nigeria

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Abstract

This study investigated the digital literacy skills (DLS) and attitude towards electronic information resource utilisation (EIRs) among polytechnic students in Ekiti state, Nigeria. Descriptive survey research was used and population comprised National Diploma (ND) and Higher National Diploma (HND) students in the two institutions Federal Polytechnic, Ado-Ekiti and Ekiti State Polytechnic, Isan-Ekiti. Multistage sampling technique was employed at the Federal Polytechnic, Ado-Ekiti, with a student population of 762, a sample size of 117 was determined and selected using stratified random sampling to ensure representation across departments and academic levels. At the Ekiti State Polytechnic, Isan-Ekiti, due to the relatively small student population of 124, a total enumeration method was adopted, in which all students were targeted to participate in the study. Results revealed a high level of DLS, with students demonstrating strong proficiency in searching electronic sources ($\bar{x}$ = 2.56) and using internet search engines ($\bar{x}$ = 2.39). Student's attitude towards the use of EIRs indicated a favorable disposition, with students acknowledging their relevance for academic purposes ($\bar{x}$ = 2.66) and their potential to enhance academic performance ($\bar{x}$ = 2.61). Extent of utilisation data showed high engagement with EIRs for research and project writing ($\bar{x}$ = 3.39). Key challenges identified includes unreliable internet connectivity ($\bar{x}$ = 2.45), and limited e-resources in some disciplines ($\bar{x}$ = 2.42). Importantly, a significant positive relationship was found between DLS and attitude towards EIR usage ($r = .479^{**}$, $p < 0.05$), indicating that improved DLS can foster more positive and effective engagement with EIRs.

Keywords: Digital literacy skills, attitude towards electronic information resource utilisation, polytechnic students, Ekiti-state

Introduction

As a result of the invention of information, communication, and technology (ICT), polytechnic students may now use electronic information resources (EIRs) to enhance their learning experience. Online databases, multimedia materials, e-books, e-journals, and other digital information are some examples of these resources. Jontagia (2020) defined electronic information resource as a resource which requires computer access or any electronic item that conveys a collection of information, be it text, electronic books, electronic journals, electronic newspaper, electronic thesis, collection of images, other multimedia items and graphical, numerical or time-based, as a commercially accessible title that has been distributed with an expect to being promoted. These might be conveyed on CD ROM, on tape, by means of web or the Internet. The usage of electronic information resources (EIR) in the higher education system has increased dramatically over the past ten years (Jontagia, 2020). As such EIR are now a highly valuable component of this educational system. However, the usage of electronic information resources by polytechnic students is contingent upon their consistent use, and attitude serves as a necessary precondition for their effective utilisation.

Ajzen and Fishbein (1977) as cited in Oladejo, Alonge, and Oyewole (2020) clarified that attitudes are held with respect to specific aspects of an individual's life. This suggests that an attitude is typically supposed to be focused on a specific thing, such another person, an occasion, an item, a type of behaviour, or a policy. There are two types of attitudes: good attitudes and negative attitudes. A positive attitude towards electronic

information resources (EIRs) can be defined as acknowledging the potential and value of digital information for learning, research, and staying informed, while approaching it with enthusiasm, openness, and a constructive outlook. A skeptical or resistive viewpoint about the usage of digital information might be characterised as a negative attitude towards electronic information resources. This may be the result of a number of things, including a mistrust of the veracity of information found online, worries about security and privacy, discomfort with technology, or a preference for more conventional sources. A pessimistic polytechnic student may be reluctant to use digital tools for studying or research because they think conventional techniques are more dependable or are afraid of being overloaded with information. In this regard, neglecting the benefits of electronic information resources and being slow to adopt new technologies are essential elements of a negative mindset.

Studies on knowledge and usage of electronic information resources in the polytechnic library in Zungeru, Niger State, Nigeria, by Mustapha, Ahmed, and Saka (2019) are among those carried out to find out how polytechnic students feel about using EIRs. The results showed that students had a bad attitude on using EIRs. The polytechnic student's lack of digital literacy may be the cause of this pessimistic outlook. In order for Polytechnic students to reap the advantages of electronic database resources, they must possess a set of abilities collectively known as digital literacy. Their acquisition of media, information, and ICT literacy will be aided by this competence and it will help them to be able to connect to library database resources thanks to all of these skills. A collection of academic and professional practices resulting from advancements in contemporary technology might be referred to as digital literacy skills. In other words, digital literacy skills is a set of skills required for productive engagement in a society that relies heavily on knowledge. These skills are necessary to guarantee that digital devices such as computers, laptops, smartphones, and tablets are used properly for sharing, collaborating, and exchanging information. According to Subaveerapandiyan, Sinha and Ugwulebo (2022) perspective, an individual who is digitally literate should be able to use computers, analyse data to make judgements that are accurate, participate in online meetings and social media while adhering to engagement protocols, and search and distribute information.

The National Education Association (2016) posited that having digital literacy skills helps people including polytechnic students to navigate online environments responsibly, safeguard their privacy, and steer clear of possible risks including identity theft, cyberbullying, and frauds. Therefore, having digital literacy skills is essential for students to succeed in the digital age. It includes information literacy, critical thinking, and foundational computing skills. Consequently, it is critical that polytechnic students possess the requisite digital literacy skills and have a favourable attitude towards using electronic information resources. This is because they may ultimately utilise EIRs for learning and research if they have a favourable mindset. When Polytechnic students utilise EIRFs appropriately, their attitude will ultimately transfer into actual use, which will guarantee that they reap the full benefits. In light of this, the purpose of this study is to ascertain students' attitudes towards using electronic information resources and their level of digital literacy in two polytechnics in Ekiti-State, Nigeria.

Objectives of the Study

The objectives of this study were to:

1. Determine the level of digital literacy skills possessed by polytechnic students in Ekiti State, Nigeria
2. Find out the student's attitude towards the use of EIRs in polytechnics in Ekiti State, Nigeria
3. Determine the extent of use of the polytechnic library EIRs by the students in Ekiti State, Nigeria
4. Find out the challenges to the use of EIRs among the polytechnic students in Ekiti State, Nigeria
5. Determine the relationship between digital literacy skills and attitude towards electronic information resource use among the polytechnic students in Ekiti State, Nigeria

Literature Review

Ivwighreghweta and Ejitagha (2022) investigated undergraduate's digital literacy skills and the use of electronic resources in private universities in Edo and Delta state, Nigeria Findings revealed a good number of the respondents (mean=3.2) are able to retrieve information online without any difficulty. Also a high number of the respondents (109) representing with a mean score of 2.9 possess the requisite skill to locate their information need on the database. Furthermore, 172 of the respondents with the mean of 2.9 are able to cite a reference online correctly using the right and standard format. While 81 of the respondents with a mean score of 2.9 have the ability to store and copy secondary storage such as flash drives and memory. Overall the aggregate mean of 3.00 is greater than the criterion mean of 2.50. it can be implied from this that the digital information literacy skills among the undergraduates is high and ths might be the case as regards the polytechnic students.

Singh (2022) studied digital literacy skills among the students of the University of Jammu, India. For

the study, survey-based method was utilised. The analysis of the findings revealed majority of the respondents (85.24%) are conversant of the concept digital literacy. Also a high number of the respondents (62.9%) are good in the use of search engines such as Google, Yahoo, Bing etc. In furtherance, to know the respondents preference for searching techniques in the electronic environment a good number of them (64.4%) preferred the field search (title/URL). While 50% of the respondent's rate their accessing, evaluating and using the information 4 in a scale of 5. It could be deduced from the feedback from the respondents that they possess a reasonably high level of digital literacy skills. From this study it can be inferred this might be the case of the polytechnic students.

As well different studies have been conducted on the student's attitude towards electronic resource use. Olatoye, Nekhwerha and Muchaonyerwa (2020) researched on the determinant of undergraduates' students' attitude and perception towards the use of electronic information resources among undergraduate students in selected universities in Eastern Cape, South Africa. The findings revealed 71% of the respondents never use and see no need to make use of Hanari, CD-roms, OPAC and other electronic information resources. Only 41% of the respondents indicated e- resources are readily available to use. Also only 33% of the respondents attested that e-resources is easy to use. The results from the study shows the students have a negative attitude towards electronic information resources because the result depicts that a preponderance of students are lacking essential skills to navigate electronic information resources. This result might as well be the case for the polytechnic students

Jato and Diyaolu (2021) investigated Users' attitudes to the use of electronic resources and services by undergraduate students of McPherson University, Ogun State, Nigeria. Majority of the respondents (72.1%) affirmed availability of e-books and (63.3%) e-journal, while (60%) denied that Virtual Library Online was not available. However the undergraduate students were not given orientation by their university library so they were not aware of online Open Access Catalogue (OPAC) in the library (54.0%) Averagely, respondents were not using e- resources to retrieve current literature for studies (56.6) and were not using the Electronic catalogue. They were faced with challenges of limited access to computer terminals 70.8% , slow Internet connectivity 68.0%, inadequate time due to pressure from academic work 65.3% and lack of training and support from staff 153 (52.1%). Decisively, students attitude to use of e-resources determine its usage by undergraduate students of McPherson University. Nevertheless, some factors such as lack of awareness of availability of some e-resources, lack of orientation programme organise by library staff among others were discovered as hindrances to the undergraduate attitude towards the use of e- resources. It could be implied from this that the undergraduates have a negative attitude towards electronic information resource. The students were charged to change their attitude towards the use of the available e-resources in their university library and take full advantages of the benefit that e-resource could offer to their studies.

Similarly, studies have been reported on the positive attitude of undergraduate student's towards use of electronic information resources. Sahabi, Askia and Umobe (2020) conducted a study on the use of electronic information resource by undergraduates of Ahmadu Bello University library in Nigeria. Findings revealed the undergraduates in federal university libraries in Ahamadu Bello university zaria considered that their overall purpose of electronic information resource usage to be high, making a decision by the overall mean score of 3.05 on the scale of five. Also of the sixteen items of electronic information resource usage investigated in the study 15(93%) were highly considered used. It can be implied from the study that undergraduates have a positive attitude towards the use of electronic information resource as it is revealed there is a high frequency of usage of EIR among the undergraduates which might as well be the case among the polytechnic students.

Al Bataineh, Al Dwaira, Humaidat and Al Fawareh (2021) investigated the use of electronic information resources Amman Arab University undergraduates of English language and translation. Mixed method research design was the method employed. The findings under the section asking to know the respondents attitude towards EIR showed 75% of the respondents agreed to the statement that electronic information resource saves time and meet their scientific needs. Correspondingly 72% indicated that electronic information resource helps them to accomplish their academic need. While 69.1% of the respondents believe electronic information resource is very effect while. It can be inferred from the study that EIR is very helpful in increasing students' scientific productivity. This reflects the positive attitude towards the use of electronic information resource. it can be inferred from the study that the polytechnic students might have same disposition towards EIR use.

Asha, Singh, Verma, Rohit and Akash (2023) studied attitude of students about e-resources for academic and research work in agricultural universities of Uttar Pradesh India. The results revealed most of the respondents (92%) agreed that e-resources are useful to update the knowledge globally. Also 83.7% of the respondents make maximum use of e-resources for academic purpose. In the same vein 80% of the respondents indicated that e-resources allow users to access and modify information in their desired format. From the pattern of

response from the respondents it can be inferred the students have a positive and favourable attitude towards e-resources which might as well be the case as regards the polytechnic students.

Accordingly different studies have been conducted to show the relationship between digital literacy skills and attitude towards electronic information resource use such as Umar and Dangwaran (2023) explored the relationship between digital literacy skills and electronic information resource use among undergraduates of Gombe state University. Findings revealed there is no significant relationship between digital literacy skills and use of electronic information resources among the undergraduates (r= .05, p 7.05). This implies that having a high level of digital literacy skills does not translate to a high level of EIRs as such it does not correlate to their attitude. Inference from the study shows the polytechnic students can be affected this way too.

Ebiefiung and Onah (2021) examined digital literacy skills as a correlate of electronic information resources use by university undergraduates in South-South Nigeria. Result revealed digital literacy skills (r=143; p< 0.05) has a significant positive relationship with the use of electronic information resources by undergraduates in South-South universities. The implication is that digital literacy skills possessed by undergraduates will determine their effectiveness and attitude towards the use of EIRs which might as well be same for polytechnic students.

Methodology

This study adopted a descriptive survey research design to investigate digital literacy skills and the use of electronic information resources (EIRs) among students of two polytechnics in Ekiti State, Nigeria. The population of the study comprised all National Diploma (ND) and Higher National Diploma (HND) students in the two institutions: the Federal Polytechnic, Ado-Ekiti and Ekiti State Polytechnic, Isan-Ekiti. A multistage sampling technique was employed. At the Federal Polytechnic, Ado-Ekiti, with a total student population of 762, a sample size of 117 was determined and selected using stratified random sampling to ensure representation across departments and academic levels. This sample size was considered appropriate, representing approximately 15.4% of the total population, and aligns with Yamane's (1967) sample size determination formula at a 95% confidence level and 5% margin of error. At the Ekiti State Polytechnic, Isan-Ekiti, due to the relatively small student population of 124, a total enumeration method was adopted, in which all students were targeted to participate in the study. Out of the 124 students surveyed, 101 completed and returned valid questionnaires, resulting in a high response rate of 81.5%, which is considered acceptable and adequate for data analysis in social science research. Data were collected through a structured questionnaire. The instrument was validated by experts in Library and Information Science to ensure content validity. Descriptive statistics such as mean and standard deviation were used to analyse the research questions, while Pearson Product Moment Correlation (PPMC) was employed to test the hypothesis on the relationship between digital literacy and EIR usage at 0.05 level of significance.

Data Analysis and Presentation of Results

Demographic characteristics of the respondents

Table 1 shows the demographic information of the respondents

Table 1: Demographic characteristics of respondents

		Frequency	Percent
Institution	Ekiti State Polytechnic, Isan-Ekiti	101	46.3
	Federal Polytechnic Ado-Ekiti	117	53.7
Department	Accountancy	83	38.1
	Agricultural Technology	24	11.0
	Computer science	59	27.1
	Electrical/Electronic Engineering	52	23.9
Age range	Below 20	103	68.8
	20 – 24	93	42.7
	25 – 29	22	10.1
	30 – above	0	0
Gender	Male	145	66.5
	Female	73	33.5
Academic level	ND 1	150	68.8
	ND 2	68	31.2
	Total	**218**	**100.0**

Table 1 shows the demographic distribution of the respondents, based on institution, department, age range, gender and level of education. The result of institution revealed that the majority of the respondents 117 (53.7%) are from Federal Polytechnic Ado- Ekiti and the least are from Ekiti State Polytechnic, Isan-Ekiti 101 (46.3%). The findings also showed that most of the respondents were accountancy students 83 (38.1%) while the least were agricultural technology students 24 (11%). Based on age, result revealed that majority of the respondents were below 20 years old 103 (68.8%) and 20-24 years old 93 (42.7%), 22 (10.1%) of the respondents were 25-29 years old while none of the respondents were above 30 years, respectively. Based on

gender, the sample shows a large male majority 145 (66.5%), with females making up 73 (33.5%). Based on academic level, the result revealed that majority of respondents 150 (68.8%) were in OND 1 while the least 68 (31.2%) were in OND 2

Research Question 1: What is the level of digital literacy skills possessed by polytechnic students in Ekiti State, Nigeria?

Table 2: Level of digital literacy skills possessed by polytechnic students

Digital literacy skills	HP (%)	MP (%)	LP (%)	Mean	Std. Dev.	Remark
Ability to search electronic sources with digital devices	132 (60.6)	71 (32.6)	15 (6.9)	2.54	.623	High proficiency
Ability to develop successful search strategies to access information	120 (55)	68 (31.2)	30 (13.8)	2.41	.721	High proficiency
Using internet search engines to search information for academic work	118 (54.1)	67 (30.7)	33 (15.1)	2.39	.737	High proficiency
Sharing resources online	108 (49.5)	81 (37.2)	29 (13.3)	2.36	.707	High proficiency
Using digital devices to download e-books for research and study	113 (51.8)	71 (32.6)	34 (15.6)	2.36	.739	High proficiency
Online database search for information	98 (45)	99 (45.4)	21 (9.6)	2.35	.650	High proficiency
Ability to evaluate a web page found online	107 (49.1)	78 (35.8)	33 (15.1)	2.34	.728	High proficiency
Multimedia searching of e-resources	94 (43.1)	96 (44)	28 (128)	2.30	.686	Moderate proficiency
Effective operation of digital devices	90 (41.3)	96 (44)	32 (14.7)	2.27	.701	Moderate proficiency
Using e-journals for academic work	73 (33.5)	101 (46.3)	44 (20.2)	2.13	.722	Moderate proficiency
Average Mean				**2.35**	**.701**	**High Proficiency**
Grand mean				**23.45**	**7.014**	

Key: HP= High Proficiency; MP= Moderate Proficiency and LP= Low Proficiency
Decision rule: 1.00-1.66: Low Proficiency; 1.67-2.33: Moderate Proficiency; 2.34-3.00: High Proficiency

Result in Table 2 revealed the level of digital literacy skills possessed by polytechnic students and showed that the ability to search electronic sources with digital devices ($\bar{x}$ = 2.56) are classified as highly proficient by polytechnic students. Following closely is the ability to develop successful search strategies to access information, with a mean of 2.41, also indicating high proficiency status. Using internet search engines to search information for academic work, with a mean of 2.39, falls into the Highly proficiency category, showcasing its importance in educational practices. Other digital skills classified as High proficiency include sharing resources online and using digital devices to download e-books for research and study, both at ($\bar{x}$ = 2.36). On the lower end, using e-journals for academic work ($\bar{x}$ = 2.13) and effective operation of digital devices ($\bar{x}$ = 2.27) are categorised as moderate proficiency. Hence, the result showed an average mean of ($\bar{x}$ = 2.35) which falls under the scale of 2.34-3.00, indicate a high level of digital skills. Thus, there is high level of digital literacy skills among polytechnic students in Ekiti state, Nigeria.

This is in conformity with the study of Ivwighreghweta and Ejitagha (2020) on undergraduate's digital literacy skills and the use of electronic resources in private universities in Edo and Delta state, Nigeria. Findings revealed a good number of the respondents are able to retrieve information online without any difficulty, possess requisite skills to locate their information need on database, have the skill to make citations online and have the necessary ability to store and copy secondary storage such as flash drives and memory. Likewise the study of Singh (2022) on digital literacy skills among the students of the University of Jammu, India. Result revealed the respondents have a good knowledge of search technique, their accessing and evaluating skills is well grounded.

Research Question 2: What is the student's attitude towards the use of EIRs in polytechnics in Ekiti State, Nigeria?

Table 3: student's attitude towards the use of EIRs in polytechnics

	SA (%)	A (%)	D (%)	SD (%)	Mean	Std. Dev.
I see the use of EIRs as a relevance for academic purpose	34 (15.6)	115 (52.8)	29 (13.3)	40 (18.3)	2.66	.953
I am convinced that the use of EIRs in the library will enhance my academic performance	31 (14.2)	114 (52.3)	29 (13.3)	44 (20.2)	2.61	.965
Augmenting my lecturers notes and handouts with the use of library e-resources seems relevant to me	33 (51.1)	101 (49.1)	22 (10.1)	56 (25.7)	2.54	1.034
I appreciate using EIRs for my academic works	32 (14.7)	102 (46.8)	28 (12.8)	56 (26.7)	2.50	1.031
I find using EIRs more easily than using printed resources	34 (15.6)	93 (42.7)	34 (15.6)	57 (26.1)	2.48	1.044
Learning to use EIRs has been fascinating to me	30 (13.8)	103 (47.2)	22 (10.1)	63 (28.9)	2.46	1.052
I prefer using the library catalogue cards to OPAC	21 (9.6)	98 (45)	32 (14.7)	67 (30.7)	2.33	1.017
Using EIRs is not as exciting as using printed resources	19 (8.7)	83 (38.1)	62 (28.4)	54 (24.8)	2.31	.942
My friends' experience with the use of library EIRs does not encourage me to use them	8 (9.7)	96 (44)	63 (28.9)	51 (23.4)	2.28	.864
The search method for EIRs does not make its use interesting to me	21 (9.6)	65 (29.8)	68 (31.2)	64 (29.4)	2.20	.971
I think the use of EIRs in the library is too technical for me to understand	20 (9.6)	71 (32.6)	62 (28.4)	65 (29.8)	2.21	.975
I consider the use of the library's EIR as time wasting	15 (6.9)	76 (34.9)	63 (28.9)	64 (29.4)	2.19	.940
Average mean					**2.58**	**.982**

Keys: SA=Strongly Agree, A=Agree, D=Disagree, SD=Strongly Disagree
Decision rule: It has been adjudged that criterion mean score of 2.50 and above is Agreed.

Result in Table 3 revealed the student's attitude towards the use of EIRs in polytechnics and the result showed that the highest-rated attitude is the use of EIRs as a relevance for academic purpose purpose, with a mean score of 2.66. Additionally, the conviction that the use of EIRs in the library to enhance academic performance received mean scores of 2.61. The attitude of augmenting lecturer's notes and handouts with the use of library e-resources which seems relevant to the respondents ranks closely behind, with a mean score of 2.54. Other notable attitude include appreciation of using EIRs for academic works ($\bar{x}$ = 2.50) and find using EIRs more easily than using printed resources ($\bar{x}$ = 2.48). The least of the respondents consider the use of the library's EIR as time wasting ($\bar{x}$ = 2.19) and think the use of EIRs in the library is too technical to understand ($\bar{x}$ = 2.21). Hence, the result showed an average mean of ($\bar{x}$ = 2.58) which exceeds the criterion mean score of 2.50. Hence, the major student's attitude towards the use of EIRs in polytechnics include the use of EIRs as a relevance for academic purpose, the conviction that the use of EIRs in the library to enhance academic performance and augmenting lecturers notes and handouts with the use of library e-resources seems relevant.

This aligns with the study of Aikahtani's (2016) who found that Princess Nora University students preferred using EIRs over printed resources, highlighting the potential benefits of EIRs in enhancing academic performance. However, not all studies have reported positive attitudes towards EIRs. Olatoye et al. (2020) study on determinant of undergraduates' students' attitude and perception towards the use of electronic information resources among undergraduate students in selected universities in Eastern Cape, South Africa and Jato and Diyaolu (2021) study on users' attitudes to the use of electronic resources and services by undergraduate students of McPherson University, Ogun State, Nigeria found that students had negative attitudes towards EIRs due to various challenges, including lack of awareness, inadequate skills, and infrastructure limitations. These findings suggest that students' attitudes towards EIRs are influenced by their

experiences and the support they receive. The contrast between this studies underscores the need for educational institutions to provide students with the necessary skills and resources to effectively utilize EIRs and maximize their benefits.

Research Question 3: What is the extent of use of the polytechnic library EIRs by the students in Ekiti State, Nigeria?

Table 4: extent of use of the polytechnic library EIRs by the students

	H (%)	A (%)	L (%)	NU (%)	Mean	Std. Dev.
I use the library electronic information resources to source materials for research and writing project	124 (56.9)	59 (27.1)	30 (13.8)	5 (2.3)	3.39	.808
I use the e-resources to update my knowledge in subject areas of interest	87 (39.9)	99 (45.4)	26 (11.9)	6 (2.8)	3.22	.762
I use the Internet in the library to generally source materials and information	99 (45.4)	70 (32.1)	41 (18.8)	8 (3.7)	3.19	.869
I use the electronic books provided by the library to compliment my class notes	86 (39.4)	93 (42.7)	32 (14.7)	7 (3.2)	3.18	.799
i use the electronic journals provided by the library for my project writing	95 (43.6)	76 (34.9)	38 (17.4)	9 (4.1)	3.18	.864
I use them to do class assignments	75 (34.4)	100 (45.9)	36 (16.5)	7 (3.2)	3.11	.792
I use the electronic information resources to augment my class works	93 (42.7)	67 (30.7)	47 (21.6)	11 (5)	3.11	.914
I us e the e -resources to retrieve current literatures for study	77 (35.3)	95 (43.6)	38 (17.4)	8 (3.7)	3.11	.816
I participate in professional discussion groups via the library's internet access	82 (37.6)	77 (35.3)	48 (22)	11 (5)	3.06	.894
I use the Internet access in the library to send e-mail	74 (33.9)	82 (37.6)	46 (21.1)	16 (7.3)	2.98	.921
Average mean					**3.15**	**.765**

Key: H= High; A= Average; L= Low; NU= Non-Use

The findings in table 4 revealed that majority of the respondents highly use the library electronic information resources to source materials for research and writing project (x=3.39), to update knowledge in subject areas of interest (x=3.22), and they use the Internet in the library to generally source materials and information (x=3.19). While the least use the Internet access in the library to send e-mail (x=2.98) and participate in professional discussion groups via the library's internet access (x=3.06). This conforms to the study of Yusuf, Ayeni, Aminu and Mahammuod (2020) on the use of electronic and print resources by students in selected tertiary institutions in Kwara State, Nigeria. The study finds out that undergraduate students use information resources for academic related purposes such as research, project writing, and updating knowledge in their subject areas, highlighting the significance of these resources in supporting their academic endeavors. This also aligns with Manzo, Bello and Kannan (2020) study on awareness and use of electronic information resources of Students in Nigeria Polytechnics. It was revealed the students use the e-resources for several purposes that include, research, general acquisition of knowledge, assignments among others.

Research Question 4: What are the challenges to the use of EIRs among the polytechnic students in Ekiti State, Nigeria

Table 5: challenges to the use of EIRs among the polytechnic students

	SA (%)	A (%)	D (%)	SD (%)	Mean	Std. Dev.
Lack of awareness	30 (13.8)	88 (40.4)	61 (28)	39 (17.9)	2.50	.942
Unreliable internet connectivity	30 (13.8)	89 (40.8)	48 (22)	51 (23.4)	2.45	.998
Insufficient e-resources in my field of study	18 (8.3)	102 (46.8)	51 (23.4)	47 (21.6)	2.42	.918
Lack of training in using e-resources	27 (12.4)	82 (37.6)	53 (24.3)	56 (25.7)	2.37	.999
Difficulty in identifying relevant information needs	18 (8.3)	77 (35.3)	75 (34.4)	48 (22)	2.30	.905
Average mean					**2.41**	**.952**

Findings in Table 5 revealed that the challenges faced by polytechnic students on the use of EIRs are lack of awareness (x=2.50), unreliable internet connectivity (x=2.45) and Insufficient e-resources in my field of study (x=2.42). The least of the respondents recognise lack of training in using e-resources (x=2.37) and difficulty in identifying relevant information needs (x=2.30) as challenges polytechnic students faced in utilising EIRs. The results corroborate the findings of Jato and Diyaolu (2021) on Users' attitudes to the use of electronic resources and services by undergraduate students of McPherson University, Ogun State, Nigeria. Which revealed the students were faced with challenges of limited access to computer terminals, slow Internet connectivity, inadequate time due to pressure from academic work and lack of training and support from staff. Similarly, Omeluzor, Akibu and Akinwoye (2016) investigate students' perception, use and challenges of electronic information resources in Federal University of Petroleum Resources Effurun, Nigeria and the result showed lack of awareness, lack of training, unreliable Internet connectivity, insufficient e-resources in various study areas, unavailability of e-resources on 24/7 and difficulty of identifying relevant information to meet users' needs are challenges hindering use of e-resources among the students. This can be inferred to be the same fate for polytechnic students.

Test of hypothesis

There is no significant relationship between digital literacy skills and attitude towards electronic information resource use among the polytechnic students in Ekiti State, Nigeria

Table 6 shows the correlation between digital literacy skills and attitude towards electronic information resource use among the polytechnic students in Ekiti State, Nigeria

Table 6: Relationship between digital literacy skills and attitude towards electronic information resource use among the polytechnic students

Institution	Variables	Mean	Std. Deviation	N	Df	R	P	Remarks
Polytechnics	Digital literacy skills	23.45	5.084	218	216	.479**	.000	Sig.
	Attitude towards electronic information resource use	72.326	13.684					

Note: hypothesis is tested at 0.05 significant level

Table 6 revealed that there was significant positive relationship between digital literacy skills and attitude towards electronic information resource use among the polytechnic students in Ekiti State ($r=.479^{**}$ df =216; $p<0.05$). This implies that digital literacy skills have direct impact on their attitude towards electronic information resource use among the polytechnic students. Thus, the null hypothesis stating that there is no significant relationship between digital literacy skills and attitude towards electronic information resource use among the polytechnic students in Ekiti State is hereby rejected. The finding suggests that enhancing digital literacy skills among polytechnic students in Ekiti State can positively influence their attitude towards utilizing electronic information resources, thereby promoting effective resource utilization. This aligns with the position of Ebiefiung and Onah (2021) who examined digital literacy skills as a correlate of electronic information resources use by university undergraduates in South-South Nigeria. Result revealed digital literacy skills has a significant positive relationship with the use of electronic information resources by undergraduates in South-South universities. The implication is that digital literacy skills possessed by undergraduates will determine their effectiveness and attitude towards the use of EIRs which might as well be same for polytechnic students. However, this is in contrast with the study of Umar and Dangwaran (2023) on the relationship between digital literacy skills and electronic information resource use among undergraduates of Gombe state University. Findings revealed there is no significant relationship between digital literacy skills and use of electronic information resources among the undergraduates. This implies that having a high level of digital literacy skills does not translate to a high level of EIRs as such it does not correlate to their attitude. Inference from the study shows the polytechnic students can be affected this way too.

Conclusion and Recommendations:

The study established that polytechnic students in Ekiti State possess a high level of digital literacy skills, with notable proficiency in searching electronic sources, formulating effective search strategies, and utilising internet search engines for academic purposes. The students also show strong capability in downloading and sharing digital content, although some digital competencies such as using e-journals and effective device operation were rated moderately. The students' attitude towards Electronic Information

Resources (EIRs) is generally positive, with a high mean score reflecting their appreciation of EIRs as relevant tools for academic work, enhancing performance, and complementing lecturers' notes. EIRs are widely used for sourcing research materials and updating subject knowledge, though less frequently for communication and participation in academic forums. However, several challenges hinder optimal utilisation of EIRs, including lack of awareness, unstable internet connectivity, and insufficient subject-specific e-resources. Most significantly, the study established a statistically significant and positive correlation between digital literacy skills and students' attitudes towards EIR use, indicating that improved digital literacy directly enhances students' willingness and ability to effectively engage with electronic information systems. This underlines the critical role of digital skills development in promoting academic resource utilisation and success among students. The following recommendations were made:

1. Polytechnic authorities should implement continuous and structured digital literacy training workshops to improve students' competence in using a broader range of digital tools, including e-journals and technical device operations, which were found to be areas of moderate proficiency.
2. Awareness and sensitization campaigns should be regularly conducted to inform students about the availability, relevance, and benefits of EIRs, especially targeting those who are unaware of these resources.
3. Polytechnic libraries should collaborate with academic departments to expand and diversify their electronic information collections, ensuring that resources are available across all fields of study to meet students' academic needs.
4. Digital literacy and information retrieval skills should be integrated into the academic curriculum as a general studies course or as part of library orientation to institutionalize these competencies from the onset of students' academic journey.
5. Library staff should be trained to provide on-the-spot technical assistance and user guidance to students navigating EIR platforms, helping to alleviate perceptions of technical difficulty.

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Emerging Issues in the Fifth Industrial Revolution (5IR): The Nigeria Experience

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Abstract

The Fifth Industrial Revolution (5IR) is steering in a deep era of technological advancement and societal renovation, prompting a critical examination of the evolving role of libraries in this digital landscape. Libraries are adapting to this new landscape by embracing technology to enhance access to information, improve user experiences, and expand their service offerings. The study explored the history of the industrial revolution and the study shed light on the emergence of the first to the fifth industrial revolutions. The study adopted an extensive review of the literature with exclusion and inclusion criteria. In addition, the study examined the benefits of 5IR in libraries and barriers towards the application of 5IR such as digital privacy, digital equity, cyberloafing, technophobia and many more were discussed. Also, identified the strategies that can be adopted to improve the utilization of the 5th Industrial Revolution in libraries. Librarians are playing a pivotal role in navigating these changes and ensuring libraries remain relevant and effective in the 5IR age. The study concludes that libraries are witnessing a new level of transformation with the rise of collaborative and user-generated content happening at an unprecedented stride in the 5IR era. Among the strategies for the effective application of 5IR are policy formulation and implementation; capacity building and training.

Keywords*: Fifth Industrial Revolution, Libraries, Cyberloafing, Technophobia, Digital privacy, Nigeria*

INTRODUCTION

The period of the technological revolution that is happening today will basically transform the way of thinking, the way of life, the way of working, and the way of working as a team in the local and international sphere. Life is dynamic and change is permanent, this pace of change in the world must be responded to an integrated and comprehensive manner by involving all stakeholders, be it global political actors, from the government sector to the private sector, academics, companies, and of course the wider community. According to Ilham and Apriliyanti (2022), this integrated and comprehensive response is not without reason, because the current era of information technology is at the peak of major changes comparable to the emergence of the First, Second, Third and Fourth Industrial Revolutions. At present, the developments have reached a stage of the industrial revolution called the Industrial Revolution (5IR) referred to as Industry 5.0.

The 5th Industrial Revolution -5IR (also known as Industry 5.0) could be described as a new and emerging phase of industrialization that sees humans working alongside advanced technology particularly Artificial Intelligence (AI) and robotics to improve workplace processes and facilitate a more human-centred, sustainable and resilient future. According to Noble et al. (2022), the 5th Industrial revolution or 5IR is defined as technology that encompasses the notion of harmonious human–machine collaborations, with a specific focus on the well-being of multiple stakeholders (i.e., society, companies, employees, customers). The Information and Communication Technologies (ICTs) serve as a platform for 5IR to flourish.

With the revolutionary movement in ICTs and industrial revolution transformation, librarians are now asking which types of library services such as digital services, membership card services and online book viewing services, should be employed. This is necessary having realized that provision of reading services, charging and discharging of books to users are not enough to satisfy them. Also, the increasing demand for services, especially the quality of service is at an alarming rate in academic libraries. The key drivers of these transformations are the rapid advancements in technology and the increasing demand for closer collaboration between librarians and library users (Aslam, 2022). Technology advancement has resulted in four global revolutions, and a fifth has arrived. All these revolutions in one way or another have impacted the practice and operations of librarianship. It is widely acknowledged that libraries leveraging emerging technologies have the potential to establish stronger connections with their communities on a global scale (Ajani et al., 2025). Thus, the need to explore the current trend in industrial revolution and its impact on librarianship is germane.

STATEMENT OF PROBLEM

The Fifth Industrial Revolution (5IR) is rapidly impacting various sectors however, research connecting it specifically to librarianship is limited. This gap in research highlights a need for further investigation into how 5IR technologies and concepts can be applied to enhance library services, including improved user experiences, enhanced research support, and increased operational efficiency.

This study is crucial for filling the gap in the literature on 5IR in librarianship. Therefore, the study explored the fifth Industrial Revolution (5IR) benefits and challenges to the libraries in Nigeria.

RESEARCH OBJECTIVES

The main objective of the study is to explore the Fifth Industrial Revolution (5IR) benefits and challenges to the libraries in Nigeria. The following specific objectives are to:

1. trace the history of the 5th Industrial Revolution (Industry 5.0);
2. identify the benefits of 5th Industrial revolution to the libraries;
3. identify the barriers facing libraries towards application of the 5th Industrial Revolution in Nigeria; and
4. ascertain strategies that can be adopted to enhance the 5th Industrial Revolution.

METHODOLOGY

The study is qualitative (Gregar, 2023) thus this study was largely based on an extensive review of the literature. The literature was related to artificial intelligence with focus on the African continent. Data were collected from documentary sources and empirical literature. It is acceptable in qualitative studies to collect data from secondary sources (Kapucu et al., 2023). Such a method has also been referred to as desktop research. The literature consulted included books, journal articles, conference papers and proceedings. Thesis and dissertations are excluded. The series of literature was searched online and downloaded. Key words such as artificial intelligence, libraries, and IoT were used to retrieve appropriate content for the study which was presented based on research questions as a guide. The literature searches conducted in the Scopus database focused on four thematic areas such as "5th industrial revolution, academic library services and data science.

RESULTS

Objective 1: Trace the history of the 5th Industrial Revolution (Industry 5.0)

There is a need to understand major activities taking place at various stages of the industrial revolution. History has established that humanity has witnessed significant achievements and progress, manifested by a steady progression towards scientific achievement and technological innovation. From the end of the 17th Century to the present time, man has been using the term "revolution" to express the radical changes in society, resulting from the outputs of human thought represented in innovation and technological innovation that touches all facets of life. A brief discussion on major activities taking place at different stage will be discussed as follows:

The 1st Industrial Revolution: This was sparked by the steam engine in the late 18th Century, using steam power to mechanize manufacturing. The steam engine substituted amplified manual labour, transforming society from agrarian to urban. This stage of revolution is tagged Industrial Steam / Electric where computer substitutes amplified mental labour

The 2nd Industrial Revolution: This stage of development introduced electricity, automobiles, and telecommunications, further industrialising society. At this phase, electric power was adopted to increase production. This stage of revolution is tagged Mass Production.

The 3rd Industrial Revolution: The third industrial revolution brought computers, electronics, and automation, ushering in the information age. Electronics and information technology were employed to automate processes. This stage of revolution is tagged Information Society. The stage is characterized by a knowledge economy that promotes economic growth that is dependent on quality and quantity access to information. The main capital at this stage is knowledge and it is tagged "thinking for a living". This is a stage where research and vast repositories are important. This stage started in the 1960's and was tagged as the digital/computer revolution that sped up the development of semiconductors and mainframe computing, personal computing and the Internet.

The 4th Industrial Revolution: The 4th phase of the revolution further impacted humanity with the development that comprises many digital technologies such as "artificial intelligence (AI), robotics, Internet of Things (IoT), cloud computing, big data, 3D printing, AI-driven automation, and the advancement of biotechnology. The Fourth Industrial Revolution, also known as Industry 4.0. At this phase of the revolution, networks and databases become societal symbols. This phase of development is tagged network society. Our idea of work and time would change at this period. There is a continuous expansion of knowledge and information into the domain of capital.

The 5th Industrial revolution: The fifth industrial revolution perceives individuals as partners at work in manufacturing and production organisations. Several studies have established that the 5th IR emerged with improvement in various activities that were developed in the 4th Industrial Revolution (4th IR). Human play a key role in transforming 4-0 systems for the new world, taking the good parts of automation and disposing of the bad (George & George, 2020)

The 5th IR is marked with advancements in activities such as digital technologies artificial intelligence (AI),

robotics, Internet of Things (IoT) cloud computing, big data, and 3D printing (Andronie et al.,2022), based on the need for higher flexibility to support new information communication devices such as moving robots or drones.

The 5IR encompasses the notion of harmonious human–machine collaborations, with a specific focus on the well-being of the multiple stakeholders (i.e. society, companies, employees, customers). According to Ibinaiye et al. *(*2021), the 5th IR includes applications of mechanical and digital machines to communication devices for information transfer over the network including the IoT. The present 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 by wireless technologies to support the emergence of 5IR. 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 Industrial Revolution has certain characteristics

Characteristics of the Fifth Industrial Revolution (5IR)

1. Energy revolution
2. A highly transformed workplace culture where robots replace routine tasks
3. Introduction of collaborative robots
4. Robots given tasks and decision-making capabilities: primarily aiming to improve quality and production processes

This development in 5IR represents an outstanding opportunity for synergistic collaboration between humans and, in due course, advanced human–machine systems, fostering a dynamic evolution characterised by unprecedented progress (Ziatdinov et al., 2024). This unique development has enormous benefits to libraries.

Benefits of the 5th Industrial Revolution to the Libraries

Objective 2: Identify the benefits of the 5th Industrial Revolution to libraries

Table 1: Benefits of 5IR to Libraries

Benefits	Description	Implications for Libraries
Human-Centric Automation	Unlike the 4IR, 5IR focuses on collaboration between humans and machines, emphasizing empathy, creativity, and personalization.	Libraries can provide personalized user services, using AI to enhance, not replace, human librarianship.
Enhanced User Engagement	Integration of AI, robotics, and IoT with human touchpoints promotes immersive, user-friendly experiences.	Virtual reference services, smart cataloging, and robotic book sorting can improve user satisfaction.
Inclusive Access to Knowledge	5IR technologies enable multi-language translation, audio-visual aids, and accessibility for differently-abled users.	Libraries can become more inclusive and barrier-free, supporting universal access to information.
Knowledge Co-Creation	Emphasis on creativity allows users to co-create content using digital and AI-powered platforms.	Makerspaces and collaborative platforms can be embedded in libraries for innovation and local content development.
Sustainable Innovation	5IR promotes the ethical and sustainable use of technology.	Libraries can adopt green technologies and ethical data management practices to support SDGs.

Source: (Researcher, 2025)

Table 1 shows the five benefits of 5IR with a brief discussion of each benefit and implication to the libraries. Several studies have established the benefits of 5IR. According to Chaturvedi and Verma (2023) 5IR technologies are instrumental in revolutionizing cataloguing, information retrieval, and user interactions. AI-

driven virtual assistants, chatbots, and recommendation algorithms are enhancing user experiences, and providing personalized and efficient library services. Similarly, Kamal and Himel (2023) reported that machine learning enables libraries to analyze vast datasets to gather insights, optimize resource allocation, and deliver services aligned with evolving user needs. More over, data analytics and Big data are useful in library operation and user statistics. This assertion is buttressed by Kraft-Terry and Brown (2023) that Big data analytics allows data-informed decision-making, enhancing operational efficiency and resource allocation. In the same vein, Akanbiemu, (2024) observed that libraries have started harnessing the power of data analytics and big data to gain deeper insights into user behaviour, resource utilisation, and collection developments. Also, reported by Tella et al. (2022) that blockchain technology can be used to strengthen the security and transparency of transactions, particularly in the management of digital assets and intellectual property. 5IR technologies have the potential to bring new developments in libraries such as the migration of libraries into smart, responsive spaces that align with the needs of information users. Azizi et al., (2020) reiterated that Big data is used to optimize space utilisation, enhance user experiences, and promote sustainability. In addition, sensors that adjust lighting and climate control systems based on occurrence facilitates a more comfortable and energy-efficient library environment. These immersive technologies empower virtual library tours, interactive learning experiences, and innovative storytelling (Zhang et al*.,* 2024). Furthermore, augmented reality and virtual reality bridge the gap between physical and digital library spaces, fostering deeper user engagement (Prouzeau et al., 2020). A study carried out by Tella and Ajani (2022) reported that robots equipped with RFID technology efficiently locate and organize materials, freeing up library staff for more complex and user-centric activities. It can be inferred that robotic automation enhances operational efficiency and contributes to the overall resource management strategy of libraries. Towards contribution to cybersecurity, Adeleke (2023) declared that intrusion detection systems and encryption protocols are essential in protecting library assets and ensuring patron privacy. The widespread deployment of 5G net works promises to revolutionize library services (Lu & An, 2025). It is observed that libraries are proactively embracing accessibility technologies to ensure inclusivity and accessibility for all patrons, including those with disabilities (Gupta et al., 2023).

Despite, the huge benefits of 5IR technologies in libraries, there are still a few challenges that require great attention from stakeholders. The challenges are discussed briefly in Table 2.

Barriers to the Application of the 5th Industrial Revolution

Objective 3: Identify Barriers Facing Libraries Towards Application of the 5th Industrial Revolution in Nigeria

Table 2: Barriers to the Application of the 5th Industrial Revolution in Nigeria

Barrier	Description	Impact on Libraries
Infrastructural Deficit	Limited access to stable electricity, internet, and digital infrastructure.	Hinders adoption of AI, robotics, and cloud-based services in libraries.
Low Digital Literacy	Many librarians and users lack the advanced tech skills required for 5IR tools.	Limits the effective use of new technologies and reduces user engagement.
Funding Constraints	Insufficient government and institutional funding for tech innovations.	This makes it difficult for libraries to acquire or maintain 5IR technologies.
Policy and Regulatory Gaps	Absence of national frameworks guiding 5IR integration in education and library systems.	Creates uncertainty and a lack of strategic direction for tech adoption.
Technophobia and Resistance to Change	Fear and reluctance to embrace disruptive technologies.	Cultural and generational resistance among staff can slow down 5IR implementation.

Source: (Researcher, 2025)

Table 2 shows the summary of barriers facing the successful application of 5IR in Nigeria. The barriers are enormous and adequate attention is required to tackled the identified constraints. The 5IR tools are expensive at initial cost and the need for continuing investment in technology, research, and training is germane. The limited funds could

prevent the development and transformation of smart services and the purchasing of all the equipment needed for the 5th IR (Ilham & Apriliyanti, 2022). Cyberloafing or cyberslacking is understood to be employees' use of ICT technologies, such as laptops, desktop computers and smartphones (Askew et al., 2019) and the Internet (provided by the organization) to access social media and other websites (Andreassen et al., 2014) during work hours (Zhang et al., 2019) for personal or non-work reasons. However, studies have established that cyberloafing may help employees relieve technostress (Gugerçin, 2020) and job stress (Koay et al., 2017) and find a work-life balance. Furthermore, an individual's right to control personal information sharing and how organizations use and protect information could be a barrier in the 5IR era. With the development of 5IR, the privacy of data could be difficult. According to Ziatdinov et al. (2024), advanced technologies drive efficiency and convenience in various aspects of life, they also raise privacy and cybersecurity concerns (Ziatdinov et al., 2024). In addition, the new technical skills that focus on the human-centered integration of advanced technologies like AI, robotics, and IoT (Keshmiry & Hassani, 2025) may constitute a barrier to the effective application of 5IR technologies. The overwhelming fear of technology could debar the effective application of 5IR technologies in libraries. A lack of understanding of the benefits of 5IR technologies may lead to negative attitudes development by the users. This can also be fuelled by concerns about the loss of jobs and anxieties about job displacement.

Strategies That can be adopted to enhance the 5IR

Objective 4: Ascertain Strategies That Can Be Adopted to Enhance the 5th Industrial Revolution

Table 3: Strategies That can be adopted to enhance the 5th Industrial Revolution

Strategy	Description	Expected Outcome
Capacity Building and Training	Regular workshops, certification, and continuous professional development for librarians and staff.	Enhances readiness and confidence in adopting 5IR tools.
Investment in Infrastructure	Government and private sector collaboration to improve power supply, internet, and digital facilities.	Provides a conducive environment for deploying smart library systems.
Policy Formulation and Implementation	Establishment of national and institutional policies guiding 5IR adoption in education and libraries.	Encourages structured, safe, and equitable technology use.
Public-Private Partnerships (PPP)	Libraries collaborating with tech companies, NGOs, and academic institutions.	Facilitates access to resources, expertise, and shared innovation platforms.
Inclusion of 5IR in LIS Curriculum	Review and redesign of library and information science curriculum to include 5IR skills.	Prepares future librarians with the necessary competencies to thrive in a 5IR-driven world.

Source: (Researcher, 2025)

Table 3 shows the strategies that could be adopted to promote the application of 5IR technologies. The awareness campaign to educate stakeholders on the benefits of the application of 5IR technologies should be embraced at all levels. The campaign about the 5th Industrial Revolution should focus on its defining characteristics, impacts, and opportunities, highlighting the need for collaboration between humans and technology. Also, the importance of upskilling and reskilling, addressing both the risks and benefits of the 5IR should be advocated for. Training on special skills for those who lack the skills is a basic requirement for the effective application of the 5IR technologies. Calvert (2017) predicts that "if computers, robots, or whatever we call them, become more efficient, more effective, and cheaper than humans, it is inevitable that they will begin to do some library work instead of us." Hence, librarians must be ready to undergo a series of training that would enhance their skills. The position of librarians is secured for those who have relevant skills to outperform robots (Tella, 2020). Library management should adopt organizational strategies to mitigate cyberloafing, implement clear policies, foster a positive workplace culture, and use technology to monitor and

manage employee activities. Also, upskilling and re-skilling should be embraced to improve existing skills and knowledge within a current role, while reskilling prepares employees for entirely new roles within the organization that will enable them to utilize 5IR technologies.

Conclusion

Information Technology is not a cause but an enabler that paves the way for a revolution in thinking about and leveraging human machine collaborations for greater societal well-being. Libraries as a custodian of knowledge must brace up to accommodate developments at various stages of industrial revolutions. Libraries will continue to experience substantial changes in their socio-economic and technological landscape over time. With the current revolution era, libraries are witnessing a new level of transformation with the rise of collaborative and user-generated content happening at an unprecedented stride in the 5IR era. Despite challenges facing the 5IR implementation in libraries, 5IR has come to stay and thrive.

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Emerging Technologies for the Promotion of Inclusive Library Information Service in Nigerian Law Libraries

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Abstract
Emerging technologies encompass a diverse range of innovations, including educational technology, information technology, biotechnology, nanotechnology, robotics, and artificial intelligence. These technologies have significantly transformed how learning, communication, research, and services are delivered across various sectors. In the realm of library and information services, emerging technologies are particularly instrumental in enhancing access to information resources and promoting inclusivity, especially in law libraries. Law libraries are tailored to meet the needs of legal professionals through specialized facilities that offer crucial resources such as statutes, case law, legal journals, and online databases like Westlaw and LexisNexis. These libraries provide valuable resources and services for legal research and practice and often include professional staff to assist users effectively. The integration of emerging technologies can revolutionize how these libraries operate, making legal information more accessible and inclusive. The paper explores emerging technologies that can be leveraged to promote inclusive library and information services in Nigerian law libraries through a documentary analysis of seven (7) sieved documents from Google Scholar that are popular on emerging technologies in the library environment and beyond. The specific objective was to identify emerging technologies that could be used for promotion of inclusive library information services in Nigerian law libraries. The steps followed include data extraction based on emerging technological themes, analysis and interpretation. The findings revealed that AI and cloud computing are crucial emerging technologies that should be integrated in law libraries for delivery of inclusive library information services. Recommendations for Nigerian law libraries include, among others, strengthening technological infrastructure, enhancing staff training, promoting inclusivity through technological solutions, developing digital repositories, fostering collaboration, and continuously evaluating technology strategies. An implantation of these recommendations would help Nigerian law libraries overcome their challenges with library services and better serve their diverse user base, ultimately improving access and inclusivity in legal information services.
Key words: E*merging technology, Inclusive library information service, Law library,*

Introduction

Emerging technologies refer to a conglomeration of new soft and hard innovations as well as upgrade of existing ones that encompass educational technology, information technology, biotechnology, nanotechnology, robotics and artificial intelligence (Winston & Straw, 2024). Some of the existing technologies that are now emerging due to their upgrade include but not limited to distributed ledger or blockchain which was first conceived in 1994 by Nick Szabo (Szabo, 1996); augmented reality, a technology that uses digital graphics that are loaded onto live footage has in fact been around since the 20th century, have also been improve upon as a result of arrival of more powerful computing hardware and implementation of open source (Rotolo, et al, 2015) and can now be used for Snapchat and Instagram filters and other fictional functions in real objects. These technologies have dramatically improved and have continued to transform the way learning, communication, research and services are delivered in all sectors of economy. In library and information service delivery for instance, a number of technologies have emerged that are currently being applied to improve and increase access to information resources, services and promotion of inclusivity through provision of, and building of diverse collections for the benefits of especially, law library users.

The law library is designed to serve unique users that are defined by their specialisation in different aspects of law and their tailor-made information resources need and interest. A law library is a specialized facility dedicated to providing resources and services for legal research and practice (American Association of Law Libraries, 2023). The library typically houses a wide array of legal materials, including statutes, case law, legal journals, and treatises, which are essential for understanding and applying the law (Smith & Johnson, 2022). Law libraries offer access to case law and statutes, which are critical for legal research. These resources are organized by jurisdiction and topic, helping users navigate complex legal information (Doe, 2021). Additionally, many law libraries provide access to online databases such as Westlaw and LexisNexis, which offer extensive collections of digital legal documents and case law (Johnson, 2024).

In addition to their collections, law libraries often have professional staff, including law librarians who assist users in finding and utilizing legal resources effectively (American Association of Law Libraries, 2023). They also provide study spaces and seminar rooms for individual and group work, supporting both legal research and academic activities (Smith & Johnson, 2022). Some law libraries feature special collections related to particular legal fields or historical documents, enhancing their role as centers for both current and historical legal research (Doe, 2021). Many law libraries also offer online access to their catalogs and resources, facilitating remote research capabilities (Johnson, 2024).

Progress towards inclusive access to information in libraries require the integration of emerging technologies and other possibilities to discover knowledge that can be turned into real development outcomes. Promotion is an enlightenment campaign geared towards creating awareness and use of library information resources and services (Alexandrescu & Marius, 2018)**.** Promotion of inclusive library and information services in Nigerian law libraries is a concerted effort in providing balanced and robust information and educational resources that included print and non-print is pivotal to meeting the information need for teaching, independent study and legal research for all students and staff. This paper explored the unusual approach to promotion of inclusive library information services through a documentary analysis of emerging technologies that are could be adopted in law libraries for generating increased traffic to them.

Problem Statement

In recent years, the role of libraries in providing equitable access to legal information and resources has gained prominence, particularly in the context of Nigerian law libraries. These libraries face significant challenges in leveraging emerging technologies to promote inclusive information services. Despite the increasing availability of advanced technological tools, there is a notable gap in their implementation and integration within Nigerian law libraries (Ojo & Olufunmilayo, 2021). Emerging technologies such as artificial intelligence (AI), cloud computing, and digital repositories have the potential to transform library services by improving accessibility and providing personalized support (Chowdhury & Chowdhury, 2020). However, Nigerian law libraries often encounter obstacles such as limited infrastructure and insufficient funding which could be addressed through adoption of emerging technologies (Adewale, 2022). This technological gap exacerbates existing disparities in access to inclusive legal information, particularly to those with disabilities (Okeke & Nwafor, 2023). Without a concerted effort to leverage these technologies, Nigerian law libraries may continue to struggle with providing inclusive and equitable information services, potentially undermining their role in supporting legal research and education.

Objective of the Study

The paper sought to achieve the following objective:

1. To identify emerging technologies that could be used for promotion of inclusive library information service in Nigerian law libraries

Review of Literature

The landscape of library and information services is rapidly evolving due to technological advancements. For Nigerian law libraries, these emerging technologies hold the promise of enhancing access to legal information and promoting inclusivity. However, the integration of such technologies presents both opportunities and challenges. This literature review examines recent studies and discussions on the role of emerging technologies in advancing inclusive library services within Nigerian law libraries.

Emerging technologies such as artificial intelligence (AI), cloud computing, and digital repositories have significantly transformed library services globally. AI has enabled the development of sophisticated search engines and automated cataloging systems, which enhance the efficiency of information retrieval (Chowdhury & Chowdhury, 2020). Cloud computing offers scalable solutions for data storage and management and for facilitation of remote access to library resources (Wang et al., 2021) and digital repositories and e-books provide users with immediate access to a vast array of legal documents and publications (Jin & Yu, 2022).

In the context of Nigerian law libraries, these technologies have the potential to address long-standing issues related to access and inclusivity. For instance, AI-powered tools can streamline legal research processes, making it easier for users to find relevant case law and statutes (Adewale, 2022). Cloud-based systems can overcome physical limitations by providing access to digital collections from any location, thus reaching users in remote or underserved areas (Ojo & Olufunmilayo, 2021). Despite the advantages, the adoption of emerging technologies in Nigerian law libraries is fraught with challenges. Infrastructure limitations are a significant barrier; many libraries struggle with inadequate technological facilities and unreliable internet connectivity (Okeke & Nwafor, 2023). This lack of infrastructure can impede the implementation of advanced technologies, which require stable and high-speed internet for optimal performance (Adewale, 2022).

Funding constraints further exacerbate the problem. Nigerian law libraries often operate with limited budgets, which restricts their ability to invest in new technologies and maintain existing systems (Ojo & Olufunmilayo, 2021). Additionally, the high cost of technology acquisition and maintenance can be prohibitive, particularly for smaller or underfunded institutions (Chowdhury & Chowdhury, 2020). Training and skill development are also critical challenges. Many library staff members lack the necessary expertise to effectively utilize and manage emerging technologies. Continuous professional development is essential to ensure that staff can harness these technologies to their full potential (Adedoyin & Ojo, 2023). Without proper training, the effectiveness of technological tools is diminished, and their potential benefits are not fully realized.

Emerging technologies offer significant opportunities to promote inclusivity in Nigerian law libraries. AI and machine learning can enhance accessibility by providing tailored information retrieval services, including translation and text-to-speech functionalities for users with disabilities (Jin & Yu, 2022). For example, AI-driven platforms can generate accessible formats of legal documents, making them available to individuals with visual impairments (Wang et al., 2021). Cloud computing can bridge geographical gaps by allowing remote access to legal resources, thus extending services to users in rural and underserved areas (Chowdhury & Chowdhury, 2020). This capability is particularly valuable in Nigeria, where there is a significant disparity in access to information between urban and rural areas (Okeke & Nwafor, 2023). Additionally, digital repositories enable the preservation and dissemination of legal materials, contributing to a more inclusive legal information environment (Adedoyin & Ojo, 2023).

Several case studies highlight successful implementations of emerging technologies in law libraries globally, which can serve as models for Nigerian institutions. For instance, the use of AI in law libraries in developed countries has demonstrated its effectiveness in improving research efficiency and user satisfaction (Jin & Yu, 2022). Similarly, cloud-based legal research platforms have been adopted successfully in various regions, providing insights into best practices for implementation (Wang et al., 2021).

In Nigeria, initiatives such as the digitization of legal archives and the development of online legal research databases have shown promise (Ojo & Olufunmilayo, 2021). These efforts have improved access to legal information and demonstrate the potential for similar approaches to address inclusivity challenges in law libraries. Emerging technologies hold transformative potential for Nigerian law libraries, offering opportunities to enhance access and promote inclusivity. However, the effective implementation of these technologies requires overcoming significant challenges, including infrastructure limitations, funding constraints, and the need for staff training. By addressing these barriers and leveraging successful case studies from other regions, Nigerian law libraries can harness emerging technologies to provide more equitable and accessible legal information services.

Emerging technologies are significantly transforming the landscape of law libraries, enhancing both the accessibility and efficiency of legal research and information services. One major advancement is the integration of Artificial Intelligence (AI) into legal research platforms. AI tools such as ROSS Intelligence and LexisNexis leverage natural language processing to automate complex research tasks, improve the accuracy of legal analysis, and predict case outcomes with impressive efficiency (American Profession Guide, 2024). In addition, AI is streamlining tasks such as contract review and case summarization, thereby reducing the workload for legal professionals and law librarians alike.

Another critical innovation is the use of generative AI in electronic discovery (e-discovery), where it automates the processing of vast volumes of electronically stored information (ESI). This not only accelerates litigation procedures but also reduces human error and operational costs. However, it raises important concerns about the transparency, validation, and legal obligations to disclose AI usage during litigation (Reuters, 2024). Simultaneously, technologies such as data analytics are helping law libraries better understand user behavior and resource utilization. This data-driven approach enables libraries to optimize their services and tailor resources to meet the evolving needs of legal researchers (Libero, 2024).

Accessibility and user engagement are also being transformed through mobile-based library services, AI-powered assistive tools, and immersive technologies like virtual and augmented reality (VR/AR). Mobile

applications allow users to access resources, receive updates, and manage their accounts remotely, making legal information more accessible to a broader audience (Libero, 2024). AI-driven assistive technologies are enhancing inclusivity by providing features such as text-to-speech and personalized navigation for users with disabilities (Arxiv, 2024). Moreover, VR/AR is being used in legal education to simulate courtroom environments and legal scenarios, offering interactive and experiential learning opportunities (iTechnolabs, 2024). These technologies collectively signal a shift toward more dynamic, responsive, and inclusive law library services.

Methodology

Documentary analysis was used to collect data. According to Bowen (2009) and Prior (2020) it is a qualitative research method that involves the systematic examination of documents to extract meaning, gain understanding, and develop empirical knowledge. This method is particularly useful in fields such as history, sociology, education, and political science, where documents serve as primary sources of data. It involves studying documents to extract meaningful insights and patterns that contribute to understanding a specific research problem. These documents can include texts, records, reports, newspapers, and official publications. The method is valued for its ability to provide historical and contextual data that can complement other research methods, such as interviews and surveys (Scott, 1990). This study is restricted to instructional texts that covered emerging technologies for libraries. Documentary analysis typically involves several stages, including document selection, data extraction, and interpretation (Prior, 2008; Bowen, 2009). Seven (7) documents were successfully distilled from Google Scholar that discussed emerging technologies for promotion of inclusive library information services in libraries around the globe based on their coverage and frequency on emerging technologies for libraries and were analysed and discussed. Thus, inclusivity criteria were based on recent documents that are relevant to the objective of the research and accessible.

Data Analysis

Table 1: Documents or Studies on Emerging Technologies for Promotion of Inclusive Library Information Service in Law Libraries

Document Title	Author(s)	Publication Year	Coverage on Emerging Technologies	Crucial Technologies Discussed
Introduction to Modern Information Retrieval	Chowdhury, G. G., & Chowdhury, S.	2020	High	AI, Machine Learning, Digital Repositories
Cloud Computing in Libraries: Benefits and Challenges	Wang, X., Zhang, L., & Wang, Y.	2021	Moderate	Cloud Computing, Virtualization
Artificial Intelligence in Legal Information Retrieval: Current Trends and Future Directions	Jin, B., & Yu, M.	2022	High	AI, Legal Research Tools
Technological Advancements in Library Services: Opportunities and Challenges	Adedoyin, I., & Ojo, J.	2023	High	Various Emerging Technologies
The Impact of Infrastructure on the Adoption of Emerging Technologies in Nigerian Libraries	Adewale, B.	2022	Moderate	Infrastructure, Emerging Technologies
Inclusive Library Services and Technological Advancements in Nigeria: Bridging the Digital Divide	Okeke, C., & Nwafor, E.	2023	Moderate	Inclusive Technologies, Accessibility
The State of Law Libraries in Nigeria: Challenges and Prospects	Ojo, J., & Olufunmilayo, A.	2021	Low	General Library Technology

High Coverage: Documents like Introduction to Modern Information Retrieval and Artificial Intelligence in Legal Information Retrieval provide extensive discussions on emerging technologies, offering detailed analyses and insights into their impact on libraries generally.

Moderate Coverage: Publications such as Cloud Computing in Libraries and The Impact of Infrastructure on the Adoption of Emerging Technologies offer balanced discussions, addressing specific technologies or challenges without exhaustive detail. The law libraries could leverage cloud computing for remote access and curation of legal information resources

Low Coverage: Documents like The State of Law Libraries in Nigeria provide limited coverage on emerging technologies, focusing more on general or methodological aspects.

Discussion of Findings

Introduction to Modern Information Retrieval by Chowdhury and Chowdhury (2020) This comprehensive text provides a thorough examination of AI and machine learning applications in information retrieval systems, including their impact on law library services. It emphasizes how AI technologies enhance search capabilities and automate cataloging processes in law libraries. The high coverage reflects its detailed exploration of these technologies in libraries including the law libraries.

In Introduction to Modern Information Retrieval, offer a comprehensive analysis of the evolving landscape of information retrieval, with particular emphasis on the integration of artificial intelligence (AI) and machine learning (ML) in modern library systems. Their work explores the conceptual and practical frameworks that underpin intelligent search technologies, demonstrating how AI can significantly improve the precision, relevance, and efficiency of information retrieval. This is especially relevant in the context of law libraries, where the ability to locate authoritative and specific legal documents quickly is critical for both practitioners and researchers.

The authors highlight how AI technologies are transforming core library functions such as cataloging, indexing, and classification. For law libraries, this automation can dramatically reduce manual labor, standardize metadata application, and streamline the organization of complex legal materials. Additionally, the implementation of natural language processing (NLP) and semantic search capabilities allows users to conduct more intuitive and context-aware searches, reducing reliance on rigid keyword-based querying. These advancements enhance the overall user experience and facilitate deeper engagement with digital legal resources.

Chowdhury and Chowdhury (2020) provide high coverage of these technologies, underscoring their current applications and future potential across library settings, including specialized environments like law libraries. Their detailed discussion reflects not only the technical aspects of AI and ML in retrieval systems but also the institutional and user-centered implications of adopting such tools. As legal information continues to expand in complexity and volume, the insights from this text serve as a valuable guide for law libraries seeking to modernize their services and remain responsive to the evolving needs of their users.

Cloud Computing in Libraries: Benefits and Challenges by Wang et al. (2021). This document addresses the implementation of cloud computing in libraries, discussing its benefits, such as scalability and remote access, and challenges like security and cost. The law libraries could leverage this technology to render remote access to e-resources and cut the cost of instituting proprietary infrastructure. The moderate coverage is reflected in its balanced approach to both advantages and drawbacks.

Additionally, cloud-based systems allow library users and staff to access digital resources anytime and anywhere, which is particularly beneficial for academic and law libraries that serve users with varied schedules and locations. For law libraries specifically, cloud computing offers the opportunity to provide seamless access to legal databases, e-books, and institutional repositories remotely, supporting legal professionals and researchers in their need for timely, location-independent access to information. Wang et al. (2021) emphasize that this shift can also help reduce operational **costs** by eliminating the need for extensive on-site servers and proprietary software. This cost-efficiency is especially valuable for smaller institutions or those with limited budgets, allowing them to allocate resources more strategically while still maintaining high service quality.

However, the document does not overlook the challenges associated with cloud adoption. Wang et al. (2021) note concerns about data security, user privacy, vendor lock-in, and long-term costs, which are critical

considerations in legal contexts where confidentiality and compliance are paramount. Law libraries must weigh these risks carefully and consider hybrid solutions or stringent service-level agreements (SLAs) with cloud providers to mitigate potential downsides. Overall, the article provides a moderate and balanced perspective, acknowledging both the promise and the perils of cloud computing, making it a valuable resource for institutions contemplating this transition.

Artificial Intelligence in Legal Information Retrieval: Current Trends and Future Directions by Jin and Yu (2022). This document provides an in-depth look at how AI is applied in legal information retrieval, highlighting current trends and future directions. It extensively covers AI technologies and their implications for legal research, reflecting its high coverage of the topic. Technological Advancements in Library Services: Opportunities and Challenges by Adedoyin and Ojo (2023). This publication provides a broad overview of various emerging technologies impacting library services. It covers a range of technologies and discusses their opportunities and challenges, thus providing high coverage on technological advancements.

The Impact of Infrastructure on the Adoption of Emerging Technologies in Nigerian Libraries by Adewale (2022): This document explores how infrastructure affects the adoption of emerging technologies in Nigerian libraries. It provides a moderate level of coverage, focusing on specific challenges related to infrastructure and technology adoption. Inclusive Library Services and Technological Advancements in Nigeria: Bridging the Digital Divide by Okeke and Nwafor (2023): This publication discusses how technological advancements can enhance inclusivity in Nigerian libraries. It addresses moderate aspects of accessibility technologies and their role in bridging the digital divide.

In their study, The State of Law Libraries in Nigeria: Challenges and Prospects, Ojo and Olufunmilayo (2021) provide a critical overview of the institutional and operational difficulties faced by law libraries in Nigeria. The document identifies core challenges such as inadequate funding, poor infrastructure, insufficient staffing, and the lack of up-to-date legal resources, all of which hinder the effective delivery of library services. These systemic issues are compounded by irregular government support and low prioritization of library development within the legal education and justice sectors. The authors argue that for law libraries in Nigeria to remain relevant, these foundational barriers must be addressed through policy reform, institutional commitment, and sustained investment.

However, the study offers limited coverage of emerging technologies in law libraries. Unlike other contemporary works that explore the integration of artificial intelligence, cloud computing, or digital cataloging systems, Ojo and Olufunmilayo (2021) largely focus on traditional operational concerns and broader structural issues. While the authors briefly acknowledge the potential of ICT in transforming library services, their discussion lacks detailed examination of specific technological tools or innovations. This omission reflects the current reality in many Nigerian law libraries, where the adoption of advanced digital systems remains minimal due to resource constraints and limited technical capacity.

Despite its limited focus on technology, the document is valuable for understanding the socio-economic and institutional context in which Nigerian law libraries operate. Ojo and Olufunmilayo (2021) present a forward-looking perspective by outlining possible solutions, such as increased collaboration between academic institutions, strategic capacity building, and the gradual integration of digital resources. These recommendations, while not extensively tied to emerging technologies, lay the groundwork for potential modernization efforts in the future, including the adoption of technologies that could help Nigerian law libraries overcome their longstanding challenges.

Conclusion

The table provides a clear overview of the literature on emerging technologies in libraries. It highlights the extent to which different documents cover these technologies and their implications for library services. By analyzing the frequency of coverage and crucial technologies discussed, researchers and practitioners can gain valuable insights into the current state of technological advancements in law libraries and their impact on practice. The integration of emerging technologies into library services presents significant opportunities for enhancing access, improving efficiency, and promoting inclusivity. By addressing infrastructure challenges, investing in staff training, promoting accessibility, developing digital repositories, fostering collaboration, and continuously evaluating technology strategies, libraries can better leverage these advancements to meet the needs of their users and improve overall service delivery. These recommendations are designed to support the effective adoption and implementation of emerging technologies in libraries, with a particular focus on addressing the specific needs and challenges faced by Nigerian law libraries.

Recommendation

The following recommendations are made:

1. Law libraries should strengthen technological infrastructure by investing and improving the technological infrastructure of libraries, especially in regions with limited resources. Upgrading internet connectivity, providing reliable power sources, and acquiring modern hardware are crucial steps for ensuring that libraries can effectively implement new technologies. Enhanced infrastructure will support the successful deployment of cloud computing, AI tools, and digital repositories, thereby improving overall library services
2. Law libraries should take steps that would include conducting needs assessment to identify specific infrastructure requirements; Seek funding from government bodies, private sector partnerships, and international grants; Implement phased upgrades to address critical infrastructure needs.
3. Law libraries should increase training and professional training and professional development opportunities for library staff to effectively use and manage emerging technologies.
5. Law libraries should promote inclusivity through Technological Solutions by utilizing emerging technologies to enhance inclusivity and accessibility within libraries. As technologies can play a vital role in bridging the digital divide and improving access for underserved populations. Implementing accessibility features such as text-to-speech, translation services, and adaptive technologies can make library resources more inclusive and accessible.
6. Steps should be taken to integrate accessibility features into digital library platforms; Ensure that library websites and resources are compliant with accessibility standards; Provide assistive technologies for users with disabilities.

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Empowering Libraries and Information Science Professionals for the 5th Industrial Revolution: Skills and Strategies for Effective Service Delivery

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Abstract

Library and information science professionals are currently experiencing a significant transformation, driven by advancements in information communication technology (ICT) that have fundamentally refined the operational framework of libraries. These changes have significantly impacted the skills and competencies required of library professionals. Information communication technology (ICT) is becoming a tool in contemporary libraries to enhance library operations and satisfy the information needs of clients. The 5th industrial revolution also known as Industry 5.0 brings along the skills and originality of human workers and offers support with precision and capabilities of advanced technologies like Artificial Intelligence AI, robotics, and the Internet of Things (IoT). Although libraries remain indispensable pillars of education and research, there is still an information gap on what technologies are needed to expand their influence within these ever evolving knowledge systems. Thus, using secondary data, this paper presents the idea of Industry 5.0, where robots are interconnected with the human brains to work as partners rather than competitors in libraries. The paper also discusses skills library and information professionals need to learn in order to navigate and thrive in the rapidly evolving landscape of the industry 5.0. Finally, it presents strategies that 5th industrial revolution can be implemented to ensure effective service deliveries in modern libraries.

Keywords: *library and information science professionals, 5th Industrial Resolution, Technology, Skills, Service Delivery, Libraries.*

Introduction

Technological developments have drastically refined ways and manners all professions in the globe operate with librarianship not being an exception. The era of 5th Industrial Revolution refers to the current and future trends in industries and technology, suggesting new waves of advancements that extend beyond the achievements of previous industrial revolutions. This era is seen as a continuation and evolution of the four (4) preceding revolutions. The steam and power mechanization of the 18th century (1IR), use of electricity in the 19th century (2IR), digital explosion and automation in the 20th century (3IR), cyber-physical systems, the Internet of Things (IoT), and artificial intelligence (AI) which is the (4IR). The 5IR deals with integrating advanced technologies in new and impactful ways. 5th industrial revolution has significantly enhanced the efficiency of library service delivery in terms of providing accurate and timely information to users. Moreover, physical catalogues have largely been replaced by user-friendly online systems that allow users locate books, journals, and other resources instantaneously. This has not only enhanced efficiency but also empowered users to engage in self-directed research with minimal or no reliance on library staff. As it is, users are no longer confined to the limitations of physical collections; they can access a diverse array of materials remotely, at any time. However, despite these advancements 5th industrial revolutions have brought to libraries, library and information professionals are yet to fully accept and implement these technologies. Perhaps, it is because of the common belief that technology is built to replace human workers in various organizations including libraries. Another possible reason might be as a result of inadequate knowledge of 5th technology among library and information professionals, or lack of strategies to implement 5th industrial resolution in libraries. It is important to note that 5th industrial revolution is not designed to replace human beings in libraries or any organization; rather, it concentrates more on an innovative human-machine interface which does not include replacing human workers. This has been highlighted by Mattila, Pratik, Prateek, Dhanraj (2022) who defined 5th industrial revolution as "a concept that has been designed to harmonize the working space and efficiency of humans and machines in a consistent manner". Hence, this paper explains the skills of 5th industrial revolution as well as strategies libraries need to follow to implement them. The paper also tries to explain how these technologies are leveraged not to replace library and information professionals, but to augment their capabilities, enabling them to provide effective services to users.

Objectives of the Paper

The objectives of this paper include the following;

1. To brief on the 5th industrial revolution.
2. To assess the 5th industrial skills for library and information science professionals.
3. To point out the strategies of implementing and effecting 5th industrial revolution in libraries.

2. Literature Review

Alojaiman (2023) described 5th industrial revolution as an era that 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. This era has profoundly transformed not only the role of library and information professionals, but also that of the users by reshaping the entire knowledge system. Ajani, Adeyinka, Dunmade,and Adeniran (2022) posited that 5th industrial resolution is a system concerned with the development of intelligent computer programs that replicate various aspects of intelligent human behavior. 5th industrial resolution is capable of performing multiple tasks, such as analyzing complex data, problem- solving and language learning among others, although it might typically require minimal human intervention to function..

3. Libraries in the 5th industrial revolution

As the world changes into more technology driven space, libraries experience both challenges and opportunities. Awoyemi (2023) highlighted that the change from traditional to digital libraries marks a significant adjustments on how information is accessed, organized, and disseminated. This is because, for libraries to remain relevant in communities, there is an urgent need for them to strategically integrate emerging technologies like artificial intelligence, robotics, Internet of Things among others to enhance resource accessibility, optimize service delivery, and foster digital literacy among their users. 5IR is transforming library operations by enabling smarter cataloging, predictive analytics for user preferences, and creating personalized learning experiences. Nwobu, Dumbiri, Ibia and Oladokun (2024) stated that 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. In addition, Karneli (2023) noted that Automation technologies from 5IR, such as RFID tagging and self-checkout systems, have streamlined routine tasks, allowing librarians to focus on higher-value activities. In essence, these technologies free up librarians from repetitive, time-consuming tasks, enabling them to focus on activities that have a greater impact on library users and the community as a whole. With the advent of 5th industrial revolution, digital asset management systems have simplified how libraries retrieve digital content and provided insights into user behavior and preferences. This has evolved libraries into dynamic hubs for learning, innovation and collaboration rather than places for books.

Essential skills for library and information science professionals in the 5th industrial revolution

The Fifth Industrial Revolution is characterized by the convergence of physical and digital technologies, which library and information science professionals need to adopt in order to remain relevant and be effective in discharging their roles beyond traditional competencies. Ekueme, Oluwaseun, Ajie Ofodu and Ambrose (2024) reported that the incorporation of cutting-edge technology like big data analytics, artificial intelligence, and the Internet of Things into a variety of industries, including libraries and education, is what defines the 5th Industrial Revolution (5IR). By developing these skills, library and information science professionals can navigate the complexities of this new era and ensure that libraries remain vital and impactful spaces for information access and lifelong learning. Some of these skills for library and information science professionals in 5th industrial revolution era include the following;

1. Digital Literacy:

Digital literacy is a fundamental skill, enabling individuals to thrive in a society where information and interaction are overwhelmingly mediated by technology. Ranjan and Patel (2021) described digital literacy in library and information science as the capacity to use digital tools and technology for information management and service delivery. The ability to use information communication technology to access, evaluate and communicate information simply describes digital literacy. Furthermore, it is one of the core competencies for librarians in the 5th industrial revolution. A digitally skilled library and information professional can effectively utilize digital tools for learning, collaboration, and problem-solving in the libraries. In addition, Thiruppathi (2024) noted that to satisfy the varied demands of users in open and distance learning contexts in today's revolutionized community, library and information professionals must be able to adept at leveraging digital resources, databases, and information systems. Ekwueme et al (2024) further observed the library and information science professionals need to be skilled in data management in order to facilitate evidence- based decision making and improve service inclusiveness. In addition to this, Bokoh, Ajiboye and Bello (2023) posit that library and information science professionals should also be knowledgeable in information retrieval to obtain and distribute material from a variety of sources, including online databases and digital repositories in order to accommodate learning needs of the users. Library and information science professionals play a vital role in the transition of libraries by learning embracing technological advancements and learning these skills to ensure diverse and inclusive services are accessible to all users.

2. Artificial Intelligence (AI):

History has is that artificial Intelligence (AI) was first introduced by John McCarthy in 1956 during his inaugural academic conference on the topic. Artificial intelligence (AI) has emerged as one of the most transformative technologies of the 21st century, possessing the potential to revolutionize various industries and reshape lives in different ways. From chatbots and virtual assistants to self-driving cars and medical diagnoses, AI has demonstrated its value as an indispensable tool for enhancing productivity, efficiency, and accuracy across diverse domains, Banafa (2024). Library and information professionals must be skilled in Artificial Intelligence (AI) in order to enhance information access and processes, cataloguing process, as well as offer personalized services and recommendations based on user preferences. Moreover, Oladokun, Owolabi, Aboyade, Wiche and Aboyade (2023) observed that the perception of library and information science professionals towards AI in the context of library services is a complex and evolving phenomenon. In their view, while some librarians view AI as a potential tool to enhance efficiency and user experience, others harbor concerns about its impact on job roles, user privacy and the quality of human interaction within libraries. This denotes that automating library and information services like reference queries and collection management could lead to staff reductions, which automatically threatens job security and expertise. However Adetayo (2023) argued that AI is a promising avenue for library and information professionals to streamline routine tasks and improve service delivery. With regards to knowledge and skills on AI, library and information science professionals should have a foundational understanding of AI, its capabilities, limitations and various techniques such as machine learning, natural language processing and data mining.

Robotics

Robotics represents a multidisciplinary field focused on the design, construction, operation, and application of robots. Rayhan (2023), described Robotics as an interdisciplinary field that deals with the design, construction, and operation of robots. They are also known to interact with their environments through sensors and actuators, and they can be controlled by computer systems. Employing principles from engineering, computer science, and mathematics, robotics automates tasks by enhancing human capabilities, solving complex problems across various sectors. These sectors may include manufacturing companies, healthcare sectors, and libraries. Owolabi, Okorie, Yemi-Peters, Oyetola, Bello, and Oladokun (2022) agreed with this adding that the presence of robots in libraries give library and information professionals more time to focus on other important information service delivery to users. Library and information professionals need to be skilled on robotics, which are a user interfaces or a messaging platforms, designed to receive textual input targeted to a wide range of users with little effort. It should be noted that implementing robots in libraries can be challenging, considering the initial investment and ongoing maintenance costs which requires specialized expertise. Additionally, concerns regarding job displacement must also be addressed through retraining and reassignment of existing library staff.

3. Internet of Things (IoT)

The Internet of Things (IoT) represents a paradigm shift in interconnectedness, facilitating communication and data exchange between physical objects and digital systems. Sinha and Brar (2022) describe Internet of Things (IoT) as a framework in which everything on the Internet has a representation and a presence. Explain further, they revealed that the Internet of Things aspires to provide new applications and services that connect the physical and virtual worlds, with Machine-to-Machine (M2M) communications serving as the foundation for interactions between Things and cloud-based applications. IoT connects various wireless systems through the internet so that it can be remotely managed, the wireless equipments can communicate without human intervention. IoT assist library and information professionals in collection management, library usage statistics, content management, information literacy, circulation and overdue records. Other benefits such as reminders, information resource sharing and reference queries may be automatically managed through IoT applications. By having this skill, library and information professionals can become more efficient, sustainable, and responsive to the evolving needs of their users, cementing their relevance in the digital age and solidifying their role as vital community hubs.

Other skills include cybersecurity solutions, blockchain, Augmented Reality (AR) and Virtual Reality (VR) among others.

Strategies for Implementing 5th Industrial Revolution in libraries

Implementing the Fifth Industrial Revolution (5IR) in libraries necessitates a multifaceted strategy. This includes investing in advanced technologies like AI and IoT, fostering digital literacy among staff and patrons, and re-evaluating library spaces to accommodate new forms of information access. Noble, Mende, Grewal, and Parasuraman (2022) observed that the key strategy for library and information professionals to implement 5IR is by prioritizing and updating skills and knowledge, this way librarians will be responsive to the evolving

needs of users. Furthermore, 5th industrial revolution can be implemented in libraries through collaboration and partnerships with other institutions, organizations, and stakeholders. It is noticeable that libraries are undergoing a transformative shift, evolving into vibrant hubs that foster collaborative learning and innovation. Therefore, it is essential for library and information professionals to enhance their preparedness in the 5th industrial revolution. These spaces enable interactive group work, workshops, and immersive learning experiences as they are equipped with state-of-the-art technologies such as augmented reality (AR) and virtual reality (VR). By integrating these advanced tools, libraries create engaging environments that facilitate active participation, knowledge sharing, and creative exploration, Ganiyu, Adigun, Yusuf and Rexwhite (2024).
Moreover, Ganiyu et al (2024) highlighted that libraries should make considerable emphasis on improving the user experience to provide engaging and seamless interactions. When libraries are supported by sophisticated algorithms, users can anticipate can receive personalized recommendations that align with their interests and preferences. Expanding on the previous course, Singh, Bilal, Cox, Chidziwisano, and Dinneen (2023) emphasized the importance of encouraging creativity, experimentation, and risk-taking among library staff is to empower them to explore novel ideas and new approaches to library services.

Methodology

This paper mainly used secondary data from appropriate publications such as journals, books, reports as well as articles publications. Majority of the publications were accessed online through databases, also the keywords mostly used during searches were 5th Industrial revolution and libraries.

Conclusion

The 5th Industrial Revolution represents a new and emerging phase of industrialization where humans collaborate with advanced technology and AI-powered robots to enhance workplace processes. This evolution is characterized by a more human-centric approach, increased resilience, and a stronger emphasis on sustainability. Adapting to this paradigm necessitates integrating advanced technologies like AI and IoT through acquiring skills and strategies to enhance user experience, streamline operations, and curate personalized learning pathways. This paper used secondary data from various literatures point out the key 5th industrial skills as well as strategies to implement them in library and information science profession. Library and information science professionals must acquire skills such as digital literacy, robotics, artificial intelligence (AI) so that libraries can evolve beyond traditional repositories and become dynamic hubs that promote digital literacy, critical thinking, and facilitate collaborative knowledge creation in today's automated world. To achieve this, libraries must implement strategic partnerships with technology providers and educational institutions to ensure equitable access and develop adaptable tasks within the workforce.

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Empowering School Libraries in Rivers State: Strategies for Thriving in the 5th Industrial Revolution

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Abstract

The 5th Industrial Revolution (5IR) is characterised by the integration of advanced technologies such as artificial intelligence (AI), robotics, and sustainable innovations with human-centred ideologies to foster inclusivity and societal progress. This paper explores strategic interventions to empower school libraries as dynamic hubs of learning and innovation in the 5IR era by leveraging digital transformation, fostering collaborations between educators and technology providers, and integrating AI-driven tools for personalised learning. The research adopted a descriptive survey design. The study population consists of School librarians from selected secondary schools in Rivers State. Data were collected through a structured questionnaire and analysed using mean. The findings of the study revealed that continuous professional development in emerging technologies, investment in high-speed internet access, virtual and hybrid learning spaces and others as strategies for empowering libraries to thrive in the 5IR. It concluded that capacity-building programmes and ICT investments play a pivotal role in modernising school libraries to thrive in the 5IR. It was recommended that training and workshops should be expanded to cover emerging trends, ensuring that librarians remain proficient in digital library management.

***Keywords**: 5th Industrial Revolution (5IR), School Libraries, Artificial Intelligence, Digital Transformation, Rivers State*

Introduction

The Fifth Industrial Revolution (5IR) is a transformative period characterised by the fusion of artificial intelligence (AI), automation, big data, and the Internet of Things (IoT), which are reshaping industries, including education and library management in driving innovation, efficiency, and sustainability (Ajani & Oladokun, 2024). In this era, the need for school libraries to adapt to the rapidly changing technological landscape remains relevant and effective in providing information and educational resources to students and teachers. Unlike previous industrial revolutions that primarily focused on mechanisation, electrification, digitalisation, and automation, the 5IR emphasises human-machine synergy, ethical AI, and sustainability (Mishra, 2024). This shift has significant implications for school libraries, necessitating a re-evaluation of their roles, significant investment in infrastructure, professional training, and strategies for knowledge dissemination. This paper explores strategies for empowering school libraries in Rivers State to thrive in the era of the 5IR.

In the context of Library and Information Science (LIS), 5IR drives the transformation of libraries into intelligent knowledge hubs, where AI-powered tools, virtual reality (VR), and augmented reality (AR) enhance information retrieval, learning experiences, and research accessibility. The revolution also advocates for digital inclusivity, equitable access to information, and ethical considerations in AI-driven services.

The traditional role of libraries as mere storage hubs for books and documents is becoming obsolete in the face of the 5IR. Libraries are now expected to provide interactive learning experiences, facilitate digital research, and bridge the gap between students and the global knowledge economy (Eiriemiokhale & Sulyman, 2023). In Rivers State, many school libraries lack the necessary infrastructure to support this shift. Issues such as limited access to high-speed internet, inadequate digital resources, and a lack of trained personnel hinder the ability of these libraries to compete in the modern educational ecosystem (Ajani et al., 2022). However, digital transformation strategies, including AI-driven search engines, virtual reality learning modules, and cloud-based knowledge management systems, offer viable solutions (Mamedova, 2023)

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Statement of the problem

School libraries in Rivers State currently face significant challenges that hinder their ability to provide quality information services and support academic excellence. Many of these libraries are underfunded, poorly equipped, and lack the modern digital resources necessary for thriving in the 5th Industrial Revolution. Traditional library structures, with limited access to technology, outdated books, and inadequate infrastructure, make it difficult for students and educators to access relevant and up-to-date information. Additionally, many libraries do not have internet connectivity, limiting digital literacy and the ability to harness global knowledge resources.

Librarians in school libraries also face challenges related to inadequate professional training and capacity-building opportunities. Many do not possess the necessary skills to manage digital library resources, utilise artificial intelligence (AI) for knowledge dissemination, or leverage modern learning tools such as virtual reality (VR) and augmented reality (AR). The lack of investment in digital transformation has left school libraries in Rivers State lagging behind global best practices in information science and academic support.
The primary problem affecting school libraries in Rivers State is their inability to integrate into the 5th Industrial Revolution, which may be due to inadequate technological infrastructure, outdated library collections, limited collaboration with technology providers, poor funding and government neglect, inadequate training for librarians and a lack of digital literacy programs amongst others. If these problems are not addressed, it may lead to widening Digital Divide especially in the 5th industrial revolution era, a decline in Educational Standards, and inefficiency in Library Management amongst others, hence, the need for the study to explore strategies for empowering school libraries in Rivers State to thrive in the era of the 5IR.

Purpose of the Study
The purpose of the study is to investigate strategies for empowering school libraries in Rivers State to thrive in the 5th Industrial Revolution (5IR). Specifically, the study sought to:

1. Ascertain the extent to which capacity-building programmes for librarians can empower school libraries to thrive in 5IR in Rivers State.
2. Examine the extent to which investments in IA-driven infrastructure can empower school libraries to thrive in 5IR in Rivers State.

Research Questions

1. To what extent do capacity-building programmes for librarians empower school libraries to thrive in 5IR in Rivers State?
2. To what extent do investments in AI-driven infrastructure empower school libraries to thrive in 5IR in Rivers State?

Literature Reviews
The Fifth Industrial Revolution (5IR) represents a new phase in the evolution of industry and technology that emphasises human-centred innovation, collaboration between humans and intelligent machines, and the ethical and sustainable use of advanced technologies. Unlike the Fourth Industrial Revolution (4IR), which focused on digitisation, automation, and AI-driven systems, the 5IR integrates empathy, creativity, and purpose with cutting-edge technologies such as artificial intelligence (AI), robotics, quantum computing, and biotechnology.
The 5IR advocates for a synergistic relationship between humans and machines, where machines handle repetitive tasks while humans focus on creativity, emotional intelligence, and critical decision-making. This shift aims to create a more inclusive, equitable, and sustainable society, where technological progress is aligned with human values and societal needs. Oyedokun (2024), 5IR redefines the interaction between humans and machines, emphasising cooperation rather than replacement, and seeks to address global challenges through technological humanism. In the context of school libraries, thriving in the 5IR implies embracing emerging technologies not only for automation but also for enhancing personalised learning, promoting digital literacy, and fostering innovation ecosystems that support holistic education and lifelong learning.
Several strategies need to be adopted by School libraries that will enable them to thrive in the 5th Industrial Revolution era, some of these strategies include capacity-building programmes for librarians, investment in AI-driven resources, partnerships with technology firms to provide access to cutting-edge tools and digital transformation amongst others (Mamedova, 2023). Schools must also prioritise training programs that equip librarians with the necessary skills to manage digital resources effectively and engage students with interactive learning materials (Adigun et al., 2022). Moreover, policymakers must ensure that libraries are adequately funded to support technological innovations and infrastructural development.
As the 5IR reshapes the role of librarians, capacity-building programmes become crucial for equipping them with essential digital skills. Eiriemiokhale and Sulyman (2023) emphasize the importance of continuous professional development in AI literacy, cybersecurity, and digital resource management. Training programs should include workshops on AI-driven cataloguing systems, digital preservation techniques, and virtual collaboration tools (Adigun et al., 2022). These programs not only improve the technological competencies of librarians but also foster innovation in information service delivery. Furthermore, Baro et al. (2019) highlight that equipping librarians with digital research methodologies enhances their ability to support academic and professional inquiries. Successful capacity-building initiatives require collaboration between educational

institutions, governmental agencies, and private organizations to provide comprehensive training modules (Oseji, 2020).

Investment in AI-driven resources enhances library efficiency by automating tasks such as information retrieval, user interaction, and data analysis. AI-powered chatbots, for example, assist users with real-time queries, reducing workload on human librarians (Mamedova, 2023). AI-driven recommendation systems personalize user experiences by suggesting relevant reading materials based on previous interactions (Ajani et al., 2022). Moreover, machine learning algorithms facilitate predictive analytics, helping libraries optimize resource allocation and inventory management (Tella et al., 2022). However, ethical concerns surrounding AI applications in libraries, such as data privacy and algorithmic bias, must be addressed through policy frameworks and ethical AI training for librarians (Eiriemiokhale & Sulyman, 2023). Investing in AI infrastructure also requires substantial funding, which can be sourced through strategic partnerships and governmental support (Adigun et al. 2022).

Collaborating with technology firms is essential for ensuring that libraries remain equipped with the latest advancements in digital tools. Nwobu et al. (2024) highlight that partnerships with AI developers, software companies, and cloud service providers can enhance library functions through customized technological solutions. For instance, integrating blockchain technology for digital rights management ensures secure access to copyrighted materials (Ajani & Oladokun, 2024). Public-private partnerships facilitate funding for library digitization projects and ensure continuous access to state-of-the-art learning technologies (Ajani & Enakire, 2024). Additionally, engaging with EdTech companies enables libraries to provide virtual reality learning experiences and gamified educational resources (Tella et al., 2022). However, these partnerships must be guided by mutually beneficial agreements that prioritize educational accessibility and ethical considerations (Eiriemiokhale & Sulyman, 2023). Establishing legal frameworks and intellectual property guidelines ensures that libraries maintain autonomy while leveraging technological advancements (Adigun et al. 2022).

Digital transformation in libraries is a strategic shift towards incorporating advanced technologies to enhance information accessibility, storage, and dissemination. According to Ajani and Oladokun (2024), libraries must adopt cloud computing, artificial intelligence (AI), and big data analytics to facilitate efficient knowledge management. Digital transformation enables automated cataloguing systems, AI-powered search engines, and virtual reference services that improve user engagement and research capabilities (Nwobu, et al., 2024). The implementation of smart libraries with real-time digital lending services ensures inclusivity and adaptability to modern educational needs (Ajani & Enakire, 2024). However, digital transformation requires substantial investment in IT infrastructure, staff training, and policy reforms to address data security and digital ethics (Tella et al., 2022).

Adopting the Fifth Industrial Revolution in school libraries results in heightened student engagement, enhanced accessibility to learning materials, and improved overall effectiveness of library operations (Adigun et al, 2024). Through AI, VR, cloud computing, and other emerging technologies, libraries can transform into interactive, efficient, and inclusive learning environments. However, achieving these outcomes requires strategic investment in digital infrastructure, librarian training, and policy frameworks to sustain technological integration. By embracing these innovations, school libraries can remain pivotal in fostering academic excellence and lifelong learning in the digital age.

One of the core outcomes of adopting the 5IR in school libraries is the improved accessibility of learning materials. Digital transformation enables cloud-based repositories, ensuring students can access resources from anywhere at any time (Eiriemiokhale & Sulyman, 2023). AI-driven cataloguing systems facilitate quick searches, allowing students to retrieve relevant materials effortlessly (Baro et al., 2019). Additionally, adaptive technologies, such as text-to-speech software and AI-powered translation tools, make information more accessible to students with disabilities and those from diverse linguistic backgrounds (Oseji, 2020). Open-access educational platforms integrated into school libraries ensure that financial constraints do not limit students' access to critical learning resources (Mamedova, 2023). Furthermore, mobile applications and digital lending services extend library functions beyond physical spaces, allowing students to utilise learning materials flexibly and efficiently (Ajani & Enakire, 2024).

The adoption of 5IR technologies enhances the overall effectiveness of school libraries by automating administrative processes, optimizing resource management, and expanding service delivery. AI-powered data analytics help librarians track user behaviour and resource utilisation, enabling data-driven decision-making to improve library operations (Ajani et al., 2024). Automated cataloguing and book recommendation systems improve efficiency, reducing the time students spend searching for information (Nwobu et al., 2024). Robotics and IoT applications in libraries further streamline inventory management, ensuring materials are well-organised and accessible (Adigun et al. 2022). Additionally, AI-driven plagiarism detection and citation tools

enhance academic integrity, supporting students in producing high-quality research outputs (Tella et al., 2022). The combination of these innovations fosters a smarter, more responsive library system that aligns with modern educational demands, ensuring continuous improvement in service delivery and student learning outcomes (Eiriemiokhale &Sulyman, 2023).

The Fifth Industrial Revolution (5IR) significantly enhances student engagement in school libraries by integrating advanced technologies such as artificial intelligence (AI), virtual reality (VR), and gamified learning environments. (Ajani and Oladokun, 2024) highlight that AI-driven personalised learning experiences cater to students' individual preferences, increasing motivation and participation. Virtual reality tools provide immersive educational experiences, making learning more interactive and enjoyable (Nwobu, et al., 2024). Chatbots and AI-powered assistants also improve student interactions with library resources, ensuring immediate responses to inquiries and facilitating seamless research processes (Ajani & Enakire, 2024). Moreover, digital collaboration tools enable students to engage in group studies remotely, enhancing teamwork and knowledge sharing (Tella et al., 2022). By fostering a technology-driven learning environment, school libraries become dynamic hubs that promote active student participation and deeper comprehension of academic materials (Adigun et al. 2022).

Methodology

The research adopted a descriptive survey method. The population of the study consists of School librarians from 10 selected Private secondary schools in Ozuoba, Obio-Akpo Local Government Secondary Schools, Rivers State. Data were collected using structured questionnaires and were analysed using descriptive statistics. A rating scale of 4,3,2,1, with a range of 2.50, was used to determine if the mean score indicates agree or disagree. Mean scores above 2.50 indicate "High Extent" while mean scores below 2.50 indicate " Low Extent"

Table 1: Capacity-building programmes for Librarians

S/N	ITEM STATEMENTS	VHE	HE	LE	VLE	N	M	DE
1	Training on digital literacy and AI applications in library services.	4	6	0	0	10	3.4	High Extent
2	Librarians' exposure to best practices in global digital library systems	5	4	1	0	10	3.4	High Extent
3	Hands-on experience with AI - driven tools for library organisations	5	5	0	0	10	3.5	High Extent
4	Continuous professional development in emerging technologies.	6	4	0	0	10	3.6	High Extent
5	Development of technical skills for managing smart library environments.	5	5	0	0	10	3.5	High Extent
6	Workshops on information management.	4	6	0	0	10	3.4	High Extent
7	Online certification programs in digital library management.	3	5	1	1	10	3.0	High Extent

Table 1 presents the extent to which capacity-building programmes for librarians can empower school libraries to thrive in the Fifth Industrial Revolution (5IR) in Rivers State. The findings indicate that all items received mean scores above the 2.50 threshold, signifying a high extent of implementation. The highest mean score (3.6) was recorded for continuous professional development in emerging technologies, highlighting the importance of ongoing training in adapting to digital advancements. Other significant areas, such as hands-on experience with continuous professional development in emerging technologies, and librarians' exposure to best practices in digital library systems (3.4), also showed a strong emphasis on skill enhancement. The lowest mean score (3.0) was for online certification programs, suggesting that while these programs are available, their accessibility or effectiveness may need improvement.

Table 2: Investments in Artificial Intelligence-Driven Technology Infrastructure

S/N	ITEM STATEMENTS	VHE	HE	LE	VLE	N	M	DE
1	Installation of high -speed internet and Wi-Fi access.	8	2	0	0	10	3.8	High Extent
2	Establishment of virtual and hybrid learning spaces.	7	3	0	0	10	3.7	High Extent
3	Implementation of cybersecurity measures for data protection.	4	6	0	0	10	3.4	High Extent
4	Adoption of smart energy solutions for library sustainability.	9	1	0	0	10	3.9	High Extent
5	Integration of Internet of Things (IoT) in library management.	1	2	3	4	10	2.0	Low Extent
6	Development of digital repositories for academic resources.	3	4	1	2	10	2.8	High Extent
7	Procurement of e -learning devices and multimedia tools.	5	5	0	0	10	3.5	High Extent

Table 2 examines the extent to which investments in ICT infrastructure can empower school libraries to thrive in 5IR. The highest mean score (3.9) was recorded for the adoption of smart energy solutions, indicating strong support for sustainability in library management. Other notable investments include high-speed internet access (3.8), virtual and hybrid learning spaces (3.7), and procurement of e-learning devices (3.5), reflecting substantial ICT integration. However, the integration of the Internet of Things (IoT) in library management received a mean score of 2.0, indicating a low extent.

Discussion of Findings

The results suggest that capacity-building programmes play a critical role in preparing librarians for the evolving technological landscape. According to Eiriemiokhale and Sulyman (2023), continuous professional development is essential in ensuring librarians remain adept at handling digital resources. The high mean scores across various training initiatives indicate that these programs are widely implemented and effective in improving librarians' competencies. However, the relatively lower score for online certification programs suggests a need for increased accessibility and engagement in digital learning platforms, as noted by Adegbore (2018); Adigun et al. (2022). Enhancing hands-on experiences with AI-driven tools and expanding continuous professional development initiatives can further empower librarians to manage digital resources effectively (Baro et al., 2019). Collaboration with academic institutions and technology firms can help improve training modules and provide a more practical learning experience (Oseji, 2020).

The findings emphasise the importance of ICT infrastructure investments in modernising school libraries. High-speed internet, hybrid learning spaces, and smart energy solutions significantly contribute to the efficiency and sustainability of digital library services (Ajani & Oladokun, 2024). However, the low mean score for IoT integration highlights a major gap that must be addressed. Schools should prioritise IoT adoption through government funding and private sector collaborations to enhance automation and resource management in libraries (Ajani et al., 2024). Additionally, improving the development of digital repositories will ensure better access to academic resources, as highlighted by Ajani and Enakire (2024). Strengthening cybersecurity frameworks is essential in safeguarding digital assets and user data from potential threats (Tella et al., 2022). By addressing these gaps, school libraries can achieve a seamless transition into the 5IR era.

Conclusion

The study concludes that capacity-building programmes and ICT investments play a pivotal role in modernising school libraries to thrive in the 5IR. While substantial progress has been made, gaps in IoT adoption and certification accessibility suggest the need for targeted interventions. By addressing these challenges, school libraries can become fully equipped knowledge hubs capable of supporting the digital transformation of education in Rivers State.

Recommendations

1. Policymakers should allocate resources for IoT infrastructure in libraries, so as to ensure seamless digital operations and resource management.
2. Training and workshops should be expanded to cover emerging trends, this will enable school librarians to remain proficient in digital library management.

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Enhancing Librarians' Skills for Better Library Services in the Era of Artificial Intelligence

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Abstract

There is need to enhance librarians' skills for better library services in the era of artificial intelligence is paramount important, this enhancement is timely because of the emergence of AI and its dominating in electronic environments which has increased users preference for e-resources. Consequently, library users now resort to artificial intelligence in search of information. This paradigm shift has caused a severe decline of library patronage. To restore this glitch in patronage and services, librarians must shift ground on programmes, training and retraining that will equip librarians with the necessary skills to tackle emerging challenges in the era of artificial intelligence ravaging electronic environment and further be more responsive to the users need and decorum in the library/academic environment. Retraining on the job will avail librarians the opportunity of learning and relearning new things in the digital era and equally give them a hands-on experience of current trends in the field to better serve users. Furthermore, librarians should not allow artificial intelligence to rubbish their natural intelligence which is the God given knowledge that is not quantitative unlike artificial intelligence which have limited programmed content while librarians are springboard who usher in users into a higher realm of knowledge to effectively assist patrons while equipping them with resources for successful academics.

Keywords: *Librarians, Skills, Academic, Libraries, Artificial intelligence (AI)*

Introduction

The rapid advancement of artificial intelligence (AI) has reshaped numerous sectors, including education and information services. Libraries, traditionally regarded as repositories of knowledge and facilitators of learning, are undergoing a profound transformation due to AI's integration. Technologies such as chatbots, AI-driven search engines, and automated cataloging systems promise to enhance library services by improving efficiency, accessibility, and personalization. However, these innovations also demand that librarians evolve beyond traditional roles, acquiring new skills to harness AI effectively. Interestingly Artificial intelligence (AI) is revolutionizing library services and introducing innovative tools that enhance efficiency and user experience is of utmost importance. However, AI is redefining how libraries operate and engage with their user communities. To fully capitalize on these advancements, librarians must develop new skills that align with the technological demands of this era.

According to Lo et al (2019), Artificial intelligence refers to the simulation of human intelligence by machines, encompassing technologies such as machine learning, natural language processing (NLP), and robotics. In libraries, AI is applied in diverse ways to streamline operations and enhance service delivery.

These AI applications offer significant benefits, including increased efficiency, better resource accessibility, and enhanced patron experiences. According to Lo et al. (2019), AI can automate repetitive tasks, freeing librarians for higher-value roles like research support and user outreaches. Similarly, Stuart (2019) highlights AI's capacity to analyze usage patterns, informing data-driven decisions such as collection development. These advancements underscore AI's potential as a vital tool in modern libraries, but they also emphasize the need for librarians to acquire skills to manage and optimize these technologies.

To ensure that libraries remain relevant and continue to serve their communities effectively, it is crucial for librarians to adapt to these technological advancements. There are several key ways in which librarians can enhance their skills to provide better services in the AI-driven era.

National Universities Commission (NUC) highlighted the role of university libraries which extends beyond providing access to books and resources (2019 Report). These libraries are crucial in supporting research, innovation, and academic excellence. Embracing AI technologies can help Nigerian university libraries streamline their operations, improve resource management, and provide more effective and personalized services to students, faculty, and researchers. Sivrajah et al. (2017) note that the use of AI in academic libraries allows for better analysis of data sets, especially large data sets used for analysis across multiple data sets. It

also helps get rid of repetitive and boring tasks. This means that the application of AI to library operations helps libraries develop capabilities that can exceed those of the human mind. Libraries, including university libraries in developing countries such as Nigeria, fails to adopt digital technologies and show resistance to change in the use of technologies in different library operations (Wheatley & Hervieux, 2019).

To leverage on AI effectively, libraries should adopt proactive strategies to enhance staff skills.
Librarians on their own should develop a blend of Technical and Soft skills that extend beyond traditional librarianship: technical skills: includes AI literacy, Programming and data literacy and Soft skills includes adaptability, critical thinking and communication (Stuart 2019). Wholistically, the adoption and the use of artificial intelligence in libraries will allow better processing of information and better search of information for both the library staff and users (Moustapha & Yusuf, 2023). As this will enhance efficiency in the operations and services of the Library.

These innovations are not without challenges, Cox (2020) highlighted the cost of implementing and maintaining AI systems, training needs, job displacement concerns and ethical issues as among the challenges in Adopting AI in Libraries. In view of this, there are also strategies for enhancing librarian skills in the face of challenges which include Era of AI Training Programs, Certifications and Degrees, Culture of Innovation and collaboration (Cox 2020). Notwithstanding, this paper aims to explore ways of enhancing librarians' skills for better library services, it will cover application of AI, competencies required for librarians, challenges and strategies for skill development in the era of artificial intelligence (AI).

Research objectives
This paper aims enhancing librarians' skills for better library services in the era of artificial intelligence (AI).
i. To identify skills relevant to AI applications in the Library services.
ii. To find out the importance of AI in the operations and services of the Library.
iii. To find out the competencies of Librarians on AI-related services/operations.
iv. To ascertain the challenges in acquiring the skills in AI for better Library services.
v. To map out strategies to enhance the skills despite the challenges in adopting AI for better Library services.

Literature review
A study by Olaore & Owolabi (2020) underscores the need for Nigerian librarians to acquire competencies in AI-related domains such as data analysis, programming, and user experience design. The necessity for skill development becomes evident when one considers the profound changes that AI technologies introduce, including the ability to process and analyze vast amounts of data, create intelligent systems, and optimize user experiences (Khoo & Yang, 2017). AI-driven technologies can automate routine tasks, enhance user experiences, and optimize resource allocation in libraries (Yoon, 2023). It is vital to nurture a culture of continuous learning, encouraging librarians to explore emerging technologies and innovative practices (Bawden, 2001).
Star'(2011) stated that the transformation of physical banking spaces highlights the need for libraries to evolve into technology-driven, user-centric environments. Embracing AI-driven strategies and investing in skill development for librarians are essential steps toward ensuring libraries' continued relevance and effectiveness in the digital age. AI offers libraries numerous opportunities to enhance services, improve efficiency, and maintain relevance in the 21st century (David-West & Ig-worlu, 2023). According to a study by Raman Nair and Ramachandran (2021), AI technologies have had a profound impact on libraries, improving efficiency, access to information, and user experience. Libraries worldwide are increasingly adopting AI solutions to automate routine tasks, enhance information retrieval, and provide personalized services to their patrons especially in the academic libraries.
By embracing AI technologies and investing in the necessary resources and training, Nigerian university libraries can position themselves as dynamic and future-ready information centers. The integration of AI will enable librarians to efficiently manage vast amounts of information, deliver personalized services, and meet the evolving needs of their users in the digital age (Hubert-Nwangwu & Ijantiku).

Here are some of key skills librarians should focus on
1. Technical Skills
2. Soft skills
3. Adapting to AI-driven Automation
4. Library-Specific Skills
5. Professional development

(International Federation of Library Associations and Institutions, 2018, International Conference on Artificial Intelligence and Libraries, 2020, Library Information Technology Association, n.d).

Technical Skills

With the proliferation of AI in libraries comes the need to address the ethical challenges of AI, particularly related to data privacy and bias. Librarians should ensure that AI technologies they implement align with ethical standards and best practices.

1. AI and Machine Learning (ML) basics: Understanding AI and ML concepts, applications, and limitations.
2. Data analysis and visualization: Ability to collect, analyze, and visualize data to inform library services.
3. Digital literacy: Familiarity with digital tools, platforms, and software relevant to library services.

Soft Skills

Many traditional library functions, such as cataloging, circulation, and even reference services, can be enhanced or automated through AI tools. Librarians should prepare for the growing automation in these areas by acquiring the technical skills needed to manage and optimize these systems.

Learn how to work with AI-powered automation tools like RFID tracking, self-checkout systems, and automated inventory management. Stay updated on emerging AI technologies for streamlining administrative tasks.

1. Critical thinking and problem-solving: Ability to evaluate information, identify problems, and develop creative solutions.
2. Communication and collaboration: Effective communication and collaboration with diverse stakeholders, including patrons, colleagues, and community partners.
3. Emotional intelligence and empathy: Understanding and responding to the emotional and informational needs of patrons.

Adapting to AI-driven Automation

Many traditional library functions, such as cataloging, circulation, and even reference services, can be enhanced or automated through AI tools. Librarians should prepare for the growing automation in these areas by acquiring the technical skills needed to manage and optimize these systems. Key Actions:

1. Learn how to work with AI-powered automation tools like RFID tracking, self-checkout systems, and automated inventory management.
2. Stay updated on emerging AI technologies for streamlining administrative tasks.

Library-Specific Skills

In an era of rapid technological advancement, many users may feel overwhelmed by the possibilities and implications of AI. Librarians can play a vital role in teaching AI literacy, helping library patrons understand AI, how it works, and its potential impact on society.

1. Information literacy: Ability to teach patrons how to critically evaluate and use information effectively.
2. Collection development and management: Knowledge of collection development principles, including AI-driven collection analysis tools.
3. Digital scholarship and research support: Familiarity with digital scholarship tools, methods, and best practices.
4. Develop workshops, classes, or informational resources on AI literacy for patrons.
5. Collaborate with schools, universities, and community organizations to foster AI awareness and education.

Professional Development

The field of AI is constantly evolving, and librarians need to commit to lifelong learning. By engaging in continuous professional development, librarians can keep their skills current and stay on top of emerging trends in library science and technology.

1. Stay up-to-date with AI trends: Participate in conferences, workshops, and webinars to stay current with AI developments.
2. Take part in ongoing education through certifications, specialized training, and academic courses.
3. Collaborate with AI experts: Network with AI professionals to gain insights and expertise.
4. Reflect and adapt: Regularly reflect on AI's impact on library services and adapt skills and strategies accordingly for the benefit of the library users.

By enhancing these skills, librarians can effectively leverage AI to improve library services, better support patrons, and remain relevant in the AI-driven information landscape. Knowledge sharing amongst my colleagues on innovative technologies in library services will daily reduce stress mount as we move through our routine assistance, yet users find

comfort in our moment-by-moments conservation with the librarians. Maintenance and periodic replacement of existing facilities and services like network, system, AC, fans, tore books etc. it helps in promotion of patronage, also necessary to achieve improvements in the library services and retention of users.

Conclusion

Librarians embracing AI tools in their services will lure/attract more patronage and thereby creating more visibility for libraries. The users gain guidance and comfort as we engage in continuous conversation with them, its help to understands the library users struggle and willingness to instruct/direct their daily steps in research. Networking with fellow librarians in other developing countries to learn from their experience and to make our clients feel better in research.

Incorporating AI into library services presents both challenges and opportunities. By enhancing their skills in AI technologies, librarians can not only improve operational efficiency but also provide more personalized and impactful services to their patrons. The key lies in continuous learning, ethical awareness, and an eagerness to embrace technological advancements that will ensure libraries remain vital, innovative, and inclusive community hubs in the digital age. The stakeholders of libraries should provide a standing policy so that there will be sustainability of AI in libraries. There should be equally, creation of awareness on AI among the librarians and proper provision of physical facilities as this will enable the librarians to well position themselves in serving the library users.

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Equipping Libraries and Information Science Professionals for the 5th Industrial Revolution

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Abstract

Advancement in technology mark the onset of the 5th Industrial Revolution (5IR), a period characterized by the convergence of digital, physical, and biological worlds through the integration of cutting-edge technologies. The 5th Industrial Revolution (5IR) is defined by the integration of digital, physical, and biological technologies. This revolution presents unique challenges and opportunities for libraries and information science professionals who must adapt to a rapidly evolving landscape. This article explores how libraries and information science professionals can be equipped to navigate and thrive in the 5IR, focusing on the necessary skills, technologies, and strategic shifts required for their success. The paper examines the role of artificial intelligence (AI), automation, big data, blockchain, and digital transformation in reshaping library services, information management, and user interactions. The paper also highlighted the Pros of 5IR, which includes; enhanced access to information, improved users experience amongst others and its cons, Job displacements and skill gaps amongst others. By leveraging AI for personalized services, automation for efficiency, blockchain for secure information management, and big data for decision-making, libraries can continue to serve as central nodes in the knowledge economy. Finally, it proposes actionable strategies for professional development, including training programs, curriculum development, and collaborative efforts with technological innovators.

Keywords: *5th Industrial Revolution, Artificial Intelligence, Automation, Blockchain, Digital Transformation.*

Introduction:

The Industrial Revolutions have historically been defined by technological advancements that disrupt existing systems, economies, and societies. The 1st Industrial Revolution introduced mechanization through steam power, while the 2nd leveraged electricity and mass production. The 3rd Industrial Revolution brought about the digital age, driven by automation and the advent of computers, followed by the 4th, which emphasized cyber-physical systems, the Internet of Things (IoT), and artificial intelligence (AI) (Schwab, 2016).

We are now entering the 5th Industrial Revolution (5IR), which is characterized by the intersection of cutting-edge technologies with human creativity and innovation. AI, robotics, biotechnology, and blockchain will not only enhance human capabilities but also redefine the very nature of work, knowledge production, and governance (Brynjolfsson & McAfee, 2014). The 5IR has important implications for libraries and information science (LIS) professionals who have long been stewards of information. As technological and societal needs evolve, libraries must adapt to maintain their relevance.

This article will examine how libraries and LIS professionals are adapting to the challenges of the 5IR, the technological tools they must adopt, the ethical considerations they must confront, and the skills they need to equip themselves for a rapidly evolving digital landscape. By enhancing library services, fostering innovation, and advocating for digital rights and equity, LIS professionals can play a pivotal role in shaping the future of knowledge in this new age.

Defining the 5th Industrial Revolution:

The 5th Industrial Revolution is an emerging era defined by a convergence of advanced technologies that seamlessly integrate with human intelligence and creativity. Unlike previous revolutions, the 5IR emphasizes a collaborative relationship between humans and intelligent machines, where the enhancement of human capacities, as opposed to their replacement, is central to the transformation (Schwab, 2016). AI, robotics, and biotechnology will be central to the 5IR, shaping how work is performed, how data is processed and managed, and how innovation occurs.

The 5IR is also distinguished by its focus on ethical considerations, such as data privacy, AI bias, and environmental sustainability. Technology is not only transforming industries but also influencing societal values, making ethical stewardship and governance critical issues for LIS professionals (Pomerantz & Marchionini, 2022). The 5th Industrial Revolution (5IR) is defined by the integration of digital, physical, and biological technologies.

Technological Trends Shaping Libraries in the 5IR

Historically, libraries have embraced technological innovations to improve access to information, beginning with the card catalog and evolving into digital catalogs and information retrieval systems. The 5IR is set to accelerate this transformation, with the following technological trends shaping the libraries:

a) Artificial Intelligence (AI) and Machine Learning

Artificial Intelligence (AI) and Machine Learning (ML) are at the core of the 5IR transformation, offering significant potential to reshape library services. Libraries can utilize AI for personalized search, content recommendations, and tailored learning experiences, as well as automated cataloging and resource management (Miller, 2020). ML algorithms can be implemented to predict user behaviors and adapt services dynamically, creating a more responsive and interactive environment. For instance, AI-powered chatbots are already providing virtual assistance in library reference services, streamlining inquiries, and improving user satisfaction (Liu et al., 2020).

Recent studies have highlighted the critical role of AI in improving access to information and services. Libraries are increasingly adopting AI to address the challenges posed by growing information volumes and the demand for more efficient and user-centric services (Xu, 2022). Furthermore, AI integration can help libraries identify new ways to engage users and optimize collection management, reducing costs and increasing the quality of service (Abdelrahman, 2021).

b) Automation and Robotics

Automation is another essential technology transforming library services. Robotic process automation (RPA) can be used for repetitive tasks such as cataloging, shelving, and document retrieval, increasing efficiency and allowing library staff to focus on more critical functions (Cai & Zeng, 2021). Automated systems for circulation and self-checkout have become commonplace in many libraries, reducing wait times and increasing user autonomy (Zhang, 2020). Furthermore, robotic systems for book sorting and retrieval, like those implemented in some libraries in the United States, are revolutionizing operational processes and improving user experiences (Liu & Zhang, 2021).

Robotics also holds promise for library architecture, including the development of automated library spaces where robots can assist with maintaining order and retrieving requested resources (Chung & Kim, 2021). The adoption of automation will allow libraries to function with greater agility, improving service quality while reducing operational overhead.

c) Big Data and Data Analytics

In the era of big data, libraries must transform into data-driven institutions. Libraries collect vast amounts of data through user interactions, circulation statistics, and digital content usage. Leveraging big data analytics will allow libraries to optimize their services, target user needs, and provide actionable insights for decision-making (Lee & Johnson, 2020). For instance, analyzing patterns in how users interact with digital resources could lead to the development of more personalized collections and services (Jantz, 2021). Furthermore, the incorporation of data science techniques in libraries will enhance their role in supporting research and development, as professionals can offer expertise in data management and analytics (Schmidt & Klaus, 2022).

Libraries are well-positioned to serve as critical players in the data ecosystem, offering services such as data curation, digital preservation, and the development of open data repositories (Ghosh & Saha, 2022). As information professionals become more skilled in handling and analyzing data, libraries will become key enablers of data-driven decision-making in both academic and research contexts (Meyer, 2021).

4 Blockchain Technology

Blockchain is an emerging technology that holds considerable promise for improving data security and transparency in libraries. Blockchain's decentralized nature can enhance digital rights management (DRM), ensuring that the ownership and usage of digital content are clear and secure (Seale, 2021). Blockchain could also facilitate more efficient interlibrary loans, offering a transparent, verifiable mechanism for tracking transactions and usage (Pappas & Mikalef, 2021). Additionally, blockchain's immutable nature ensures that records cannot be altered, which has the potential to revolutionize archival practices in libraries, offering a new layer of trust and security for digital assets (Zohar, 2022).

Blockchain technology could also lead to the creation of decentralized knowledge-sharing networks, allowing libraries to collaborate in a secure, transparent manner. This has the potential to reduce administrative costs and increase efficiency in resource sharing (Atzori, 2017).

Pros of the 5th Industrial Revolution on Libraries and Information Professionals

1. **Enhanced Access to Information**: The integration of AI and E-learning has led to smarter, more efficient search engines, which improve access to resources and knowledge. Libraries can offer highly personalized user experiences based on AI algorithms that predict user needs and recommend relevant resources (Miller, 2020). Automation of cataloging and indexing processes ensures faster and more accurate categorization, making vast information repositories more accessible.
2. **Improved Operational Efficiency**: Automation and robotics can help streamline routine tasks such as shelving, book retrieval, and checking in/out materials. This leads to significant time savings for staff and allows them to focus on higher-value tasks such as user interaction, content curation, and research support (Cai & Zeng, 2021). Blockchain can automate and secure interlibrary loan transactions, reducing the administrative burden and increasing the efficiency of resource-sharing systems (Pappas & Mikalef, 2021).
3. **Better Data-Driven Decision Making**: Big data and advanced analytics allow libraries to track user behaviors, study trends in resource utilization, and identify knowledge gaps. This data-driven approach helps libraries to tailor services to user needs and anticipate demand for specific resources or services (Lee & Johnson, 2020). Libraries can use analytics to improve resource management, such as optimizing collection development and identifying underutilized resources (Ghosh & Saha, 2022).
4. **Expanded Roles for Information Professionals**: As libraries transition to digital ecosystems, information professionals have the opportunity to take on new roles, such as data curation specialists, metadata managers, and digital preservation experts. The need for professionals skilled in big data management, AI applications, and cybersecurity will grow, leading to new career paths and opportunities (Jantz, 2021). Information professionals will become key players in data governance, providing oversight and ensuring that digital content remains accurate, accessible, and ethically managed (Meyer, 2021).
5. **Global Collaboration and Access to Knowledge**: Blockchain and other decentralized technologies enable secure, transparent sharing of resources, creating opportunities for cross-border collaborations between libraries (Atzori, 2017). This promotes global access to research materials and enhances the collective knowledge pool. Libraries can become hubs for global open-access initiatives, supporting the widespread dissemination of research outputs and information.
6. **Improved User Experience**: With AI-powered chatbots and virtual assistants, libraries can offer real-time assistance, reducing wait times and enhancing user satisfaction. Personalization algorithms can provide tailored reading suggestions, thereby improving engagement and satisfaction (Liu et al., 2020).

Cons of the 5th Industrial Revolution on Libraries and Information Professionals

In as much as 5IR has its numerous advantages, it still has some disadvantages on libraries and information professionals which includes;

1. **Job Displacement and Skill Gaps**: The rise of automation and AI may lead to the displacement of some library jobs that were previously reliant on manual tasks, such as book sorting, cataloging, and customer service (Zhang, 2020). While these tasks will be automated, there may be resistance to change from some staff members who may not be equipped to transition into new roles. Libraries will need to invest in upskilling their workforce to address skill gaps related to AI, data science, and cybersecurity. Information professionals without these technical skills may struggle to adapt to the new landscape (Liew & Chan, 2020).
2. **Ethical and Privacy Concerns**: As libraries increasingly adopt AI and big data solutions, there are concerns over the collection and use of personal data. Libraries must balance user privacy with the need for data collection to enhance services. Without strong ethical frameworks in place, the misuse of data or unauthorized surveillance could undermine trust in libraries (Seale, 2021). Blockchain offers secure data management, but it also raises concerns about the potential for over-surveillance and the inability to erase outdated or incorrect information due to the immutable nature of blockchain (Pappas & Mikalef, 2021).
3. **Digital Divide and Access Inequality**: The rapid digital transformation may exacerbate the digital divide between communities with access to advanced technologies and those without. Libraries in underserved or rural areas may face challenges in adopting the latest technologies, which could limit their ability to provide cutting-edge services (Zohar, 2022). Similarly, not all library users may have the

digital literacy necessary to engage with AI-driven or blockchain-enabled services. This could create a barrier for certain user groups, such as older adults or those without access to high-end technology (O'Reilly, 2023).

4. **Dependency on Technology and Potential Vulnerabilities**: As libraries increasingly rely on automation, AI, and blockchain technologies, they risk becoming overly dependent on these systems. In the event of a technical failure, libraries could face significant disruptions in service (Chung & Kim, 2021). Additionally, AI algorithms may make decisions that are opaque or difficult for humans to understand, leading to potential errors.

Essential Skills for Libraries and Information Science Professionals in the 5IR

1. **Technological Proficiency:** A fundamental skill required in the 5IR is technological literacy. Information science professionals must possess an understanding of AI, data science, and blockchain. This includes knowledge of software tools, coding languages, and data management techniques, which are critical in a rapidly evolving landscape (Jantz, 2021; Liew & Chan, 2020). Training in artificial intelligence and machine learning, as well as an understanding of data privacy laws, will enable LIS professionals to make informed decisions regarding new technology adoption (Tan & O'Reilly, 2023).
2. **Data Curation and Management:** With the proliferation of data, libraries are increasingly tasked with managing, curating, and preserving vast quantities of information. Librarians and information managers must become skilled in data science and metadata standards, ensuring that datasets are structured, accessible, and preserved for future generations (Schmidt & Klaus, 2022). Data stewardship, metadata creation, and ensuring the integrity and accessibility of digital collections will be central to the evolving role of libraries in supporting research and academic endeavors (Jantz, 2021).
3. **User-Centered Design:** While technology will play a major role in the future of libraries, the human element remains central. Information professionals must continue to prioritize user needs, designing systems and interfaces that are intuitive, accessible, and user-friendly. Libraries must innovate in providing personalized user experiences, guided by human-centered design principles (O'Reilly, 2023; Dunlop & Minocha, 2020). By embracing these principles, LIS professionals can ensure that technological advancements serve to improve user engagement rather than creating barriers to access.

Ways forward for LIS Professional Development in the 5IR

To prepare for the future, libraries must invest in the professional development of their staff. Several key strategies can help libraries adapt to the demands of the 5IR;

1. **Curriculum Reform in LIS Programs:** As the skills required in libraries evolve, so too must the curricula in library and information science programs. Universities should integrate subjects like AI, big data, cybersecurity, and blockchain into LIS education. These programs should also include opportunities for hands-on experience with emerging technologies, either through internships, partnerships with technology firms, or project-based learning (Jantz, 2021; Liew, 2022).
2. **Lifelong Learning and Continuing Education:** Given the rapid pace of technological change, libraries should promote a culture of lifelong learning among their staff. Continuous professional development programs should be established to ensure that information professionals remain at the forefront of technological advancements. Regular workshops, webinars, and access to online courses can support ongoing education (Tan & O'Reilly, 2023). Libraries could collaborate with universities and tech companies to provide specialized training in areas such as AI and blockchain (Stern & Blomqvist, 2022).
3. **Cross-Disciplinary Collaboration:** Libraries should collaborate with technology experts, including software developers, data scientists, and AI specialists. Cross-disciplinary collaboration fosters innovation and allows libraries to stay ahead of technological trends. These partnerships can help ensure that library staff are equipped to effectively integrate new technologies into their work environments (Stern & Blomqvist, 2022; Atzori, 2017).

CONCLUSION

The 5th Industrial Revolution presents a profound shift in how libraries operate and how information professionals serve their communities. Embracing technologies such as AI, automation, and blockchain will be crucial for libraries to remain relevant and effective in this new era. Information science professionals must equip themselves with the necessary technological skills and knowledge, fostering an environment that

balances innovation with user-centered values. By investing in education and strategic partnerships, libraries can prepare for a future where technology and human expertise are seamlessly integrated.

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Equipping Libraries and Librarians for Innovative Service Delivery in Academic Libraries in Kogi State in the 5th Industrial Revolution

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Abstract
5th Industrial Revolution (5IR) has emerged as a result of advances in technology leading a new paradigm in service delivery, this shift presents libraries and her professionals an opportunity to redefine their roles in academic environment by enhancing access, personalization, and efficiency in knowledge dissemination. This study examines how libraries and library and information science (LIS) professionals can be equipped for innovative service delivery in the era of the 5IR. Innovation in library services transcends traditional practices, adapting to changing user preferences, progress in technology advancements, and teaching methods. In the academic sphere, innovative library services play a pivotal role in enhancing access to information, promoting digital literacy, and supporting scholarly inquiry. Innovation within the libraries can position them as a vocal point for academic success and intellectual growth in the academic institutions. Special focus is given to ***examining the state of infrastructure and technology adoption*** *in relation to the demands of the 5IR among academic libraries in Kogi State, identifying training programs that equip* ***Libraries and LIS professionals*** *to leverage 5IR technologies such as artificial intelligence, robotics, and blockchain for innovative service delivery and* ***identifying existing challenges faced by academic libraries and LIS professionals*** *in adopting and integrating emerging technologies for innovative service delivery. The study adopts a quantitative approach, employing surveys with librarians in selected academic institutions across Kogi State. Descriptive statistics was used to analyze the data collected through questionnaire. The finding reveal the existing gaps in infrastructure, best practices in leveraging these technologies and identifies the challenges faced by librarians in embracing these emerging trends for innovative service delivery. It also outlines the importance of policy advocacy to ensure sustainable funding and support for librarians training in academic institutions.*
Keywords: *5th Industrial Revolution, Academic Libraries, Innovative Service Delivery, Librarians.*

Introduction

The concept of the 5th Industrial Revolution (5IR) emphasizes collaboration between humans and advanced technologies like artificial intelligence (AI), robotics, and the Internet of Things (IoT). 5IR seeks to humanize technology, blending high-tech solutions with human-centric values such as sustainability, empathy, and personalization. In academic libraries, the 5IR heralds an era where librarians are not just custodians of information but active facilitators of knowledge creation, innovation, and lifelong learning. This industrial revolution is also known as industry 5.0. In the words of Ekwueme, Oluwaseun, Ajie, Ofodu, & Ambrose, (2024), 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. This industrial revolution has applications across various industries, including libraries (Rame, Purwanto & Sudarno, (2024). Equipping libraries and librarians in Kogi State for this revolution involves rethinking service delivery, integrating cutting-edge technologies, and fostering skills development to meet the evolving needs of students, faculty, and researchers.

In the era of the 5IR, libraries must transition into innovation hubs, offering services that go beyond traditional cataloging and lending to include digital literacy training to help users navigate complex digital environments. It offers opportunities for AI-powered personalized services for research assistance and learning recommendations, support for interdisciplinary collaboration through innovative spaces and resources like makerspaces, virtual reality labs and sustainability practices aligned with global goals, such as energy-efficient facilities and the promotion of open-access resources. 5IR proclaims 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 including the kind of services libraries should offer (Callaghan, 2023).

One of the defining features of the 5IR era is its steadfast commitment to sustainability, environmental responsibility, and ethical considerations (Nwobu, Dumbiri, Ibia, & Oladokun, (2024). 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 become invaluable in this context. Awoyemi (2023) emphasizes that the shift from traditional to digital libraries marks a significant paradigm change in how information is accessed, organized, and disseminated. Tella et al. (2023) recommended that librarians must continuously update their skills and knowledge to maintain relevance in the digital age. This involves staying informed about emerging technologies such as artificial intelligence, machine learning, and augmented reality, and understanding how these technologies can be leveraged to enhance library services. Ajani et al. (2022) argued 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. It is imperative that university libraries in Kogi State will not be left out in this shift so that they can provide services that satisfy users' needs.

It is important to note that the provision of library services are aimed at satisfying the informational, recreational and reference needs of the library users. In order to meet these objectives and to ensure the overall satisfaction of the users' information needs, the application of ICTs and ther electronic information resources is necessary (Cox & Corrall, 2013). According to Onuoha, Chikezie and Chukwueke (2019) opined that any library service that is provided effectively, it will ncreasingly meets the needs of its patrons. Kogi State, situated in North Central Nigeria, hosts several academic institutions, including Federal, State, and Private universities, polytechnics, and colleges of education. The strategic location of the state and diverse academic community offer opportunities for transforming libraries into modern knowledge centers. Equipping libraries and librarians in this region for the 5IR is both a challenge and an opportunity to redefine the role of academic libraries; embracing innovation, fostering partnerships, and addressing systemic challenges that position libraries as central players in advancing education, research, and sustainable development. The success of this transformation depends on the collective efforts of stakeholders, including librarians, academic institutions, government, and the private sector, to align with the values and technologies of the 5IR.

Statement of the Problem

Equipping libraries and librarians prepare them to satisfy users in 5IR, who seek digital resources, personalized research assistance, and collaborative spaces furnished with cutting-edge technological tools. Academic libraries support education, research, community development and innovation through efficient service delivery. According to Oseji (2020) it is has imperative for librarians to have technical skills and subject-based- knowledge so as to add value to library services rendered to user.

As the global community continues to witness technological advancement, users' expectations for library services have been redefined. Regrettably, many university libraries in developing nation are not measuring up to the expectations in terms of meeting the demands of the modern academic environment through innovative services. Also, lack of investment in continuous professional development for librarians intensifies the skills gap, making it difficult for library staff to effectively integrate and manage 5IR technologies. This stagnation threatens the relevance and functionality of academic libraries, possibly marginalizing them in an era where information accessibility and technological competence are paramount.

This situation demands urgent attention in order to reposition academic libraries as dynamic, technology-driven knowledge hubs that can thrive in the 5IR by being intentional in equipping libraries and librarians with the tools, skills, and infrastructure necessary for innovative service delivery. Thus, the need to study equipping libraries and librarians for innovative service delivery in academic libraries in Kogi State in the 5th Industrial Revolution

Objectives of the Study

1. To **examining the state of infrastructure and technology adoption** in relation to the demands of the 5IR among academic libraries in Kogi State.
2. To identifying training programmes that equip **libraries and LIS professionals** to leverage 5IR technologies such as artificial intelligence, robotics, and blockchain for innovative service delivery.
3. To **identifying challenges faced by academic libraries and LIS professionals** in adopting and integrating emerging technologies for innovative service delivery.

Literature Review

The transformations brought by 5IR require substantial investments in technology, infrastructure, and skills development, which are often lacking in many academic libraries. Libraries must invest in state-of-the-art facilities, high-speed internet, and energy-efficient systems to support innovative services. Raju (2020) says that policy reforms are needed to prioritize library development and encourage innovation in academic institutions. Training should be a continuous and regular practice among librarians especially in this age fast growing technologies. Ross and Maynard (2021) highlight the need for librarians to explore and experiment with new technologies such as artificial intelligence, machine learning, augmented reality, and blockchain to implement personalized recommendation systems, developing virtual reality-enhanced learning experiences, or use data analytics to optimize library operations and enhance the delivery of library services. King (2020) underscores that continuous learning is fundamental for librarians to remain updated on emerging trends, technologies, and best practices in the 5IR. He opined that librarians should actively participate in professional development activities, such as attending workshops, webinars, and conferences, pursuing advanced degrees or certifications, and engaging in online courses or self-directed learning opportunities

One of the primary challenges in preparing libraries for the 5IR is lack of adequate funding. Ocholla & Ocholla, (2019) opined that most academic libraries in developing countries operate on limited budgets, which constrain their ability to acquire modern technologies and update their facilities. The financial limitations are compounded by unreliable power supply, inadequate internet connectivity, and outdated infrastructure. This revolution demands that librarians develop new skill sets. The rapid evolution of technology requires librarians to develop new competencies in areas such as data analytics, AI, and IoT. According to Ifijeh & Yusuf, (2020) many librarians lack access to training opportunities and professional development programs and this deficiency hampers their ability to integrate and manage innovative tools effectively. Some librarians and library users are reluctant to embrace new technologies due to a lack of awareness, fear of obsolescence, or cultural attitudes towards traditional methods of knowledge dissemination (Kumah, 2021).

The challenges affecting libraries and librarians' innovative services require a multi-faceted approach. Capacity building is a crucial strategy, involving continuous training and professional development programs tailored to equip librarians with the skills needed for 5IR technologies (Ifijeh & Yusuf, 2020). Partnerships with technology firms, government agencies, and international organizations can also provide libraries with access to resources, funding, and expertise. The integration of sustainable practices into library operations aligns with the human-centric values of the 5IR. Green technologies, such as digital collections and energy-efficient facilities, can enhance service delivery while minimizing environmental impact (Smith, 2019). The success of academic libraries in the 5IR depends on their ability to meet the evolving needs of users. Research indicates that students and faculty increasingly demand personalized, accessible, and technology-driven library services (Kumah, 2021). AI-driven tools, such as chatbots and adaptive learning systems, can enhance user experiences by providing tailored recommendations and real-time support. Collaborative spaces like makerspaces and innovation hubs enable interdisciplinary research and experiential learning, fostering creativity and problem-solving (Ocholla & Ocholla, 2019).

Empirical Review of Related Literature

Ekwueme, Oluwaseun, Ajie, Ofodu, & Ambrose, (2024), investigated the impact of Fifth Industrial Revolution (5th IR) technologies on enhancing diversity and inclusive services in Open and Distance Learning libraries. The study adopted a descriptive design, the research focused on librarians at the National Open University of Nigeria and collected data through a Google Form questionnaire. SPSS was used to analysis the data collected and linear regression to test hypotheses. Findings revealed that librarians believe 5th IR technology improves data extraction, processing, and service efficiency. The study identifies key implementation strategies, including awareness-raising, curriculum updates, training, collaboration, and skill enhancement. It emphasizes the importance of funding, reliable power supply, and collaboration for effective 5th IR adoption. The study highlights the potential for human-machine partnerships to automate tasks and foster connectivity, suggesting an optimistic outlook for the 5th IR's role in promoting inclusive, customized library services in academic and distance learning environments. In relation to the present study, the previous used questionnaire to collect data and the findings revealed gap in curriculum updates, training, collaboration, and skill enhancement which this study intends to fill.

Ajani, & Oladokun, (2024). carried a study titled Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution which explored the evolving role of libraries in the 5th Industrial Revolution, emphasizing the integration of smart technologies. The study employed an interpretive content/document analysis methodology to systematically review and analyze literature sourced from reputable databases such as Scopus and Web of Science. This methodological approach was chosen to ensure a well-rounded

examination of the subject, incorporating diverse perspectives and insights from existing research. The analysis process involved a thorough interpretation of textual materials to develop a nuanced understanding of the topic. The study showed that key technologies such as AI, machine learning, data analytics, IoT, blockchain, AR/VR, and 5G significantly influence library operations and user engagement. However, it also identified challenges, including digital equity, ethical AI use, data security, interoperability, and financial constraints. The study concluded that libraries must evolve into dynamic, intelligent hubs that contribute to sustainable knowledge systems while upholding foundational principles of inclusivity, transparency, and intellectual freedom. It recommended that libraries adopt ethical and privacy-conscious strategies, secure adequate funding, and develop policies that support the seamless integration of emerging technologies to enhance user expences and operational efficiency.

Methodology

The study adopted survey research design. Stevens (2023) describe the descriptive survey as a research technique which is used in gathering information from a large sample of people using questionnaire with the aim of describing the current situation with a subject. The design involves the collection of data in other to answer questions concerning a condition or practices that prevail in an environment such as beliefs, point of views or attitudes that are accepted by people, effects that are being felt or trends that are developing in societies. Structured questionnaire was used as instrument for data collection and descriptive statistics (using SPSS) to analyze the data presented in percentage and frequency table.

The population of the study comprised of librarians from the five universities in Kogi State which include federal university Lokoja, Prince Abubakar University Anyiugba, Conference University of Sciences and Technology Osara, Salem University and Kogi State University, Kabba. The population comprises 14 librarians from Osara, 1 from Kabba, 33 from federal university, 68 Prince Abukakar University and 6 from Salem, bringing the total to 122 librarians. Since the population is of a manageable size, there was no sample and no sampling techniques adopted. Out of 122 questionnaires distributed, 103 were properly filled, returned and used for the study.

Results

Table 1: Age Range of Respondents

Age Range	Frequency	Percent
18-25 Years	19	18.4
26-30 Years	20	19.4
36-45 Years	24	23.3
46 -55 Years	24	23.3
Over 55 Years	16	15.5
Total	**103**	**100.0**

Table 2: Gender

Gender	Frequency	Valid Percent
Male	54	52.4
Female	49	47.6
Total	**103**	**100.0**

Table 3: Highest Educational Qualification

Educational Qualification	Frequency	Percent
Diploma in LIS	27	26.2
Bachelor's Degree	29	28.2
Master's Degree	27	26.2
PhD	20	19.4
Total	**103**	**100.0**

Table 4: Working Experience

Years	Frequency	Percent
Less than a Year	18	17.5
1-5 Years	20	19.4
6-10 Years	23	22.3
11-15 Years	26	25.2
16 Years and above	16	15.5
Total	**103**	**100.0**

Table 5: Job Designation

Job Designation	Frequency	Percent
Professional Librarian	73	70.9
Para-Professional Librarian	17	16.5
Library Assistant	7	6.8
Library Administrator	6	5.8
Total	103	100.0

Demographics Data Discussion of Result (Tables 1-5)

The age distribution data in Table 1 reveals a balanced representation across different age groups among the librarians surveyed. The largest segments are those between 36-45 years and 46-55 years, each accounting for 23.3% of respondents. Younger professionals in the 18-25 and 26-30 age brackets constitute 18.4% and 19.4% respectively, while those over 55 years make up 15.5%. This diverse age profile suggests a healthy mix of experienced librarians and younger professionals who might bring different perspectives to technology adoption.

Gender distribution shown in Table 2 indicates relative balance with 52.4% male and 47.6% female respondents, suggesting gender inclusivity within the library profession in Kogi State. This balance could contribute to diverse viewpoints when implementing innovative services.

The educational qualifications presented in Table 3 demonstrate a well-educated workforce. The largest group holds Bachelor's degrees (28.2%), followed by equal proportions of Diploma in LIS and Master's degree holders (26.2% each), with PhD holders comprising 19.4%. With nearly half of the respondents possessing advanced degrees (Master's or PhD), the academic foundation for understanding and implementing complex 5IR technologies appears promising.

Work experience data in Table 4 showcases a distribution across various tenure lengths. The most represented group has 11-15 years of experience (25.2%), followed by those with 6-10 years (22.3%), 1-5 years (19.4%), less than a year (17.5%), and 16+ years (15.5%). This combination of experienced professionals and newer entrants could prove advantageous for balancing institutional knowledge with fresh technological perspectives.

Table 5 indicates that the vast majority of respondents (70.9%) are professional librarians, with smaller percentages of para-professionals (16.5%), library assistants (6.8%), and administrators (5.8%). The predominance of professional librarians suggests there are individuals with the authority and knowledge necessary to drive innovation initiatives.

Table 6: Rating the Current State of Infrastructure in Libraries

	Frequency	Percent
Excellent	20	19.4
Good	22	21.4
Average	33	32.0
Poor	28	27.2
Total	**103**	**100.0**

The current state of infrastructure, as reflected in Table 6, reveals concerning patterns. Only 19.4% of respondents rate their library infrastructure as "Excellent," while 21.4% consider it "Good." A significant portion rates it as "Average" (32.0%) or "Poor" (27.2%). With nearly 60% of respondents rating infrastructure as average or poor, this represents a substantial barrier to implementing 5IR technologies effectively.

Table 7: Multiple Responses on Digital Technologies Available in Libraries

		Responses	
		N	Percent
Digital Technology Available in Libraries	Computers	68	16.0%
	Internet and Wifi	69	16.3%
	Digital Repositories	64	15.1%
	AI Tools	61	14.4%
	Smart Library System	50	11.8%
	Robotics	51	12.0%
	Blockchain Applications	61	14.4%
Total		**424**	**100.0%**

The multiple response data on digital technologies available in libraries (Table 7) show varying levels of availability and of adoption across different technologies. Internet and WiFi access leads slightly at 16.3%, closely followed by computers at 16.0% and digital repositories at 15.1%. More advanced technologies relevant to the 5IR such as AI tools and blockchain applications each stand at 14.4%, while robotics (12.0%) and smart library systems (11.8%) lag somewhat behind. While the presence of these emerging technologies is encouraging, their relatively lower representation indicates room for growth in adoption.

Table 8: Extent of Adopting Emerging Technologies

Extent	Frequency	Percent
Fully Adopted	25	24.3
Partially Adopted	34	33.0
Not yet Adopted	18	17.5
Not Sure	26	25.2
Total	103	100.0

In regard to the extent of technology adoption (Table 8), only 24.3% of respondents report full adoption of emerging technologies, with 33.0% reporting partial adoption. A concerning 17.5% have not yet adopted these technologies, and 25.2% are unsure about their institution's adoption status. This data suggests that comprehensive implementation of 5IR technologies remains a work in progress for most libraries surveyed.

Table 9: Multiple Responses on Factors Affecting Technology Adoption in Libraries

		Responses	
		N	Percent
Factors Affecting Technology Adoption	Inadequate Funding	68	26.1%
	Lack of Technical Expertise	64	24.5%
	Resistance to Change	59	22.6%
	Poor ICT Infrastructure	70	26.8%
Total		**261**	**100.0%**

The factors affecting technology adoption in libraries (Table 9) highlight several key barriers. Poor ICT infrastructure emerges as the most significant challenge (26.8%), closely followed by inadequate funding (26.1%). Lack of technical expertise (24.5%) and resistance to change (22.6%) also feature prominently. These factors represent systemic issues that must be addressed for successful technology integration.

Table 10: Response on Participation in Training Related to Emerging Technologies

Response	Frequency	Percent
No	33	51.5
Yes	70	48.5
Total	**103**	**100.0**

Participation in training related to emerging technologies (Table 10) shows a concerning divide. Only 48.5% of respondents have participated in such training, while a slight majority (51.5%) has not. This significant gap in professional development likely impedes the ability of libraries to effectively implement and utilize 5IR technologies for innovative service delivery.

Table 11: Multiple Responses on Types of Training Received

Table 11: Multiple Responses on Types of Training Received

		Responses	
		N	Percent
Types of Training Received	Workshop Seminars	75	30.7%
	Online Courses	58	23.8%
	In House Training	62	25.4%
	Certification Programs	49	20.1%
Total		**244**	**100.0%**

Among those who have received training (Table 11), workshop seminars represent the most common format (30.7%), followed by in-house training (25.4%), online courses (23.8%), and certification programs (20.1%). This distribution suggests a greater reliance on shorter, less formalized training approaches rather than comprehensive certification programs that might provide deeper knowledge.

Table 12: Response on the Need for More Training Programmes

Response	Frequency	Percent
No	26	25.2
Yes	77	74.8
Total	**103**	**100.0**

The recognition of the need for additional training (Table 12) is overwhelming, with 74.8% of respondents acknowledging this necessity compared to just 25.2% who do not see this need. This strong majority highlights the widespread recognition among library professionals that current training opportunities are insufficient for meeting the demands of the 5IR.

Table 13: Multiple Response on Perception on Areas of Training that are important

		Responses	
		N	Percent
Areas of Training that are Important	AI in Library Services	76	21.9%
	Blockchain for Secure Information Management	68	19.6%
	Robotics in Library Operations	70	20.2%
	Data Analytics and Smart System	65	18.7%
	Cybersecurity in Library Management	68	19.6%
Total		**347**	**100.0%**

The areas identified as important for training (Table 13) reveal diverse technological interests. AI in library services leads at 21.9%, followed by robotics in library operations (20.2%), with blockchain for secure information management and cybersecurity in library management tied at 19.6%, and data analytics and smart systems at 18.7%. This relatively balanced distribution suggests recognition that librarians need broad technological competence across multiple domains rather than specialization in just one area.

Table 14: Multiple Responses on Challenges Faced in Adopting 5IR in Libraries

		Responses	
		N	Percent
Challenges Faced in Adopting 5IR	High Cost of Implementation	65	25.1%
	Limited Technical Knowledge among Staff	62	23.9%
	Poor ICT Infrastructure	69	26.6%
	Lack of Government Institutional Support	63	24.3%
Total		**259**	**100.0%**

The challenges specifically related to adopting 5IR technologies (Table 14) mirror these findings, with poor ICT infrastructure again leading the concerns (26.6%). High implementation costs (25.1%), lack of governmental or institutional support (24.3%), and limited technical knowledge among staff (23.9%) follow closely. The consistency between these two tables reinforces the reliability of these findings and underscores the persistent nature of these barriers.

Table 15: Rating of Level of Awareness about 5IR Technologies in Institutions

Responses	Frequency	Percent
High	25	24.3
Moderate	30	29.1
Low	26	25.2
Very Low	22	21.4
Total	**103**	**100.0**

Awareness levels of 5IR technologies (Table 15) vary considerably among respondents. Those reporting high awareness constitute 24.3%, while moderate awareness accounts for 29.1%. A good number report low awareness (25.2%) and very low awareness (21.4%). With nearly half of respondents (46.6%) acknowledging low or very low awareness, there exists a significant knowledge gap that requires addressing through educational initiatives

Table 16: Multiple Responses on Strategies for improving adoption of 5IR

		Responses	
		N	Percent
Strategies for Improving adoption of 5IR	Increased Funding for Tech Adoption	76	17.8%
	Regular training	73	17.1%
	Improved ICT infrastructure	72	16.8%
	Stronger Institutional Support	69	16.1%
	Collaboration with Technology Providers	68	15.9%
	Awareness Campaigns on 5IR tech	70	16.4%
Total		**428**	**100.0%**

The strategies identified for improving 5IR adoption (Table 15) reveal a multi-faceted approach. Increased funding for technology adoption leads slightly at 17.8%, followed closely by regular training (17.1%), improved ICT infrastructure (16.8%), awareness campaigns on 5IR technologies (16.4%), stronger institutional support (16.1%), and collaboration with technology providers (15.9%). The relatively even distribution across these strategies indicates recognition that no single approach will suffice, comprehensive solutions are needed.

Discussion of Findings

The findings of the study reveal several important insights that require thoughtful consideration. The demographic data presents a library workforce with a balanced age distribution, suggesting potential for intergenerational knowledge transfer, which could be particularly valuable during technological transitions. The relatively high educational attainment of library staff, with nearly half possessing advanced degrees, indicates a solid foundation of academic knowledge that could be leveraged for understanding and implementing complex 5IR technologies. However, the state of infrastructure in these libraries poses significant concerns. The finding that approximately 60% of respondents rated their library infrastructure as only average or poor indicates a substantial gap between state of facilities and those required for effective implementation of 5IR technologies. This infrastructure deficit aligns with findings from similar studies in

developing regions, by Ocholla and Ocholla (2019), who identified infrastructure challenges as a primary barrier to technological advancement in African academic libraries.

The data on available digital technologies reveals some progress, with basic technologies like computers and internet access being widely available. The emerging presence of 5IR-specific technologies such as AI tools, blockchain applications, and robotics, albeit at lower levels, indicates that these libraries are beginning to engage with advanced technologies. However, the finding that only about one-quarter of respondents report full adoption of emerging technologies suggests that comprehensive implementation remains an aspiration rather than a reality for most libraries surveyed. The factors affecting technology adoption identified in this study mirror those found in related research. Ifijeh and Yusuf (2020) similarly identified inadequate funding, poor infrastructure, and limited technical expertise as significant barriers to technology integration in academic libraries in developing countries. The consistency of these findings across studies underscores the systemic nature of these challenges and the need for coordinated approaches to address them.

The training and professional development findings are particularly revealing. There exit an even split between those who have and have not participated in training related to emerging technologies, coupled with the overwhelming majority who recognize the need for additional training, points to a critical gap in professional development. This aligns with King's (2020) assertion that continuous learning is fundamental for librarians to remain updated on emerging trends and technologies in the 5IR era. The preference for workshop seminars and in-house training over more comprehensive certification programs suggests that while there is interest in professional development, there may be limitations in terms of time, resources, or access to more structured training opportunities.

The varying levels of awareness about 5IR technologies among respondents, with nearly half reporting low or very low awareness, further emphasizes the need for librarians' professional development programs. This finding echoes Ekwueme et al. (2024), who emphasized awareness-raising as a key implementation strategy for 5IR technologies in academic libraries.

The relatively even distribution of responses regarding strategies for improving 5IR adoption suggests recognition of the need for multi-faceted approaches. This understanding aligns with comprehensive frameworks for technology adoption in libraries, as proposed by Ajani and Oladokun (2024), who advocated for holistic strategies that address funding, training, infrastructure, and institutional support simultaneously.

The identified training needs spanning AI, robotics, blockchain, cybersecurity, and data analytics reflect the complex technological landscape of the 5IR. This finding confirms Tella et al.'s (2023) observation that librarians must continuously update their skills across multiple domains to maintain relevance in the digital age.

Conclusion

This study has illuminated the current state of readiness for innovative service delivery in academic libraries in Kogi State within the context of the 5th Industrial Revolution. The findings reveal a library ecosystem that is poised at a critical juncture—equipped with human resources possessing educational qualifications and diverse experience, yet constrained by significant challenges in infrastructure, funding, technical expertise, and awareness.

The research demonstrates that while there is recognition of the transformative potential of 5IR technologies such as artificial intelligence, blockchain, and robotics, the actual implementation of these technologies remains limited. This gap between aspiration and reality can be attributed to systemic challenges including poor ICT infrastructure, inadequate funding, lack of technical expertise, and limited awareness of emerging technologies. These challenges are interrelated and require comprehensive solutions that address multiple facets simultaneously.

The study also highlights the critical role of training and professional development in equipping librarians for innovative service delivery. Despite strong recognition of the need for additional training, participation in training programs remains suboptimal, and there appears to be a preference for shorter, less formalized training approaches over comprehensive certification programs.

The findings suggest that the successful integration of 5IR technologies in academic libraries in Kogi State will require concerted efforts from multiple stakeholders, including library professionals, institutional leadership, government agencies, and technology providers. Without strategic interventions to address the identified gaps in infrastructure, funding, awareness, and skills development, these libraries risk falling further behind in an increasingly digital and technological academic landscape.

Nevertheless, the presence of a well-educated workforce with diverse experience levels, coupled with emerging adoption of some 5IR technologies, provides a foundation upon which transformative change can be built. The findings from this study can serve as a roadmap for academic libraries in Kogi State and those in similar contexts as they navigate the transition to the 5th Industrial Revolution.

Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance the readiness of academic libraries in Kogi State for innovative service delivery in the 5th Industrial Revolution:

1) **Infrastructure Development and Technology Acquisition**: Academic institutions and library administrators should prioritize investment in modern infrastructure that can support 5IR technologies. This includes high-speed internet connectivity, reliable power supply systems, and updated computer hardware. A phased approach to technology acquisition should be adopted, beginning with foundational technologies and gradually incorporating more advanced systems like AI tools, blockchain applications, and robotics as capacity and expertise develop.

2) **Sustainable Funding Mechanisms**: Libraries should explore diverse funding sources beyond institutional allocations, including grants, public-private partnerships, and collaborative funding models with other academic institutions. Library administrators should develop compelling business cases for technology investments that demonstrate return on investment in terms of enhanced user experiences, improved operational efficiency, and support for institutional research and teaching missions.

3) **Comprehensive Training and Professional Development**: Academic institutions should establish structured, continuous professional development programs specifically focused on emerging technologies relevant to the 5IR. These programs should include both theoretical knowledge and practical skills application, with opportunities for hands-on experience with new technologies. Formal partnerships with technology providers and other educational institutions can facilitate access to specialized training and certification programs.

4) **Awareness and Knowledge Building**: A systematic approach to raising awareness about 5IR technologies and their potential applications in academic libraries should be implemented. This could include regular seminars, webinars, newsletters, and knowledge-sharing sessions within and across institutions. Library associations in Nigeria should develop resources specifically addressing 5IR technologies and their implications for academic libraries.

5) **Policy Development and Institutional Support**: Academic institutions should develop clear policies that support and guide the integration of emerging technologies in library services. These policies should address issues such as data privacy, ethical use of AI, digital rights management, and sustainable technology practices. Institutional leadership should demonstrate commitment to library innovation through strategic planning, resource allocation, and public support for transformation initiatives.

6) **Collaborative Networks and Knowledge Sharing**: Libraries in Kogi State should establish formal collaborative networks for knowledge sharing, resource pooling, and collective problem-solving related to 5IR technologies. These networks could facilitate shared access to expensive technologies, collaborative training programs, and exchange of expertise and best practices. Regional and national library associations should facilitate these collaborative efforts.

7) **Research and Innovation Culture**: Academic libraries should cultivate a culture of research and innovation by encouraging librarians to engage in action research, experimentation with new technologies, and documentation of lessons learned. Institutions should provide support for librarians to publish their findings and participate in relevant conferences and professional forums.

8) **Phased Implementation Approach**: Libraries should adopt a strategic, phased approach to implementing 5IR technologies, beginning with those that address immediate needs and build on existing capabilities. Pilot projects should be used to test new technologies, gather user feedback, and refine implementation strategies before full-scale deployment.

9) **User-Centered Design**: Libraries should ensure that technology adoption is driven by user needs rather than technology trends. Regular user surveys, focus groups, and usability testing should inform decisions about which technologies to prioritize and how to implement them in ways that enhance user experiences and support academic outcomes.

10) **Advocacy and Stakeholder Engagement**: Library leaders should engage in active advocacy with institutional leadership, government agencies, and potential funding partners to increase understanding of the importance of modern library services in the 5IR era. Regular communication of successes, challenges, and impacts can help build sustained support for library transformation initiatives.

Implementation of these recommendations will require sustained commitment, strategic planning, and collaborative effort from multiple stakeholders. However, the potential benefits enhanced access to information resources, improved support for teaching and research, and the development of digital literacy skills among library users, justify the investment required. By taking proactive steps to address the challenges identified in this study, academic libraries in Kogi State can position themselves as vital contributors to academic excellence and innovation in the 5th Industrial Revolution era.

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Exploring the Prospects and Challenges of the 5th Industrial Revolution in Nigerian Libraries: A Systematic Review

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Abstract

This study explores the prospects and challenges associated with the adoption of Fifth Industrial Revolution (5IR) technologies in Nigerian libraries. The objectives were to identify the key technologies driving the 5IR, examine their potential benefits for library services, and explore the barriers hindering their integration. The study employed a systematic review methodology, analyzing peer-reviewed literature published between 2020 and 2025 that focused on libraries and 5IR-related technologies such as artificial intelligence (AI), robotics, big data, blockchain, and the metaverse. The findings reveal that these technologies offer transformative opportunities for personalization, operational efficiency, inclusive access, and enhanced service delivery. Libraries could evolve into smart, user-centric spaces where human and machine collaboration foster innovation and lifelong learning. However, the review also highlights significant challenges, including infrastructural inadequacies, insufficient funding, digital skill deficits, outdated curricula, and institutional resistance to change. Moreover, ethical concerns regarding data privacy and the equitable deployment of AI systems are increasingly relevant in the Nigerian context. The study concludes that while Nigerian libraries are at the threshold of a digital transformation, realizing the full potential of 5IR requires strategic investment, professional development, and collaborative policymaking.

***Keywords**: Fifth Industrial Revolution, Nigerian libraries, artificial intelligence, robotics, digital transformation*

Introduction

The emergence of the Fifth Industrial Revolution (5IR) comes with a significant turning point in global technological and socio-economic development, which is characterized by the convergence of advanced technologies with human-centric values. Unlike the Fourth Industrial Revolution (4IR), which emphasized automation, artificial intelligence (AI), and data-centric innovations, the 5IR reintroduces the importance of human agency by fostering synergy between humans and intelligent machines (Ashiq, 2024; Oladokun et al., 2024). This paradigm shift presents prospects and challenges for sectors worldwide, including library and information services. In Nigerian libraries, particularly, the implications of 5IR are profound, affecting service delivery models, human resource development, technological infrastructure, and the evolving role of librarians (Ayinde, Ajayi, & Adedeji, 2025; Ekwueme et al., 2024).

The central concepts explored in this study are the "prospects", which are defined as potential benefits, and opportunities, and "challenges", which in this context, refer to constraints, barriers, and limitations posed by the 5IR in the context of Nigerian libraries. These libraries, which serve as critical hubs for knowledge access, research facilitation, and information literacy, are at a crossroads where traditional practices must adapt to cutting-edge innovations such as robotics, AI, blockchain, the metaverse, and human-machine collaboration (Oyedokun, 2024; Wu, 2024). The systemic integration of these technologies, while promising enhanced personalization, efficiency, and inclusivity, also raises concerns about digital divides, ethical considerations, infrastructural limitations, and workforce preparedness (Moonasar & Ngoepe, 2023; Hodonu-Wusu, 2024).

A key facet of the 5IR's influence on libraries is the increasing adoption of robotics and AI to automate routine tasks and augment user services. As documented by Basumatary et al. (2025) and Adetayo, Abwage, and Oduola (2023), robotic technologies are being explored for cataloging, reference services, inventory management, and user engagement. These tools hold the potential to revolutionize how Nigerian libraries operate, offering round-the-clock services, multilingual interfaces, and personalized assistance. However, the readiness of library staff and the institutional infrastructure to support these technologies remains questionable. Studies such as Tella (2020) and Owolabi et al. (2022) emphasize that while there is growing awareness, there is still a significant gap in technical capacity, funding, and policy frameworks to ensure effective implementation. Ajani et al. (2024) highlight how big data enables libraries to understand user behavior, improve resource allocation, and design responsive services. Yet, the application of such data-driven strategies requires digital competencies and data governance policies that are often lacking in many Nigerian institutions. This calls for urgent policy attention and strategic investment in digital infrastructures and training programs (Ekwueme et al., 2024).

The role of librarians is also undergoing a dramatic shift. In the 5IR era, librarians are not only custodians of

information but also digital curators, data analysts, and tech-savvy educators (Ayinde et al., 2025). This evolving role demands a new skill set that combines technical know-how with soft skills like adaptability, ethical reasoning, and user-centered service design. Studies such as Lira and Jacintho (2023) and Tait and Pierson (2022) stress the importance of revising library and information science (LIS) curricula to prepare future professionals for this complex landscape. The Nigerian context, however, reflects uneven progress in this regard, with disparities in training opportunities, access to professional development, and institutional support (Oladokun et al., 2023).

Moreover, the concept of Library 5.0, discussed by Noh (2023), introduces a futuristic model where libraries serve as immersive, interactive, and intelligent spaces integrating technologies such as virtual and augmented reality, blockchain for information security, and the metaverse for virtual collaboration. In theory, this vision aligns with global trends and aspirations. Yet, in practice, Nigerian libraries face systemic challenges, including underfunding, inadequate ICT infrastructure, and limited policy support to actualize such transformative ideas (Hussain, 2020; Ahmat & Hanipah, 2018).

While these challenges are formidable, the prospects offered by 5IR are equally compelling. As highlighted by Apriliyanti (2022), libraries that embrace these changes can position themselves as innovation hubs, lifelong learning centers, and agents of digital inclusion. In a country like Nigeria, where literacy gaps and educational inequalities persist, the democratizing potential of 5IR technologies could be harnessed to bridge socio-economic divides—provided that equitable access, local relevance, and sustainability are prioritized (Luca, Narayan, & Cox, 2022).

Furthermore, the adoption of 5IR tools in libraries offers opportunities for interdisciplinary collaboration, enhanced research support, and improved user satisfaction. This is reinforced by Shahzad, Khan, and Iqbal (2024), who found that successful implementation of robotics in academic libraries depends on organizational culture, leadership, and user acceptance. These factors must be critically examined within the Nigerian context to inform scalable and sustainable innovations. This study seeks to systematically review the current literature on the prospects and challenges of the Fifth Industrial Revolution in Nigerian libraries. It also explores how stakeholders, including policymakers, LIS educators, library administrators, and technology developers, can collaboratively navigate the opportunities and mitigate the risks of this transformative era.

Objectives of the study

1. To determine the key technologies associated with the Fifth Industrial Revolution (5IR) and their applicability to Nigerian libraries.
2. To examine the opportunities that 5IR technologies present for library services and operations.
3. To identify the major challenges faced by Nigerian libraries in adopting 5IR-related technologies.

Literature Review

In the context of libraries, the 5IR is driven by the integration of technologies such as artificial intelligence (AI), robotics, the metaverse, blockchain, and big data, all harmonized with human creativity and empathy (Ashiq, 2024; Oyedokun, 2024). Central to the transformation of library services in the 5IR is the adoption of robotics and AI, which are redefining traditional modes of information delivery and access. Adetayo et al. (2023) noted the importance of a collaborative model where robots and human librarians co-deliver services, enhancing efficiency while retaining the human touch essential to user engagement. Similarly, Basumatary et al. (2025) map out various applications of robotic technology in libraries, underscoring the potential for automation in circulation services, book retrieval systems, and user interaction.

Oladokun et al. (2023) observe that while robotic technologies have started penetrating Nigerian academic libraries, their integration remains superficial due to financial, technical, and policy-related constraints. Owolabi et al. (2022) further reveal that librarians' readiness for such technological adoption is uneven, with many professionals lacking adequate training and exposure. This highlights a key challenge of the 5IR: the need for proactive capacity building. As Ayinde, Ajayi, and Adedeji (2025) observe, reimagining the roles of information professionals requires not only technical knowledge but also a reorientation towards lifelong learning and adaptability.

The shift toward AI-driven services also introduces new dimensions of ethical, operational, and user-focused considerations. Luca, Narayan, and Cox (2022) discuss the evolving expectations of librarianship as AI becomes more embedded in library systems, calling for a nuanced understanding of how these tools impact data privacy, user autonomy, and decision-making. Echoing this, Hodonu-Wusu (2024) addresses the ethical and equitable dimensions of AI in libraries, arguing that these technologies must be deployed in ways that empower users rather than marginalize them. These perspectives are particularly pertinent in a developing context like Nigeria, where disparities in digital access and information literacy persist across social groups.

Noh (2023) traces the evolution from Library 1.0 to 5.0, illustrating how libraries have progressively adapted to societal and technological changes. Library 5.0, in particular, envisions a smart, personalized, and

emotionally intelligent service environment where user experiences are co-created through advanced technologies and human empathy. On the other hand, Apriliyanti (2022) provides a comparative perspective by exploring the challenges of digital library evolution in Indonesia across industrial revolutions. Her findings resonate with the Nigerian situation, particularly regarding infrastructural gaps, limited digital resources, and resistance to change. Similarly, Ahmat and Hanipah (2018) emphasize the importance of strategic planning and policy frameworks in preparing libraries for technological revolutions. For Nigeria, this implies the need for institutional reforms, governmental support, and academic partnerships that foster innovation and sustainability in library services.

One of the most profound opportunities of the 5IR lies in the use of big data for decision-making and service personalization. Ajani et al. (2024) elaborate on how big data can enhance library management by revealing user behavior patterns, optimizing resource allocation, and informing policy. This data-driven approach supports a more responsive and user-centered library environment. However, the implementation of big data analytics in Nigerian libraries remains nascent, hindered by technical constraints and a lack of skilled personnel. Ekwueme et al. (2024) stress that librarians must be empowered with not only technical skills but also critical thinking, emotional intelligence, and communication competencies. These attributes are crucial in open and distance learning contexts, where librarians serve as digital guides and information coaches. Lira da Silva et al. (2024) reinforce this view by mapping emerging trends in library services to the evolving skillsets of librarians, highlighting areas such as digital curation, data ethics, and user experience design. These skills become more relevant as libraries shift from passive repositories to active learning and innovation hubs.

The literature also reveals a growing recognition of the need to adapt library and information science (LIS) education to prepare future professionals for 5IR demands. Tait and Pierson (2022) advocate for the integration of AI and robotics into LIS curricula to ensure graduates possess the necessary digital competencies. Wu (2024) extends this argument by discussing how information professionals must adapt to the anticipated era of artificial general intelligence (AGI), which will bring even more complex tasks into the scope of library work. Thus, the future of librarianship lies in a balanced interplay between human judgment and machine intelligence, where each enhances the capabilities of the other.

There is also evidence of gradual institutional responses to these changes. Moonasar and Ngoepe (2023), in their case study of a South African university library, document how disruptive changes are prompting academic libraries to redefine their missions and service models. This mirrors developments in Nigeria, where institutions are beginning to experiment with emerging technologies despite systemic limitations. Oyedokun (2024) suggests that the integration of blockchain, the metaverse, and AI will shape the future of Nigerian libraries, offering decentralized, immersive, and intelligent information environments that transcend current boundaries. Nevertheless, the adoption of these technologies is influenced by a range of contextual factors. Shahzad, Khan, and Iqbal (2024) identify institutional readiness, leadership commitment, and user attitudes as key determinants of robotic technology uptake in libraries. Tella (2020) raises concerns about librarian preparedness, urging proactive professional development and institutional support to prevent obsolescence. Shubha (2023) and Wójcik (2024) further examine the prospects and limitations of robotics and AI in library settings, cautioning that technological success must be accompanied by thoughtful design, equitable access, and clear value propositions for users.

Methodology

This study adopts a systematic review design, which is the most appropriate for synthesizing existing research on the emerging theme of the Fifth Industrial Revolution (5IR) and its implications for Nigerian libraries. A systematic review enables the researcher to critically appraise, collate, and analyze a broad range of scholarly works in a structured, replicable, and unbiased manner. This approach is particularly suitable given the interdisciplinary and rapidly evolving nature of the 5IR and the need to evaluate how libraries are responding to its developments. (Akhter et al., 2019)

The review focused on peer-reviewed journal articles, conference proceedings, and scholarly publications retrieved from major academic databases, including Google Scholar, ResearchGate, EBSCOhost, and ProQuest. The justification for selection of these databases is because they provide vast and broad access to peer-reviewed journal articles, conference papers, theses, and preprints across multiple disciplines.

The use of these databases is because they are vastKeywords and search strings were developed based on the core themes of the study, including: *"Fifth Industrial Revolution" OR "5IR" AND "libraries" OR "Nigerian libraries" AND "robotics" OR "AI" OR "emerging technologies" OR "library services".* Boolean operators and truncations were used where necessary to enhance search accuracy and breadth.

Studies were included in the review if they met the following conditions:

a) Published between 2020 and 2025 to capture the most recent trends in 5IR-related research.
b) Focused specifically on libraries, librarianship, or library services concerning the Fourth or Fifth Industrial Revolution.

c) Addressed emerging technologies such as robotics, artificial intelligence, big data, blockchain, the metaverse, or related innovations.
d) Published in English and accessible in full text.
e) Peer-reviewed journals.

Studies were excluded if they:

a) Focused exclusively on the 1st to 3rd Industrial Revolutions without connecting to 4IR or 5IR themes.
b) Did not mention libraries, library professionals, or library-related technologies.
c) Were editorials, book reviews, news articles, or opinion pieces without empirical or conceptual depth.
d) Were not accessible in full text or written in languages other than English.

Following the final selection of eligible studies, a thematic analysis approach was employed to extract and synthesize data. Thematic analysis involves identifying, analyzing, and interpreting patterns (themes) within the dataset. This method provided a structured yet flexible way to understand how Nigerian libraries are navigating the prospects and challenges of the 5IR. The data extraction process involved reviewing the titles, abstracts, and full texts of the selected articles. Relevant information was organized in a matrix including author(s), year, study focus, methodology, findings, and relevance to the 5IR framework. This facilitated cross-comparison and synthesis of diverse insights across the reviewed literature.

Results

The findings address the study's specific objectives and are discussed in line with relevant and related literature.

Key Technologies Associated with the Fifth Industrial Revolution (5IR) and Their Applicability to Nigerian Libraries

The Fifth Industrial Revolution introduces an era where emerging technologies converge with human-centered values to transform service delivery. Within Nigerian libraries, several technologies are emerging as central to this shift. Robotics is a recurring subject, with Adetayo, Abwage, and Oduola (2023) highlighting the collaborative potential of robots and human librarians to deliver efficient services. Their study underscores the adaptability of robotic systems in circulation, reference services, and user engagement—functions critical in modern libraries. Similarly, Oladokun et al. (2023) examine the implications of robotic technologies for Nigerian academic libraries, noting their growing relevance for automating repetitive tasks and improving service accuracy. AI is another prominent 5IR technology. Luca, Narayan, and Cox (2022) explore how AI tools are reshaping the library and information profession by enhancing personalization and streamlining information retrieval. Oyedokun (2024) provides a broader technological perspective, identifying robotics, AI, blockchain, and the metaverse as integral to the future of libraries. These tools are positioned to facilitate immersive virtual experiences, secure information transactions, and real-time user analytics.

Big data analytics also features prominently as a transformative tool for Nigerian libraries. Ajani et al. (2024) discuss their role in guiding management decisions and tailoring services based on user behavior. The use of smart data platforms aligns with the 5IR goal of leveraging technology for improved human experiences. Blockchain, though still emergent, is recognized by Oyedokun (2024) as a future tool for ensuring data integrity and access transparency in digital libraries. Noh (2023), in conceptualizing Library 5.0, encapsulates these technologies under a unified framework of hyper-personalization and smart interactions, a vision that, though aspirational, signals the path forward for Nigerian libraries seeking global relevance.

Opportunities that 5IR Technologies Present for Library Services and Operations

The 5IR era offers libraries a transformative opportunity to rethink their operational models and user engagement strategies. One of the key benefits is enhanced personalization and user experience. Ashiq (2024) notes that Industry 5.0 promotes human-centric solutions where technology enhances, not replaces, personal interactions, creating more responsive library environments. This aligns with the vision of a service model that blends automation with emotional intelligence. In Nigerian libraries, this could mean AI-powered virtual assistants that adapt to individual user needs while providing culturally relevant services.

Robotic integration into library services introduces operational efficiencies and consistent user support. Wójcik (2024) identifies several use cases for robotics, including shelving, guided tours, and self-service kiosks—all of which streamline workflows and free up staff for more complex tasks. Adetayo et al. (2023) similarly highlight the productivity gains when robots handle repetitive duties, allowing librarians to focus on strategic and user-centric functions. In the Nigerian context, these improvements can address manpower shortages and extend service hours, especially in academic libraries with large user populations.

Big data presents another opportunity, allowing for evidence-based decision-making. Ajani et al. (2024) argue that data analytics can provide actionable insights into user behavior, enabling libraries to optimize acquisitions, manage space, and predict user needs. Such data-driven strategies could drastically improve resource allocation in Nigerian libraries, where funding is often limited. Furthermore, AI and smart systems

can promote inclusive access by offering multilingual, speech-to-text, and assistive technologies, a point reinforced by Hodonu-Wusu (2024), who emphasizes AI's potential to empower marginalized users through accessible and ethical service design.

From a professional standpoint, 5IR technologies redefine the roles of librarians. Ekwueme et al. (2024) discuss how the shift to digital and distance learning platforms demands new skills in digital content curation, online engagement, and virtual instruction. These shifts are not merely technical but strategic, opening pathways for librarians to become innovators and digital mentors. Ayinde et al. (2025) further argue that the adoption of 5IR technologies elevates librarianship to a multidisciplinary field, integrating IT, data science, and user experience design. For Nigerian professionals, this presents a unique opportunity to rebrand and expand the relevance of the profession within the national knowledge economy.

Challenges Faced by Nigerian Libraries in Adopting 5IR-Related Technologies

Despite these opportunities, several challenges impede the widespread adoption of 5IR technologies in Nigerian libraries. One of the most cited issues is infrastructural inadequacy. Oladokun et al. (2023) stress that while robotic technologies are gaining ground globally, Nigerian libraries lack the physical infrastructure and maintenance capacity to deploy them effectively. This is corroborated by Owolabi et al. (2022), who found that even where robotic systems are introduced, implementation is often hampered by inconsistent power supply, limited internet access, and the absence of supportive IT frameworks.

Funding constraints further complicate technology adoption. As noted by Apriliyanti (2022), in both Indonesian and Nigerian contexts, libraries often operate under strict budgetary limitations, making it difficult to acquire, maintain, and upgrade digital systems. This lack of financial investment affects not only technology procurement but also staff training and system sustainability. Ahmat and Hanipah (2018) reinforce this concern, pointing out that without strategic national policy and investment in library infrastructure, developing nations risk falling behind in the global digital revolution.

Digital skill gaps also pose a significant barrier. Tella (2020) questions whether librarians are prepared for the integration of robots, noting that fear, resistance to change, and lack of exposure to advanced technologies slow down adoption. Similarly, Shahzad, Khan, and Iqbal (2024) identify human factors—such as limited training, negative attitudes, and absence of institutional support—as major determinants of technological success. In Nigerian libraries, where many librarians were trained under traditional models, transitioning to AI- and data-driven environments requires deliberate and sustained professional development.

Cultural and organizational resistance is another challenge. Moonasar and Ngoepe (2023) document how institutional inertia and traditionalist attitudes in academic libraries can stifle innovation, even when resources are available. This resonates with findings by Lira and Jacintho (2023), who argue that leadership vision and organizational culture are crucial for fostering innovation in libraries. In Nigeria, the absence of innovation-driven leadership within some library systems limits the motivation for experimentation and the creation of a supportive digital culture.

Finally, ethical concerns surrounding the use of AI and data systems are beginning to surface. Hodonu-Wusu (2024) raises alarms about data surveillance, algorithmic bias, and the marginalization of vulnerable users in automated systems. While these issues are more pronounced in technologically advanced contexts, they are relevant for Nigerian libraries seeking to import foreign technologies without adapting them to local socio-cultural realities. As 5IR advances, ethical considerations must be embedded in policy and practice to ensure that technological adoption does not compromise user rights and equity.

Conclusion and Recommendations

The study explores the prospects and challenges associated with libraries in the Fifth Industrial Revolution (5IR). The study indicates that while emerging technologies such as artificial intelligence, robotics, big data, blockchain, and the metaverse offer unprecedented opportunities for enhanced personalization, operational efficiency, and inclusive access, their adoption in Nigerian libraries is still in its infancy. These technologies, when effectively integrated, can redefine libraries as innovation-driven, user-centered, and digitally empowered spaces, fostering interdisciplinary collaboration and responsive service delivery. However, systemic challenges, including inadequate infrastructure, funding limitations, digital skill gaps, and resistance to change, pose significant barriers to the successful implementation of 5IR innovations.

The readiness of library personnel and institutions to embrace these shifts is further hampered by outdated curricula, weak policy frameworks, and a lack of strategic investment in professional development. Nevertheless, the human-centric ethos of the 5IR aligns closely with the evolving role of libraries as agents of social transformation and digital inclusion. For Nigerian libraries to realize the full potential of the 5IR, there is a critical need for coordinated efforts among policymakers, library educators, institutional leaders, and technology developers to foster a supportive ecosystem that promotes innovation, addresses infrastructural deficits, and equips library professionals with the necessary competencies to thrive in a digitally convergent future.

Based on the findings and conclusion, the study recommended that:

1. The government and institutional stakeholders should prioritize funding for the development of modern ICT infrastructure, including high-speed internet, power supply, and digital tools that support the integration of AI, robotics, and other 5IR technologies in library environments.
2. Continuous training and upskilling programs should be established to equip librarians with emerging digital competencies, including data analytics, AI literacy, ethical technology use, and user-centered service design.
3. Library and information science (LIS) curricula must also be revised to reflect the technological demands of the 5IR era. Library leadership should foster a culture of experimentation and innovation by encouraging openness to change, interdisciplinary collaboration, and user feedback. This can help overcome institutional resistance and accelerate technology uptake.

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Factors Affecting the Adoption of Robot Technologies in Libraries of the Fifth Industrial Revolution

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Abstract

The adoption of robot technologies in libraries is a significant advancement within the Fifth Industrial Revolution, yet its implementation remains uneven across institutions. This study investigates the factors influencing the adoption of robot technologies in libraries, focusing on technological, organizational, and environmental determinants. A systematic literature Review was employed. The databases of Google Scholar and ResearchGate were used for the study, and studies between 2020 and 2025 were considered for inclusion. The findings reveal that technological infrastructure, cost implications, staff readiness, and institutional policies are key determinants in the decision to integrate robotic systems. Additionally, external factors such as vendor support, regulatory frameworks, and user acceptance play a crucial role. The study highlights that while automation can enhance efficiency and service delivery, concerns related to job displacement, ethical considerations, and data security must be addressed. The study concludes that successful adoption requires a strategic approach, balancing technological advancements with human-centric library services.

Keywords: *Robot technologies, Library automation, Fifth Industrial Revolution, Adoption factors, Smart libraries.*

Introduction

The rapid advancement of technology has significantly changed everything, including how robots are increasingly automating many processes across many industries, including libraries where we will experience a shift as part of the Fifth Industrial Revolution (5IR). The Fifth Industrial Revolution is about joining the human intellect with robotics and artificial intelligence (AI) to enhance productivity and improve user experiences. It is important to note that the Fourth Industrial Revolution focused on artificial and digitalization and that the 5IR is focused on human-centered technology, and should insist on technology working in cooperation with a person rather than replacing that person with robots, AI, or other technologies. As information access and management centres, libraries are shifting to using robotics as more capabilities of robotics emerge, with the objective of improving library services, advancing library operations, and meeting users' needs. (Emmanuel, Ameh and Oladokun 2025).

Robotics in libraries is not a new phenomenon. Many libraries have experimented with robotics over time, whether this has involved robotic book retrieval systems, or AI-powered chatbots that help patrons with their inquiries. Robotics attempt to improve efficiency (and save costs and improve the user experience) and there is enormous potential to deliver better service to users. Despite the advances in robotics, there continues to be variation in the application of robots in libraries. Full use of robotics in libraries is happening, but on the opposite end of the spectrum libraries have not adopted robots for a number of reasons including cost, inability to connect the relevant technological infrastructure, staff anxiety, and ethical pressures.

Problem Statement

While automation and robotics are generating interest every day, robotic technologies are still in the early adopter stage among libraries as a whole. Although some university and public libraries have adopted robots specifically for book retrieval, cataloguing, and service, many have yet to progress not only to robotics but even further transformation.

Several factors prevent libraries from adopting robotic technologies, including funding issues, qualified technical knowledge, fear of resistance from library staff, and concerns about what robotics may mean for library services. One challenge includes the immense cost of prototyping, acquiring, and maintaining robotic technologies. Funding is already restricted for many libraries, so funding the additional costs of robotics is difficult to justify when other library materials are still usable. Additionally, the lack of technical knowledge possessed by many library staff inhibits implementation and maintenance of this technology. Staff may also

fear that robots, or automation in general, may replace their services and therefore, oppose change involving automation. Moreover, ethical issues concerning data privacy, interactions with robots, and biases in AI generated services raise concerns about the large introduction of robotics in libraries. Therefore, there is a need for a thorough investigation into the issues influencing the adoption of robotic systems in libraries. The overall aim of the study is to determine the factors that shape robotic adoption, determine libraries' readiness for technological change, and consider how to achieve the potential benefits of robotic adoption wherever possible.

Rationale for the Study

The integration of robotics into libraries is not just a fad, it's a necessity, especially during a time when technology is inherently a part of our society. The exponential desire for efficiency, accessibility, and user-focused solutions provides the opportunity for robotics to be a possibility for libraries in the modern context. The slow speed of adoption indicates the need to deepen our understanding of the factors surrounding it. This research is meaningful because it will shed light on the barriers to adoption and enablers of robotic technologies in libraries. This research will be useful to policymakers, library management, and developers to think about training and development systems that will enable libraries to adopt robotics. Ultimately, this work will add to the greater body of literature that describes an increasingly software-based library, and assist in developing a framework for further research into the role of robots in library services.

Objectives of the Study

1. To determine the use of robots in libraries of the 5thIndustrial Revolution
2. To determine the factors affecting the adoption of robot technologies in libraries

Literature Review

Use of Robots in Libraries of the Fifth Industrial Revolution

The integration of robotic technologies into libraries has emerged as a transformative trend in the wake of the Fifth Industrial Revolution (5IR), an era characterized by the fusion of advanced technologies with human-centric values. Various studies have explored the application of robots in libraries, shedding light on their roles, benefits, and challenges. The increasing reliance on artificial intelligence (AI) and robotics is driven by factors such as the growing demand for efficient library services, the need to manage vast amounts of information, and the desire to enhance user experience.

Wójcik (2024) highlights the growing but underexplored application of robotic technologies in library settings. The study reveals that while the use of robots in libraries is not widely discussed in Library and Information Science (LIS) literature, numerous practical implementations exist, particularly in educational and promotional activities. Similarly, De Sarkar (2023) provides an in-depth exploration of how libraries are utilizing robots for various tasks, including shelf management, circulation workflows, document retrieval, and reference services. This aligns with findings from Folorunso and Momoh (2020), who stress that the adoption of AI and robotics in libraries is essential due to the complexities of the information age, the rising number of library users, and the increasing demand for efficient service delivery.

The fear that robots might replace librarians has been a common concern. Tella (2020) examines this apprehension and clarifies that robots are not intended to replace librarians but to complement their work by automating repetitive tasks. This view is echoed by Omame and Alex-Nmecha (2020), who argue that AI-powered robots can significantly enhance library services without eliminating the role of human librarians. Rather than replacing librarians, AI-driven systems and robots are designed to support decision-making, automate book retrieval, and assist in reference services, ultimately improving efficiency.

The potential of robots to improve literacy activities is another critical area of research. Yueh et al. (2020) conducted an experimental study on how children interact with robotic and human reading companions in library literacy activities. Their findings suggest that children responded positively to robotic co-readers, who enhanced social interaction and reading comprehension. This underscores the ability of robots to provide engaging and interactive educational opportunities in library settings.

Despite their advantages, the implementation of robotic technologies in libraries faces challenges, including a lack of technological infrastructure, resistance to change, and financial constraints. Tait and Pierson (2022) assess the role of AI and robotics in LIS education, revealing gaps in curricula that could hinder the smooth adoption of these technologies. Similarly, Owate and Ogonu (2023) report that many academic libraries, particularly in developing regions, lack the digital infrastructure and expertise needed to implement robotic technologies effectively. Their findings indicate that financial limitations, lack of awareness, and inadequate training of library staff pose significant barriers to the adoption of robotics in library services.

Public libraries have also embraced robotic technology, as highlighted by studies such as Tella and Ajani (2022) and Ajani et al. (2024). These studies reveal that humanoid robots, chatbots, and telepresence robots have been deployed to assist with reference services, enhance patron interactions, and provide informational support. However, Nguyen (2020) emphasizes that the integration of humanoid robots in public libraries extends beyond service efficiency; these robots act as community builders, teachers, and assistants, fostering a more interactive and engaging library environment.

In academic libraries, Shahzad et al. (2024) identify various factors influencing the adoption of robotic technologies, including advancements in AI, security concerns, and personalized services. Their study also notes that robotic adoption significantly improves space management and enhances patron engagement. However, challenges such as loss of critical thinking, financial hurdles, and fear of job loss among librarians remain obstacles to full-scale implementation. The concern about job displacement is further explored by Sambo and Oyovwe-Tinuoye (2023), who find that while librarians acknowledge the potential of robotic technologies, anxiety over job security remains a major deterrent to their acceptance.

The readiness of libraries to adopt robotic technologies varies across regions and library types. Tella (2023) examines the adoption of robots in open and distance learning university libraries, demonstrating that these institutions stand to benefit significantly from robotic assistance, particularly in automating repetitive tasks and enhancing user services. However, Oladokun et al. (2023) caution that despite the potential benefits, the adoption of robotic technologies must be guided by careful planning and assessment of institutional needs. Owolabi et al. (2022) highlight the reluctance of Nigerian university libraries to adopt robotics due to infrastructural and financial challenges.

One of the key challenges in the successful integration of robots in libraries is the issue of human-robot interaction and acceptance. Vlachos et al. (2020) stress that for robots to be successfully implemented in library environments, factors such as cultural perceptions, user expectations, and technological capabilities must be considered. They identify anxiety among librarians, financial constraints, and the need for human interaction as potential barriers to robotic acceptance in libraries. Similar findings are reported by Lin et al. (2024), who investigate academic librarians' attitudes toward robotic process automation (RPA) in Hong Kong. While many librarians expressed a willingness to learn about robotic automation, concerns about implementation challenges and resistance to change were evident.

The perception of students regarding robotic librarianship is also a crucial factor in determining the future of robotic technologies in libraries. Adetayo et al. (2023) examine students' preferences for robotic versus human librarians, finding that while most students preferred human librarians, they recognized the utility of robots in performing specific tasks such as security monitoring, book retrieval, and user assistance. Their study suggests that a hybrid model, where robots and human librarians work together, would be the most effective approach to library service delivery in the 5IR era.

The evolving landscape of robotics in libraries reflects broader technological advancements and the shifting role of libraries in the digital age. Hussain (2020) links the adoption of robotic technologies in libraries to the broader trends of the Fourth Industrial Revolution (4IR) and highlights the challenges libraries face in keeping pace with technological advancements. The transition from 4IR to 5IR underscores the growing emphasis on human-centered innovation, where technology and human expertise work collaboratively to enhance library services.

Factors affecting the adoption of robots technologies in libraries

The adoption of robotic technologies in libraries is influenced by various factors, including librarian perceptions, financial constraints, technological preparedness, and institutional readiness. Jha (2023) highlights the advantages of robotic integration in libraries, such as improved efficiency, enhanced user engagement, and interactive educational opportunities. However, despite these benefits, the widespread adoption of robots in libraries is hampered by several critical factors. One such factor is the perception and preference of library users. Adetayo et al. (2023) found that while students recognized the effectiveness of robots in tasks such as giving directions, ensuring security, and assisting with circulation, they still preferred human librarians for service delivery. This preference suggests that while robots can enhance library operations, their full acceptance among patrons remains uncertain, potentially slowing their adoption.

Librarian awareness and attitudes toward robotic technologies also play a significant role in adoption. Sambo and Oyovwe-Tinuoye (2023) reveal that while certified librarians acknowledge the potential of robotic technologies to enhance library services, concerns over job displacement and funding constraints hinder their willingness to embrace these technologies. Similarly, Lin et al. (2024) found that although Hong Kong academic librarians showed interest in robotic process automation (RPA) and its implementation in libraries, their lack of prior knowledge and concerns about emotional and cognitive effects created barriers to adoption. This underscores the importance of adequate training and awareness programs to equip librarians with the necessary skills and confidence to integrate robots into library services.

Yoon et al. (2022) emphasize the differing attitudes between academic and public librarians toward artificial intelligence (AI) and robotics. Their study found that while academic librarians were more aware of AI applications in libraries, public librarians expressed more positive perceptions about their potential to transform library functions. However, despite this awareness, the readiness to adopt AI and robotics was not universal. The study also found that 68% of librarians expressed interest in training, indicating a need for capacity-building initiatives to bridge the knowledge gap and facilitate smoother adoption.

Nguyen (2020) explores the impact of humanoid robots on Australian public libraries and identifies key roles these robots play, such as acting as community builders, aides, and educators. While these roles demonstrate the potential value of robots in libraries, the study also suggests that successful implementation depends on how well robots integrate with existing library cultures and workflows. Resistance from library staff and patrons, coupled with concerns about maintaining human-centered services, can slow the adoption of robotics in libraries.

Financial and infrastructural challenges are also significant barriers to adoption. Ajani et al. (2022) examined the awareness and readiness of Nigerian academic libraries to integrate AI and robotics and found that while there was a general awareness of the benefits, actual implementation was hindered by financial constraints, inadequate expertise, and unreliable power supply. The study also noted that the fear of job displacement among librarians contributed to resistance, despite the acknowledgment that AI could enhance efficiency and reduce errors in repetitive tasks. Similarly, Oladokun et al. (2023) argue that although robotic technologies could enhance library services and foster growth, their adoption in Nigeria is slow due to infrastructural limitations and financial constraints.

Owolabi et al. (2022) reinforce these findings by investigating the readiness of Nigerian university libraries to adopt robotic technologies. Their study concluded that despite the clear advantages of automation in library operations, the lack of preparedness among libraries was a major hindrance. They found that university libraries were not actively investing in robotic technologies, citing financial difficulties, lack of technical expertise, and minimal institutional support as key barriers. This aligns with the broader theme that while the potential benefits of robotic technologies in libraries are widely acknowledged, practical implementation remains challenging due to systemic and logistical issues.

ójcik (2024) highlights that discussions about robots in library and information science (LIS) literature remain limited, despite their increasing presence in library activities, particularly in educational and public engagement functions. This lack of discourse may contribute to slow adoption, as librarians and decision-makers may not fully grasp the potential benefits and use cases of robotic technologies. Similarly, Tait and Pierson (2022) find that AI and robotics are rarely included in LIS education programs, further limiting professional preparedness. The study suggests that integrating AI and robotics into LIS curricula would better equip future librarians with the knowledge and skills needed to leverage these technologies effectively.

Another significant factor influencing adoption is librarian perception and readiness. Tella (2020) discusses the apprehension among librarians regarding the introduction of robots, particularly concerns about job displacement. While the study emphasizes that robots are designed to complement rather than replace librarians, this fear persists and may contribute to resistance. Ajani et al. (2022) and Sambo and Oyovwe-Tinuoye (2023) also highlight similar concerns, noting that librarians often view robotic technologies with suspicion, fearing that automation may reduce the need for human staff. However, Omame and Alex-Nmecha (2020) argue that AI and robotics in libraries are more likely to enhance librarians' roles rather than eliminate them, improving service delivery and expanding the capabilities of libraries in a digital society.

Financial and infrastructural constraints also play a crucial role in determining the adoption of robotic technologies. Studies conducted in Nigeria, such as those by Ajani et al. (2022) and Owolabi et al. (2022), highlight the challenges of funding, inadequate technical expertise, and unreliable power supply as major barriers to implementing robotics in libraries. Without sufficient investment, libraries struggle to acquire and maintain these technologies, limiting their ability to integrate AI-driven solutions into their services. Similarly, Folorunso and Momoh (2020) emphasize the increasing complexities of information management in the 21st century, such as big data and information overload, which necessitate AI-driven solutions. However, despite the recognized need for these technologies, financial and technical limitations prevent many libraries from fully adopting them.

The practical applications of robotics in libraries also influence their adoption. De Sarkar (2023) identifies several roles for robots in libraries, including shelf management, circulation control, document retrieval, and reference services. These functionalities demonstrate the potential for robots to enhance efficiency in library operations. However, Yoon et al. (2022) note that while academic librarians are more aware of AI applications in libraries, public librarians tend to have more positive perceptions of their transformative potential. This discrepancy suggests that different types of libraries may have varying levels of enthusiasm and preparedness for adopting robotics, with academic libraries focusing on awareness and public libraries embracing the potential impact on user engagement.

Furthermore, the role of robots in enhancing user experience is another critical factor. Yueh et al. (2020) explore the use of robots in literacy activities, finding that children responded positively to robotic companions during reading sessions. This suggests that robots can play an effective role in user engagement, particularly in educational contexts. Similarly, Jha (2023) argues that robotic technologies help libraries create more dynamic and user-friendly environments, increasing accessibility and interaction. However, despite these benefits, the novelty effect of robots in libraries must be considered, as their long-term effectiveness in engaging users remains an area for further research.

The perceived role of robotics in libraries also affects their adoption. Nguyen (2020) identifies four key roles for humanoid robots in Australian public libraries: community builder, teacher, aide, and challenger. These roles highlight the diverse ways in which robots can support library functions beyond traditional service delivery. Tella and Ajani (2022) further expand on this by discussing various types of robots used in libraries, including chatbots, telepresence robots, and shelf-reading robots. Their study emphasizes that humanoid robots are particularly useful in reference services, improving response efficiency and expanding the scope of library assistance. However, despite these advantages, the perception of robots as competitors to human librarians may still limit their acceptance and integration into library workflows.

Methodology

The study employed a systematic review of the literature. The researchers consulted the databases of Google Scholar and ResearchGate. Articles published in the English Language were considered for inclusion while studies on other languages were largely exclusive. Further, articles such as research papers, reviews, theses and conference papers published between 2020 and 2025 were only considered for the review. Keywords such as "Robotics in Libraries", "Libraries and Robots", "Robots in Fifth Industrial Revolution Libraries" "Factors affecting the use of Robots in Libraries", "adoption of robots in libraries". The literature search took place between January and March; 2025.Content analysis was used for the analysis of the data collected. Ethical consideration was duly adhered to by the researchers. The researchers carefully sought the literature and ensured all sources and literature were duly referenced and cited.

Findings and Discussions

Given the review, the findings of the study were based on the study's objectives.

Theme 1: The Use of Robots in Libraries of the Fifth Industrial Revolution

The literature highlights the increasing role of robots in modern libraries, especially within the framework of the Fifth Industrial Revolution (5IR). Unlike the Fourth Industrial Revolution, which focused primarily on automation and artificial intelligence (AI), the 5IR emphasizes human-centric technologies where robots work collaboratively with humans to enhance library services. One of the primary applications of robots in libraries is in automating routine tasks such as book sorting, shelving, and retrieval. Autonomous mobile robots are deployed to assist in navigating large collections, ensuring efficient book management, and reducing human effort in repetitive tasks. Additionally, service robots are increasingly used for customer engagement, providing information, guiding users, and assisting patrons with disabilities, thereby improving accessibility and inclusivity in library spaces. The literature also indicates the role of robotic technologies in digital preservation, where AI-driven robots scan and digitize rare books and manuscripts, making them accessible to a wider audience while ensuring the preservation of fragile documents. Furthermore, libraries are leveraging social robots to facilitate interactive learning experiences, offering educational support through AI-driven assistance. The adoption of humanoid robots in libraries further illustrates the trend of blending human-like robotic interactions with traditional library services, thereby enhancing user experience and fostering innovative engagement strategies.

Theme 2: Factors Affecting the Adoption of Robot Technologies in Libraries

Several factors influencing the adoption of robot technologies in libraries are discussed in the literature, ranging from technological to socio-economic and ethical considerations. One of the key determinants is the financial investment required for robotic integration. Many libraries, especially in developing regions, face budgetary constraints that limit their ability to acquire and maintain sophisticated robotic systems. The cost of purchasing robots, trainingstaff, and maintaining these technologies pose a significant challenge to widespread adoption. Another critical factor is technological readiness, as some libraries lack the necessary infrastructure, such as reliable internet connectivity, software integration capabilities, and skilled personnel to manage robotic operations effectively. Resistance to change among library staff and users also emerges as a notable barrier. Traditional library staff may perceive robots as a threat to job security, leading to reluctance to embrace automation. Similarly, patrons unfamiliar with robotic interactions may feel hesitant to engage with robotic services, necessitating user training and awareness programs. Ethical concerns surrounding data privacy, AI biases, and the potential depersonalization of library services also contribute to adoption challenges. The literature further emphasizes the regulatory and policy environment as a determining factor,

where the absence of clear guidelines on the ethical deployment of robots in libraries affects decision-making processes. Cultural attitudes toward automation and robotics influence the pace of adoption, as societies with higher acceptance of technological innovations tend to integrate robots more seamlessly into library operations. Lastly, the literature highlights the role of strategic partnerships between libraries, technology developers, and policymakers in fostering an enabling environment for robotic adoption, ensuring sustainable implementation and continuous improvement of library automation systems.

Conclusion

The study on the factors affecting the adoption of robot technologies in libraries of the Fifth Industrial Revolution has revealed critical insights into the opportunities and challenges associated with integrating robotic systems into library operations. The findings indicate that while robot technologies hold significant potential to enhance efficiency, accessibility, and user experience in libraries, several factors influence their adoption. One of the key findings is the role of technological infrastructure in determining the feasibility of robot implementation. Libraries with advanced digital infrastructure, including high-speed internet, automation systems, and AI-driven platforms, are more likely to integrate robot technologies successfully. However, institutions with outdated or limited digital resources face significant barriers to adopting these innovations. Additionally, financial constraints emerged as a major challenge, as the high cost of acquiring, maintaining, and upgrading robotic systems poses a substantial burden, especially for public and academic libraries with limited budgets.

The study also highlights the importance of librarians' skills and perceptions regarding robot technologies. While some professionals embrace automation as a tool for improving service delivery, others express concerns over job displacement, ethical considerations, and the impersonal nature of robotic interactions. This underscores the need for targeted training programs to equip librarians with the necessary skills to work alongside robots and leverage their capabilities effectively. Furthermore, user acceptance and expectations play a crucial role in the adoption process. While many library users appreciate the efficiency and convenience brought by robotic assistants, concerns about privacy, data security, and the quality of human interaction remain prevalent. Addressing these concerns through ethical AI design and transparent data policies will be critical in fostering user trust and encouraging widespread acceptance of robotic services.

Implications of the Findings

The findings of this study have several implications for library administrators, policymakers, and technology developers. First, there is a need for increased investment in technological infrastructure to support the seamless integration of robotic solutions in libraries. Governments and funding agencies should consider providing grants or subsidies to help libraries, particularly public and academic institutions, overcome financial barriers.

Second, training and capacity-building programs should be implemented to equip librarians with the necessary technical skills and knowledge to work alongside robots effectively. Professional development initiatives can help address resistance to change and ensure that library staff are prepared for the evolving technological landscape.

Third, ethical considerations should be a priority in robot deployment. Developers and library administrators must ensure that robots are designed with user privacy, data security, and inclusivity in mind. Addressing ethical concerns proactively can enhance public trust and acceptance of robotic technologies.

Finally, policymakers should establish clear guidelines and regulations to support the adoption of robots in libraries. Standardized policies on technology integration, maintenance, and ethical use can create a structured framework that enables libraries to maximize the benefits of robotics while mitigating potential risks.

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Harnessing Emerging Technologies to Promote Library Services in Michael Okpara University of Agriculture, Umudike and National Root Crops Research Institute, Umudike

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Abstract

This study investigated the emerging technologies that can be harnessed to promote library services in the context of 5IR in Michael Okpara University of Agriculture, Umudike and National Root Crop Research Institute, Umudike, all in Abia State, Nigeria. This study adopted a descriptive survey design, while the population of study comprised 35 librarians from the libraries under study. 25 Academic Librarians from MOUAU and 10 Special Librarians from NRCRI. Census sampling technique was used for the study because the population was both manageable and accessible. The instrument for data collection was structured questionnaire using the 4. Likert scale type of measurement. 34 Librarians from both libraries responded to the questionnaire sent through google form. Inferential statistics such as frequency counts, percentages and mean value analysis was used to analyze the data collected. Emerging technologies such as AI for personalized experiences, AR/VR for immersive learning, blockchain for security, robotics for automation, and IoT for real-time data management, enhancing operational efficiency and user engagement were studied. The study revealed that the Librarians in the libraries studied are aware of some the emerging technologies in the 5^{IR} that promotes library services. Artificial Intelligence (AI) was top on the list of the 5IR technologies that promotes library services. Findings on the benefits of integrating these emerging technologies into library services revealed that majority of the respondents corroborated that integrating these emerging technologies into library services enhances efficiency, improves user experience, leads to better data management, expansion of digital resources, increases collaboration, and personalized library service. However, significant challenges, including high cost of implementation, lack of technical expertise, resistance to change, limited institutional support, ethical and privacy concerns, that hinder widespread implementation and adoption were identified.
***Keywords**: Emerging Technologies, Library Services, 5th industrial revolution, MOUAU, NRCRI*

Introduction

Emerging technologies are new and cutting-edge technologies that are either being created now or are anticipated to be developed. Muthusamy, & Palanisamy, (2024) identified Artificial Intelligence, Block chain technology, Virtual and Augmented Reality, the Internet of Things (IoT), Quantum Computing, and 5G wireless networks as few instances of developing technologies. Din, & Ali, (2024) corroborated by stating that technological integration in library services by 2025 will include AI for personalized experiences, AR/VR for immersive learning, blockchain for security, robotics for automation, and IoT for real-time data management, enhancing operational efficiency and user engagement. The Fifth Industrial Revolution (5IR) represents a transformative shift towards enhancing human well-being through collaborative relationship between humans and robots across various sectors, including library services and information science. It builds upon the foundations of Fourth Industrial Revolution (4IR), focusing on efficiency, ethical considerations, and sustainability through human and machine collaboration in addressing complex societal challenges. 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 libraries (Noble et al., 2022). 5IR is an era marked by integration of advanced technologies and human-centric approaches. It prioritizes human involvement in technological processes, with emphasis on human to machine interactions (Musarat, Irfan, Alaloul, Maqsoom, & Ghufra., 2023). This approach promotes creativity and innovation, providing opportunity for workers to leverage advanced technologies like Artificial Intelligence (AI) and robots for improved productivity (Zeb et al., 2023).

Fifth Industrial Revolution is redesigning knowledge system especially in the context of libraries, which are developing to meet the demands of the digital society. Adoption of technologies like Artificial Intelligence (AI), Internet of Things (IoT) which are necessary in redesigning the role of libraries are the major aspects of the 5IR. Enakarire, Oladokun,Nsiri, Gaitanou (2024) asserts that 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 break

throughs in areas such as biotechnology, nanotechnology, quantum computing, and more. Adigun et al., (2024) states in agreement that the 5IR encompasses a convergence of IoT, cloud computing, biotechnology, and quantum computing, all driven by data currency. More so, libraries are crucial in providing equitable access to technology and digital resources thereby promoting community engagement and bridging the digital divide (Ortega, 2024). In recent times, AI has been the topic on everyone's lips, and the innovations in the space don't seem to be winding down. One of the most popular uses of this technology in libraries is AI chatbots. AI chatbots provide a great opportunity to free up librarians' time to complete more demanding tasks. They can be set up as a virtual guide for library services, answering frequently asked questions and providing information to patrons outside of office hours. They can even troubleshoot technical problems, such as issues accessing electronic resources. AI chatbots provide other benefits for patrons too, and can be an excellent tool for improving accessibility to library services. They help users navigate books and journals and will even suggest different databases if materials are more likely to be found there. Some libraries use AI technology to curate lists of recommended materials for patrons, based on their previous engagement with collections.

In the context of 5IR, libraries are transitioning from traditional repositories of physical materials to dynamic, technology-driven centers of knowledge dissemination and community engagement. This evolution is propelled by the adoption of emerging technologies that streamline library operations and enrich user experiences. Technological proficiency is another essential skill for librarians in the 5IR. As libraries increasingly rely on digital tools and resources to serve their patrons, Tella, Bamidele, Olaniyi, & Ajani (2023) believe that librarians must be comfortable with a wide range of technologies, including library management systems, digital asset management platforms, and online research tools. They must also stay abreast of emerging technologies that have the potential to reshape library services, such as artificial intelligence, machine learning, and augmented reality (Oladokun, Enakrire, & Ajani, 2023). Given these, librarians can enhance the efficiency and effectiveness of library operations and improve the user experience. Artificial Intelligence (AI) and Machine Learning (ML) are at the forefront of this transformation, enabling the automation of routine tasks such as cataloging and information retrieval, thereby allowing library professionals to focus on more strategic initiatives. AI-driven chatbots and virtual assistants provide personalized user interactions, enhancing the efficiency and effectiveness of information services. (Pressreader team, 2024)

The Internet of Things (IoT) further augments library environments by creating interconnected systems that monitor and respond to user needs in real time. IoT devices can track resource usage, manage energy consumption, and maintain optimal environmental conditions, thereby enhancing both operational efficiency and user comfort. Furthermore, blockchain technology offers robust solutions for secure and transparent management of digital assets and intellectual property within libraries. By providing immutable records of transactions, blockchain ensures the authenticity and integrity of digital resources, which is crucial in the digital age where data manipulation is a growing concern (Marc, 2017). Other emerging tools that facilitate interactive educational programs and remote access to library resources, breaking down geographical barriers and fostering inclusivity are Augmented Reality (AR) and Virtual Reality (VR). These technologies are redefining user engagement by offering immersive learning experiences and virtual explorations of library spaces (Casey & Savastinuk, 2020). The shift towards paperless libraries exemplifies the commitment to sustainability and efficiency in the 5IR. Digital repositories reduce the reliance on physical materials, leading to cost savings and environmental benefits. This transition is supported by advancements in digital archiving and content management systems, ensuring the preservation and accessibility of information in electronic formats.

As libraries embrace these emerging technologies, there is a concurrent need to reimagine the roles and skills of information professionals. The 5IR demands a workforce skilled in digital literacy, data analytics, and the management of sophisticated information systems. Continuous professional development and a proactive approach to technological adoption are essential for librarians to navigate and thrive in this evolving landscape (Nwobu, Dumbiri, Ibia, & Oladokun, (2024).

The Fifth Industrial Revolution presents a unique opportunity to harness emerging technologies in promoting library services and information science. By integrating AI, IoT, blockchain, AR/VR, and embracing digital transformation, libraries can enhance their service delivery, foster greater user engagement, and redefine their roles in the digital age. This evolution not only aligns with the technological advancements of the 5IR but also reinforces the enduring mission of libraries as pivotal centers of knowledge and community development. the challenges of integrating these technologies should be taken care of to avoid pitfall. The use of AI, IoT, and big data raises concerns about user data privacy and security. Libraries must ensure compliance with ethical standards and data protection regulations (Chowdhury & Roy, 2023).

Michael Okpara University of Agriculture, Umudike as an academic library and National Root Crop Research Institute, Umudike as a special Library require the knowledge of these emerging technologies, their benefits and challenges to avail them the opportunity to harness them for efficient library services

Statement of the problem

The rapid advancement of emerging technologies such as Artificial Intelligence (AI), Blockchain, the Internet of Things (IoT), Big Data, Augmented Reality (AR), Virtual Reality (VR), and Cloud Computing, in the 5th Industrial Revolution (5IR) presents both opportunities and challenges for library services. Libraries, as vital institutions for knowledge dissemination, research, and lifelong learning, must adapt to these technological shifts to remain relevant and effective, despite significant challenges like high cost of implementation and maintenance, limited infrastructure, inadequate digital literacy among librarians, ethical and privacy concerns, and resistance to technological change. Acknowledging the existence of these emerging technologies, their benefits and challenges and merging it with the right policies and best practices will provide grounds for their integration into library services for enhanced user experiences, improved information accessibility, among others without replacing traditional roles of librarians. Harnessing these technologies to improve library services irrespective of the type of library in this era is a welcome development for our libraries. This study, therefore seeks to explore the level of awareness of librarians in MOUAU and NRCRI of the emerging technologies that promote library services and how they can effectively leverage these 5IR technologies to transform library services, by understanding their benefits and challenges.

Purpose of the study

1. To identify specific emerging technologies that are significantly promoting library services in the 5IR.
2. To find out the benefits of integrating emerging technologies into library services in the 5IR
3. To identify the challenges of integrating these emerging technologies in library services in the 5IR

Research Questions

1. What are the specific emerging technologies that are significantly promoting library services in the 5th Industrial Revolution?
2. What are the benefits of integrating these emerging technologies into library services in the 5IR?
3. What are the challenges associated with integrating these emerging technologies into library services in the 5IR?

Literature Review

Overview of 5IR and Paradigm Shift in Library Services

In the practice and philosophy of librarianship, the 4th law of library science emphasized the need to save the time of the user. In a bid to save the time of the user, technology comes handy to complement human effort, not to replace it. The emergence and adoption of technologies in library practice has simplified library services. Chigwada and Chisita, (2021) opine that the current industrial age is changing and will continue to greatly affect the way library and librarians conduct their daily activities in ensuring that dynamic and diverse needs of users are met. Library services and information science is undergoing profound transformation, driven by the rapid evolution of emerging technologies in the context of the 5th Industrial Revolution (5IR

The Fifth Industrial Revolution (5IR) heralds the integration of cutting-edge technologies like Artificial Intelligence, Robots, Biotechnology and the Internet of Things (IoT), demanding individuals to possess critical skills such as creativity, crucial thinking, adaptability, digital literacy, emotional intelligence, resilience and cross-cultural competency (Ikenga & Sijide, 2024). In agreement, Ajani, & Oladokun (2024) recognized AI, ML, Data Analytics, IoT, Blockchain, AV/AR, 5G as the key technologies that are transforming services in the library. 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, digital literacy skills, carrier and life skills, encompassing creativity, crucial thinking, communication, collaboration, flexibility, adaptability, initiative, social interaction, productivity, accountability and leadership (Ikenna & Sijide, 2024).

To thrive in the 5IR, librarians need competencies in technology use and development, analytical thinking, emotional intelligence among others. (Demir & Ercan, 2019). The 5IR is an era characterized by the fusion of physical, digital and biological worlds, leading to a new wave of technological advancements, such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, big data analytics, and augmented reality (AR). Libraries, traditionally viewed as repositories of information, are increasingly expected to evolve into dynamic, tech-savvy hubs of knowledge sharing, learning, and community engagement (Bryson & Helms, 2021). AI and Machine Learning in Library Services has emerged as a pivotal tool in the automation and personalization of library services. Machine learning algorithms are being applied to enhance information retrieval systems, streamline cataloging processes, and provide tailored recommendations to users. As Kroski (2020) points out, AI-powered chatbots are also being integrated into libraries to assist with user inquiries and facilitate 24/7 access to services.

Furthermore, predictive analytics allows libraries to better understand user behavior and optimize their collections based on usage patterns, which can lead to more efficient resource allocation (Galloway & Dilevko, 2022). Internet of Things (IoT) and Smart Libraries has introduced the concept of "smart libraries," wherein physical library spaces are equipped with interconnected devices that monitor usage patterns and improve operational efficiency. For instance, Radio Frequency Identification (RFID), technology is being used for inventory management, self-checkout stations, and even to track the movement of books within library spaces (Alsagoff & Lee, 2021). According to Ahmed and Dhamdhere (2022), IoT-enabled libraries also enhance the user experience by creating personalized interactions based on real-time data, such as temperature preferences or specific search histories, ensuring that users have a more seamless and interactive engagement with library services. Blockchain for Digital Archives and Intellectual Property Management

The use of blockchain technology in libraries and information science is another emerging trend, particularly in the areas of digital archives, intellectual property, and secure data sharing. Blockchain's decentralized and immutable nature makes it ideal for creating secure and transparent systems for managing scholarly communications, intellectual property, and digital rights management (DRM). Libraries are experimenting with blockchain to authenticate and track the provenance of digital resources, ensuring that content remains untampered with, and access rights are clear and respected (Samarati & Ambrosino, 2021). Additionally, blockchain's potential in establishing decentralized knowledge-sharing platforms opens new avenues for collaborative research and open-access publishing models (Li, Zhang, & Zhou, 2022).

The availability of vast amounts of data has paved the way for the application of big data and analytics in libraries. Libraries are leveraging big data tools to analyze trends in information consumption, identify gaps in collections, and even predict future research needs (Liu et al., 2022). By tapping into patron data and other metadata, libraries can make informed decisions regarding acquisition strategies, program development, and user engagement. Moreover, the application of sentiment analysis and natural language processing (NLP) enables libraries to gain insights into user satisfaction, enhance user experience, and improve service delivery (Sharma & Pandey, 2021).

Another promising technology is augmented reality (AR) and virtual reality (VR), which have begun to find applications in library settings, particularly in creating immersive learning environments. By using AR and VR, libraries can offer more interactive and engaging educational experiences, such as virtual tours of rare collections, simulated historical events, or 3D visualization of scientific concepts (Casey & Savastinuk, 2020). These immersive technologies not only attract younger, tech-savvy patrons but also offer new opportunities for information literacy and distance learning in the digital age (Huang, Zhao, & Sun, 2022).

Overview of AI Applications in Libraries

Artificial Intelligence (AI) has emerged as a transformative force in the domain of Library and Information Science (LIS), offering novel solutions to enhance library operations, improve user services, and automate information processing. Libraries are increasingly adopting AI technologies such as natural language processing (NLP), machine learning (ML), and robotics to perform functions ranging from cataloging and classification to reference services and personalized recommendations (Yusuf, Okunlola, & Alabi, 2021). The adoption of AI is driven by its potential to streamline repetitive tasks, reduce human errors, and provide real-time assistance to users. Tools like ChatGPT exemplify how AI can interact in human-like ways, supporting both professionals and users in conducting research, accessing resources, and resolving queries (Chen, 2023). As academic and research libraries face growing user expectations and digital content expansion, AI tools are becoming increasingly essential for maintaining efficiency and relevance.

Importance of Metadata in Library Systems

Metadata serves as the backbone of library information systems. It provides structured information that describes, explains, and enables the discovery and management of library resources. Effective metadata supports searchability, accessibility, interoperability, and preservation of resources in both physical and digital formats (Musoke, 2022). In digital environments, metadata enhances the visibility of resources by enabling users to locate and retrieve information quickly and accurately. It also facilitates data integration across platforms, allowing for seamless interoperability among library catalogs, databases, and repositories (Park & Lu, 2020). As libraries continue to evolve into hybrid and fully digital models, the significance of metadata has increased, particularly in supporting user navigation and ensuring long-term digital preservation.

II. AI and Metadata Generation

Metadata is commonly defined as "data about data." In the library and information science (LIS) context, it refers to the structured information that describes the attributes, content, and context of information resources. Metadata supports essential library functions such as cataloging, classification, resource discovery, access control, and digital preservation (Musoke, 2022). It enables users to efficiently locate and retrieve resources

within an increasingly complex digital ecosystem. Metadata categories often include descriptive (title, author), structural (format, file type), administrative (rights, preservation), and technical elements (software version, creation date) (Park & Lu, 2020). As the volume of electronic resources continues to grow, metadata becomes critical in managing digital content and enhancing user accessibility.

Manual metadata creation, although thorough and reliable, is labor-intensive and time-consuming. It requires skilled cataloguers who apply standard classification schemes such as MARC, Dublin Core, or Library of Congress Subject Headings (LCSH). However, as libraries face increased acquisition of digital materials—ranging from e-books and multimedia to datasets and digital archives—manual processes are struggling to keep pace (Yang, Liao, & Zhu, 2019). Additionally, inconsistencies in human cataloging, variations in interpretation, and resource constraints often result in incomplete or inaccurate metadata entries. These limitations can hinder searchability, access, and interoperability between library systems, making the case for automation even more compelling.

Tools and Technologies (e.g., ChatGPT, Bard, GPT-4, Claude)

Several AI-driven tools are now being adopted in libraries to support metadata creation:

* ChatGPT (OpenAI): A conversational language model capable of generating summaries, extracting keywords, and classifying texts. It can be integrated into digital library systems to assist with metadata generation and user interaction (Cox & Tzoc, 2023).
* Bard (Google): Powered by Google's Language Model for Dialogue Applications (LaMDA), Bard can assist in generating metadata from Google Scholar-indexed content, offering a unique edge in academic settings (Panda & Kaur, 2023).
* GPT-4 (OpenAI): An advanced iteration of ChatGPT, GPT-4 supports multi-modal input (text and images) and offers improved reasoning and accuracy. It can generate complex metadata and understand contextual nuances better than earlier models.
* Claude (Anthropic): Designed with a focus on AI safety and alignment, Claude can be used in environments where ethical considerations are paramount, such as in managing metadata involving sensitive or culturally significant content (Afgiansyah, 2023).

III. Accuracy and Consistency of AI-generated Metadata

Accuracy in metadata is essential for the effectiveness of information retrieval systems. In library and information science, accurate metadata ensures that users can find the right information efficiently and reliably. Inaccurate or incomplete metadata can result in missed resources, poor search engine performance, and user dissatisfaction (Musoke, 2022). Metadata serves as a guidepost for catalogues, databases, and search interfaces, supporting resource discoverability, classification, and contextual relevance. For digital libraries, in particular, accurate metadata is even more crucial due to the diversity of formats and content types available (Park & Lu, 2020). An error in author name, subject heading, or publication date can lead to incorrect categorization or omission from search results, ultimately weakening the library's utility and credibility.

Factors Influencing Accuracy (e.g., Training Data, Context Awareness)

The accuracy of AI-generated metadata is heavily influenced by the quality and diversity of the training data used to develop the model. If the training datasets contain biases, inconsistencies, or errors, the AI may replicate or even amplify those issues (López Espejel et al., 2023). Furthermore, context awareness is critical for accurate metadata generation. For instance, AI must be able to distinguish between homonyms, cultural references, and domain-specific terminologies. ChatGPT and other AI tools can sometimes misinterpret context, especially in specialized academic or indigenous knowledge domains, which leads to inaccuracies in subject categorization or keyword assignment (Kolawole, 2021). Additionally, metadata generation models may perform well in general literature but poorly in niche areas such as law, medicine, or historical archives due to insufficient representation in training data.

Natural Language Processing (NLP) tools like GPT-4 and Bard have shown improvements in contextual comprehension, but they are still limited by the breadth and balance of the data they are exposed to (Afgiansyah, 2023). Without proper contextual tagging, AI may generate metadata that is syntactically correct but semantically misleading.

Impact on Cataloguing Standards and System Interoperability

The integration of AI into metadata creation poses both opportunities and disruptions to traditional cataloguing standards. On one hand, AI can automate repetitive cataloguing tasks and reduce workload. On the other hand, it challenges the maintenance of long-standing standards like AACR2, RDA, and MARC21. Since AI tools are not inherently designed to conform to bibliographic standards, metadata must often be reviewed and adjusted manually before integration into library systems (Kolawole, 2021). System interoperability depends on

consistent metadata structures. Libraries collaborating through union catalogues or digital repositories may face synchronization issues when AI-generated metadata fails to align with shared schemas or crosswalks. According to Musoke (2022), discrepancies in data formatting, field usage, and term mapping can hinder the seamless exchange of records between institutions. To bridge this gap, some library systems are exploring hybrid approaches, where AI is used for initial metadata drafting and human librarians refine and validate outputs for standard compliance. This collaborative model offers a way to harness AI's efficiency without compromising quality and uniformity.

The integration of ChatGPT into academic libraries presents a timely and relevant area of research for several key reasons:

1. Advancing Technological Integration in Libraries: Academic libraries are continuously evolving to meet the changing needs of their users, often through the adoption of emerging technologies. ChatGPT, as a sophisticated natural language processing tool, represents one of the latest advancements. Exploring its application within library settings is essential for understanding how libraries can remain innovative and responsive in a digital age.

2. Improving User Experience: Enhancing the user experience is central to the mission of academic libraries. This study investigates how ChatGPT can support information retrieval, respond to user queries, and facilitate problem-solving. By examining these interactions, the study aims to identify potential improvements in service delivery and user satisfaction.

3. Gaining Insight into AI Perspectives: A unique aspect of this research is the consideration of ChatGPT's own "perspectives"—its programmed responses regarding its role, usefulness, and limitations. While ChatGPT lacks consciousness, analyzing its outputs offers insight into how AI models are trained to interpret their functions and contributions in professional contexts, such as academic libraries.

4. Addressing Ethical and Operational Challenges: The deployment of AI tools in libraries raises important ethical questions related to data privacy, algorithmic bias, and transparency (Patel et al., 2023). Investigating these concerns in the context of ChatGPT helps inform best practices and encourages the responsible, ethical use of AI in library services. This study not only explores the practical implications of using ChatGPT in academic libraries but also contributes to the broader discourse on the ethical and effective integration of AI in information management.

The Internet of things (IoT)

The internet of things (IoT) describes physical objects (or groups of such objects) that are embedded with sensors, processing ability, software and other technologies thst connect and exchange data with other devices and systems over the internet or other communications networks. The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human- to- computer interaction.

(Bansal, Arora, and Suri, 2018), discussed in his article, that the libraries are changing and he talked about distinctive angles of loT in the library. It was also discussed that libraries have to plan to keep pace with the flow of time in our society and adopt various technological innovations. One of the biggest changes in innovation is the move from the Internet of communication mentioned that libraries are always at the forefront when it comes to comes to adoring and using new technology,. This paper also helps in exploring the meaning and definition of the internet of things , it's chronological background, it's potential applications in libraries, and some of the challenges faced by the library professional while implementing it. It clearly states that the internet of things technology can be used in a variety of ways in a library. Such as digitization tools technology library , library management tools, library automation software, search and access tools, preservation tools, social media, internet, mobile applications, SMS, e-in his articles mail,etc.

(Mondal , 2021) discussed in the article, he that the libraries are changing and talked about distinctive angles of IoTin the library. It was also discussed that adopt various technological innovations. One of the biggest changes in innovation is the move from the Internet of communication to the internet of things.

(Nag and Nikam, 2016) discussed the possible usage of the loT in his paper. The Internet of Things is a new evolving technology as well as an ideal emerging technology to impress supporters by providing fast and convenient efficient services. The present study provides the concept of Internet of Things technology with a view to enhancing services in libraries. Using cloud computing, magic mirrors, and wireless sensor networks to take a step towards a smart library. Thus an approach has been proposed to improve the library facilities and provide a patron-friendly system. The proposed system is expected to enhance user convenience and will be used effectively in the near future.

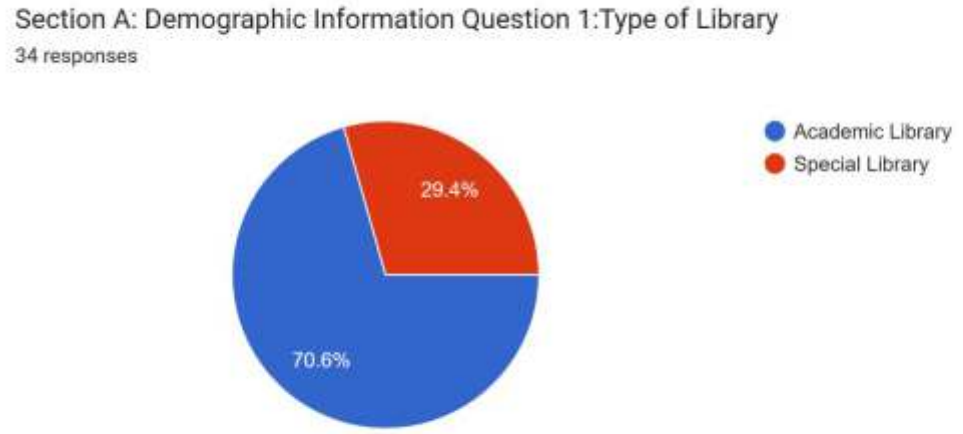
(Abo-Seada, 2019) covers loT and its applications in libraries by his article. He says libraries have been influenced by all the developments in IT and have benefited from IT tools. In recent years, new IT concepts have emerged, including digital transformation, cloud computing, and the Internet of Things (loT). Libraries have to adopt new approaches to save a large portion of their IT budget. IT is useful not only for rationalizing costs but also for achieving efficiency.
Furthermore, while the libraries must take care of the user community, they must apply the concepts of the Internet of Things, digital transformation, and cloud computing to provide the best modern services.

Blockchain as a technology tool
Blockchain is a new and reliable technology that helps with security, preservation and reliability of data. Libraries are change agents of the 21st century and are implementing new technologies to provide maximal information in minimal time. Blockchain technology can be used to solve different problems in library field with proper usages for storing information in a distributed temper-resistant setting. Blockchain in library settings can be used to gather, preserve and share authoritative information devoid of many technological hurdles. Some challenges such as finance, technical and security issues are troubling factors, but proper training, support from decision makers and technical skills regarding this technology will pave the way for library practitioners. Undoubtedly, libraries are changing agents of the 21st century and are working for the goodwill of the communities. Evidence has also shown that blockchain is a perfect tool for Digital Rights Management (DRM) since digital resources are inherently reproducible and this creates issues for libraries and publishers. Publishers have imposed draconian, often unworkable DRM tools on libraries and consumers in order to prevent copying of their materials. Because the block chain creates a unique, verifiable record that can be accessed by any one, it could be tied to digital materials and used as a method to show "provable scarcity" of that resource. This would allow digital materials to be uniquely identified, controlled and transferred. Publishers could be reassured that no copies were being made, but whether or prices would decrease accordingly is debatable (Dabbs, 2016).
Furthermore, the Blockchain basically is about storing information in a distributed, tamper- resistant setting. This fits well with the work librarians have always been doing, that is, gathering, preserving and sharing authoritative information. To this end, the Blockchain can help librarians achieve that work, especially in the world of scientific publications and one other potential use for the blockchain could be to create time stamped, verifiable versions of journal articles. In this regard, Irving and Holden (2016) successfully tested the use of the Bitcoin blockchain "as a low cost, independently verifiable method that could be widely and readily used to audit and confirm the reliability of scientific studies and this they did by creating a cryptographic hash of the plain.

Key competencies for librarians in the 5th Industrial Revolution
There are basic skills and competencies required to effectively drive these technologies when adopted and Demir & Ercan, (2019) identified the following:
*Learning and innovation skills (creativity, critical thinking, problem-solving)
*Digital literacy skills (data management, AI applications, cybersecurity awareness)
*Career and life skills (collaboration, leadership, adaptability, resilience)
*Self-management and technology skills (analytical thinking, emotional intelligence, technological proficiency)

Methodology
This study adopted a descriptive survey design to investigate the integration of emerging technologies to promote library services in the 5th Industrial Revolution (5IR). The population of study was 35 librarians from Michael Okpara University of Agricuture, Umudike (MOUAU) and National Root Crop Research Institute (NRCRI) Umudike, all in Abia State, Nigeria. Census sampling technique was used for the study because the population was both manageable and accessible. Bernard (2012) supported this idea by asserting that if a population of a study is less than two hundred (200), the entire population should be used for the study. The instrument for data collection was structured questionnaire using the 4. Likert scale type of measurement. Inferential statistics such as frequency counts, percentages and mean value analysis was used to analyze the data collected.

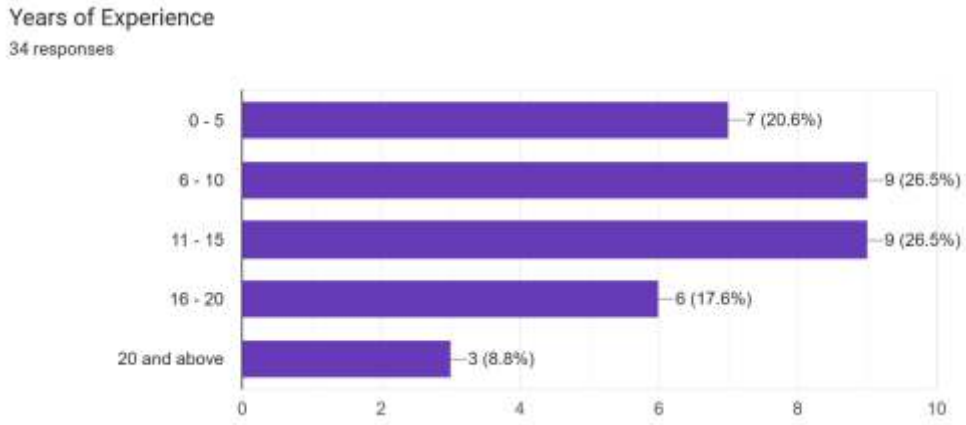
Section A: Demographic Information
What type of library do you work in?
Figure 1



Source: Field work, 2025

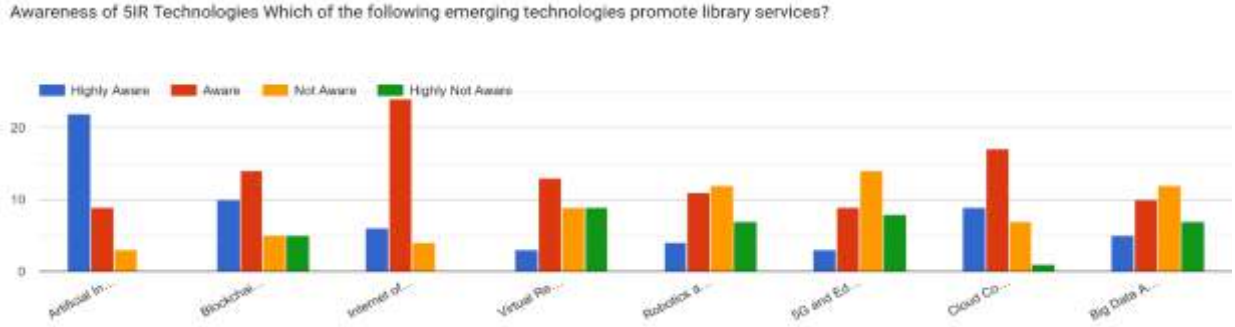
From the Figure 1 above, responses received from the Academic Library Staff are more with 70.6%, while that of Special Library is 29.4%

How many years of experience do you have in the library and information science field?



Source: Field work, 2025
Figure 2 shows that the respondents within the 6 – 15 (that is; 6 – 10, and 11 – 15) years of experience are more. Those with 0-5 years working experience are 7(20.6%), 6-10years, and 11-15 years are 9 each representing 26.5% respectively. 6 respondents have 16-20 years working experience, representing 17.6%, while only 3(8.8%) respondents have a working experience of above 20 years.

Section B: Awareness of 5IR Technologies that promotes library services
How familiar are you with the concept of the (5IR) technologies?



Which of the following emerging technologies are you aware that promotes library services in the 5th Industrial Revolution (Select all you know).

- ☐ Artificial Intelligence (AI) (e.g., chatbots, recommendation systems)
- ☐ Blockchain Technology (e.g., secure digital records, copyright protection)
- ☐ Internet of Things (IoT) (e.g., smart shelves, automated inventory)
- ☐ Virtual Reality (VR) / Augmented Reality (AR) (e.g., virtual library tours)
- ☐ Robotics and Automation (e.g., automated book sorting, self-checkout kiosks)
- ☐ 5G and Edge Computing (e.g., ultra-fast wireless access, seamless remote access)
- ☐ Cloud Computing (e.g., digital repositories, remote library access)
- ☐ Big Data Analytics (e.g., data-driven decision-making, user behavior analysis)
- ☐ Other (please specify) _____

S/N	Question items	HA	A	NA	HNA	MEAN	DECISION
1	Artificial Intelligence (AI)	22	9	3	0	3.55	HA
2	Blockchain Technology	10	14	5	5	2.85	A
3	Internet of Things (IoT)	6	24	4	O	3.05	HA
4	Virtual Reality (VR) / Augmented Reality (AR	3	13	9	9	2.29	NA
5	Robotics and Automation	4	11	12	7	2.35	NA
6	5G and Edge Computing	3	9	14	8	2.20	NA
7	Cloud Computing	9	17	7	1	3.00	A
8	Big Data Analytics	5	10	12	7	2.38	NA

GRAND MEAN **2.70**

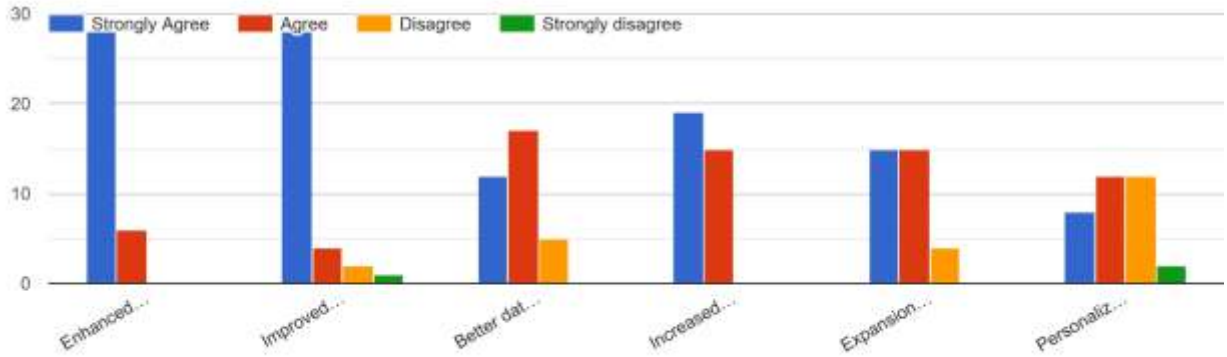
Key: HA=Highly Aware; A= Aware; NA= Not Aware; HNA= Highly Not Aware

Source: Field Work, 2025

TABLE 1: Findings from the data collected in relation to how familiar the Librarians are with the emerging technologies that promote library services reveals that the respondents are aware that AI with mean score of 3.55, IoT (3.05), Cloud computing (3.00) and Blockchain technology (2.85) promote library services. On the other hand, the respondents are not aware that VR/AR, Robotics, 5G and edge computing, as well as Big Data promote library services. In summary therefore, it is evidenced that the librarians in Michael Okpara University of Agriculture, Umudike and National Root Crop Research Institutes, Umudike are aware of some of the Emerging Technologies in 5IR that promote library services with Artificial Intelligence having the highest mean score. The study by Lulu-Pokubo & Okwu, (2024) revealed that there is a high extent of librarians' awareness regarding the use of artificial intelligence technologies for sustainable library services. This agrees with the finding from this paper. Furthermore, the study by Ji, (2022) reveals that librarians in Nigeria are not evolving at the desirable pace in infusing emerging technologies into library service delivery. While these technologies, such as artificial intelligence and blockchain, are recognized as enablers for sustainable library services, there is a significant gap in awareness and adoption among librarians. This indicates a need for a change in disposition towards these technologies, which are essential for enhancing library services in the contemporary global ecosystem.

RESEARCH QUESTION 2: What are the key benefits of integrating emerging technologies into library services? (Select all that applies to you)

RESEARCH QUESTION 2: What are the specific benefits of integrating emerging technologies into library services? (Select all that applies to you)



- ☐ Enhanced efficiency and automation of library processes
- ☐ Improved user experience and accessibility
- ☐ Better data management and security
- ☐ Increased collaboration with researchers and technology providers
- ☐ Expansion of digital resources and services
- ☐ Personalized library services using AI and analytics
- ☐ Other (please specify) _____

S/N	QUESTION ITEMS	SA	A	D	SD	MEAN	DECISION
1	Enhanced efficiency	28	6	0	0	3.82	SA
2	Improved user experience	27	4	2	1	3.67	SA
3	Better data management and security	12	17	5	0	3.20	SA
4	Increased collaboration with researchers	19	15	0	0	3.55	SA
5	Expansion of digital resources and services	15	15	4	0	3.32	SA
6	Personalized library services using AI	8	12	12	2	2.76	A

GRAND MEAN **3.38**

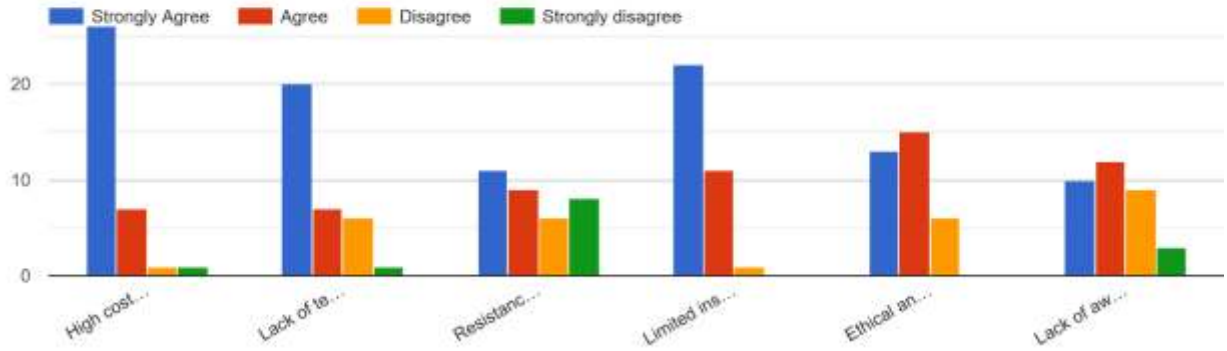
Key: SA= Strongly Agree; A= Agree; D= Disagree; SA= Strongly Disagree.

Source: Field Work 2025

TABLE 2: From the responses on the benefits of integrating these emerging technologies into library services, all the respondents agreed that integrating the emerging technologies into library services will promote library practice in Michael Okpara University of Agriculture, Umudike and National Root Crop Research Institute, Umudike. Summarily, the respondents corroborated that integrating the emerging technologies into library services enhances efficiency, improves user experience, leads to better data management, expansion of digital resources, increases collaboration, and personalized library service. This is in line with the study by Olafimihan, Atanda, Gbotosho, & Ekeh, (2024) that highlights that integrating emerging technologies, particularly Artificial Intelligence, enhances user experience, improves resource discovery, and increases accessibility in library services.

RESEARCH QUESTION 3: What are the primary challenges in adopting emerging technologies in libraries? (Select up to three)

RESEARCH QUESTION 3: What are the primary challenges in adopting emerging technologies in libraries? (Select up to three)



- ☐ High cost of implementation
- ☐ Lack of technical expertise among library staff
- ☐ Resistance to change from library professionals
- ☐ Limited institutional support and funding
- ☐ Ethical and privacy concerns
- ☐ Lack of infrastructure and training opportunities
- ☐ Others (please specify.

S/N	QUESTION ITEMS	SA	A	D	SA	MEAN	DECISION
	High cost of implementation	26	6	1	1	3.67	SA
	Lack of technical expertise among library staff	20	7	6	1	3.35	SA
	Resistance to change from library professionals	11	9	6	8	2.67	A
	Limited institutional support and funding	22	11	1	0	3.61	SA
	Ethical and privacy concerns	13	15	6	0	3.20	SA
	Lack of infrastructure and training opportunities	10	12	9	3	2.85	A

GRAND MEAN **3.22**

Key: SA= Strongly Agree; A= Agree; D= Disagree; SA= Strongly Disagree.

Source: Field Work, 2025

TABLE 3: The summary of the responses on the challenges in adopting emerging technologies in libraries shows that all the respondents agreed that high cost of implementation, lack of technical expertise, resistance to change, limited institutional support, ethical and privacy concern, and lack of infrastructure and training are the major challenges militating against the adoption of these emerging technologies in the libraries under study. This finding corroborated with Ji, (2022) who highlighted that in Nigeria, the adoption of emerging technologies is hindered by numerous challenges, including a lack of infrastructure and expertise. This has resulted in a slower pace of integration compared to developed countries. Subaveerapandiyan, Alam, Subaveerapandiyan, Taj, & Kataria, (2024) further identified cost, expertise, ethics, and infrastructure as barriers hindering their integration into library services.

Conclusion

The 5th Industrial Revolution presents unparalleled opportunities for libraries to enhance their services through emerging technologies such as AI, IoT, blockchain, big data, and AR/VR. These innovations have the potential to transform libraries into intelligent, user-centric institutions that facilitate unified knowledge access and community engagement.

However, successful adoption requires addressing the high cost of implementation, limited institutional support, ethical considerations, and equipping librarians with the necessary skills to navigate technological advancements. By striking a balance between technological innovation and core library values, libraries can fully harness the potential of the 5IR to serve diverse user needs effectively.

Recommendations

1. Institutions should make conscious efforts to provide required support and funding for facilities and infrastructures and be willing to provide adequate trainings for librarians and other library staff on the relevant skills that will enable them to effectively discharge their duties using these technologies.
2. Institutions should advocate for increased funding, collaborate with Government and its agencies to reduce the high cost of integrating and maintaining these emerging technologies in libraries.
3. There is need for Librarians to embrace positive innovations and changes as presented by these emerging technologies. This will enable them to remain relevant and keep abreast with global best practices.
4. As institutions advocate for the integration of these emerging technologies into library services, adequate provisions should be made to ensure ethical use of them.

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Impact of Artificial Intelligence (AI) in Marketing Library and Information Services in Federal Universities in Kaduna State, Nigeria

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Abstract

Artificial Intelligence (AI) is transforming academic libraries by enhancing marketing strategies, improving information retrieval, and optimizing library services. AI-driven marketing tools enable libraries to personalize user engagement through targeted recommendations, automated outreach, and chatbots that provide instant assistance. In library operations, AI enhances cataloging, smart search capabilities, and automated metadata management, ensuring efficient resource discovery. This paper explores the role of AI in marketing, library management, and information services within academic institutions. The objectives of the study were: to identify the AI applications currently used in marketing library and information services in Federal universities in Kaduna State; to assess the impact of AI in marketing library and information services and to examine the challenges faced by libraries in implementing AI driven marketing strategies in Federal Universities in Kaduna State, Nigeria. The study adopted Quantitative research method, using a survey research design with the use of academic librarians as the population. Questionnaire was used as data collection instrument. The data was analysed using frequency counts, percentage and mean score with a benchmark of 3.0. This study discovered that chatbot and virtual assistance, Machine Learning and Data Analytics, Natural Language processing and AI powered Digital libraries are the AI tools mostly utilized for marketing library and information Services by Federal Universities in Kaduna State. AI-powered bots provide instant assistance, improving accessibility and user satisfaction and also AI tools (e.g., Turnitin, iThenticate) ensure content originality and support research are some of the impacts of AI tools in marketing Library and Information Services. Epileptic power supply and inadequate fund are the major challenges encountered by the Federal Universities in Kaduna State in marketing Library and Information Services. It can be concluded from the findings of this study that AI has a significant positive impact on the marketing of library and information services in Federal Universities in Kaduna State. Chatbots and virtual assistants are the most widely adopted AI tools for marketing library and information services in federal universities in Kaduna State. This suggests a growing trend and recognition of AI's potential in enhancing user engagement and improving service delivery in academic libraries. This study recommends that Federal universities should further integrate AI technologies beyond chatbots, especially in areas like NLP and Data Analytics, to automate cataloging, personalize user experiences, and improve decision-making.

***Keyword**: Artificial Intelligence (AI), academic Libraries, Marketing Library and Information Services, AI driven tools,*

Introduction

Libraries have become one of the institutions mostly used to manage, disseminate, and preserve knowledge as such entering a revolutionary period in the digital age as a result of the integration of artificial intelligence (AI), (Jones & Umoh, 2022). Academic libraries are the back bone of an educational institution and a place where information is provided to serve all users irrespective of their ages, political or ethical background, religion, sex, etc. It will be difficult for higher institutions to play specific roles without the presence of libraries that are adequately equipped with printed materials, Information and Communication Technology (ICT) and its related facilities, well trained staffs and a high level of services to users that will satisfy their information needs (Ajibero, 2004 as cited in Isiaka 2023).To satisfy the information needs of users, libraries especially academic libraries are adapting to evolving technologies and emerging trend like Artificial Intelligence (AI) in Library and Information Science.

Artificial Intelligence (AI) refers to the capability of a machine or system to perform functions traditionally associated with human intelligence, such as reasoning, learning, and optimization through experience. In essence, AI represents the intelligence of machines, enabling them to mimic human cognitive functions and

make data-driven decisions. As a specialized branch of computer science, AI integrates a wide range of computational methods and tools, including expert systems, fuzzy logic, artificial neural networks, and evolutionary algorithms, case-based reasoning, image processing, natural language processing, speech recognition, and robotics (Kaushal *et al.,* 2012, as cited in Isaiaka, 2023). It was also stated by Jesubukade et.al. (2023) that Artificial intelligence (AI) is an aspect of computational science that is concerned with making machines provide answers to complicated and difficult issues in a way that humans do. Human cognitive characteristics are appropriated, modelled, and integrated as algorithms in a manner that computers understand and can process to give an output or result. In its logical approach, Artificial Intelligence is a neural network, which is a network of artificial neurons or nodes that mimics the human biological processes of neurons. It was developed in a system to imitate the structural organization of the neural activities of humans.
The neural network collectively generates informed decisions as they pass from one to the other. It models biological processes and makes best guesses as they process data. Neural networks are hence a certain form of machine learning system, which is an AI system. Artificial intelligence started as a field in the 1950s and its application to libraries started in the 1990s. (Jesubukade *et al*, 2023)
However, in the context of Library and Information services, AI is not a single technology but rather a collection of interrelated tools and systems that allow machines to sense, comprehend, act, and learn. The capabilities of AI are increasingly being leveraged to perform administrative and operational functions within libraries. For instance, AI is used to automate routine tasks such as cataloging, classification, and metadata generation, thereby improving workflow efficiency. Additionally, AI-powered applications like chatbots and virtual assistants enhance user interaction by providing instant responses to inquiries, facilitating resource discovery, and offering personalized service recommendations based on user behavior analytics. As libraries evolve into digital and hybrid information hubs, the adoption of AI is transforming service delivery by increasing accessibility, enhancing user satisfaction, and expanding the role of librarians in knowledge management (Bello & Abdusalam, 2023).
The integration of artificial intelligence (AI) into library services and content marketing is increasingly recognized as a vital strategy to enhance user engagement and improve service delivery (Sapri *et al,* 2024). However, AI can significantly enhance marketing library and information services delivery in Federal University Libraries, Nigeria by automating tasks, personalizing user experiences, and improving information access. AI-powered tools can automate tasks like cataloging and managing inventory, freeing up librarians to focus on higher-level services. It can also personalize recommendations, enhance user engagement, and provide instant support for inquiries, improving the overall user experience. So also, AI can be used for predictive analytics to optimize collection development and anticipate user needs, ensuring relevant services are provided.

Statement of the Problem

Academic libraries are essential hubs for knowledge dissemination, research support, and user engagement. However, face growing challenges in effectively marketing its services, managing vast collections, and ensuring seamless information access. Traditional marketing strategies often lack personalization and responsiveness, leading to low user engagement. Additionally, conventional library and information services struggle to efficiently organize, retrieve, and recommend relevant resources, especially with the exponential growth of digital and physical collections (Houghai, 2020)
Artificial Intelligence (AI) offers transformative solutions by enhancing marketing efforts, automating library operations, and optimizing information services. AI-driven tools such as personalized recommendation systems, intelligent chatbots, predictive analytics, and automated metadata generation can significantly improve user engagement, streamline resource discovery, and enhance service efficiency (Allison, 2020). However, despite these potential benefits, academic libraries face key barriers to AI adoption, including concerns over data privacy, algorithmic bias, technical implementation challenges, and the need for human oversight to ensure ethical and accurate decision-making. This study explores the impact of AI in marketing, library and information services in Federal University Libraries in Kaduna State, Nigeria.

Research objective

The objectives of this study are to:

1. Identify the AI applications tools currently used in marketing library and information services in academic libraries in Kaduna State, Nigeria.
2. Assess the impact of AI in marketing library and information services in academic libraries in Kaduna State, Nigeria
3. Examine the challenges faced by libraries in implementing AI driven marketing strategies in academic libraries in Kaduna State, Nigeria.

Literature Review

Artificial intelligence (AI) is reshaping the landscape of library and information science (LIS) by introducing innovative solutions that enhance information management, user experiences, and operational efficiency within libraries and information centers (Mupaikwa, 2024). In marketing Library and Information services using AI, certain AI application tools are used.

According to Mulimani, (2024) some of the AI application tools used in marketing library and information services are:

Chatbots and Virtual Assistants: chatbots, driven by AI, provide immediate assistance to users by answering inquiries, guiding them through library resources, and assisting in navigating the library's digital and physical space. These virtual assistants significantly improve accessibility by ensuring users can obtain information and support around the clock (Manjunatha, 2023).

User analytics and personalization: user analytics and personalization are crucial for delivering tailored recommendations, improving resource discovery, and increasing user engagement. By leveraging data and analytics, libraries can gain insight into user behavior, preferences, and needs (Kellar et al., 2007). Kim et. al. (2019) stated that effective personalization can lead to improved user satisfaction, increased resource utilization and enhance learning outcome.

Automation of routine tasks: AI automated 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.

Text classification and sentiment analysis tools: text documents are divided into predetermined categories by text categorization systems using AI algorithms. These technologies have the ability to automatically classify documents in the context of information retrieval, which facilitates the organization and retrieval of data. Sentiment analysis, is a subset of text classification, assesses a text's emotional content and is useful for gauging the general public's perception of or attitude toward a given subject (Haliru & Lawal, 2024).

Cox (2021) also opined that Natural language Processing (NLP) is another AI application tool for marketing library and information services. NLP is the analysis and generation of natural language text by computers. The goal is to enable natural languages such as French, English or Chinese to serve either as the medium through which users interact with computer system or as the object that a system processes. In libraries, NLP can be used to design intelligent expert reference system or information retrieval system, where users can interact directly with the system using natural languages. The computer takes in the natural language as input, analyses and processes it, then respond accordingly with the needed information.

AI Improves Operational Effectiveness and Efficiency: The most significant use of AI in the discipline of Library and Information Science (LIS) has been the development of expert systems. Expert systems have shown to be helpful not just in performing routine but also in boosting productivity and assisting library professional's decision-making processes (Cox *et al.,* 2019). Libraries can determine and boost the organizational effectiveness and efficiency of library services by enhancing the provision of information resources and service efficacy while decreasing operating costs through automation, digital asset management, and optimized research data governance. Collection analysis, visualization, conservation and preservation, and reducing the cost of providing library services can be achieved with the development of artificial intelligence tools in library processes and services. Implementing intelligent systems for the provision of library information resources and services can help develop innovation or creativity that further improve operational effectiveness and efficiency (Stearns, 2014)

Opportunity to Engage Larger Audiences: The library will be able to provide information services to a larger audience by enhancing search engine results with chatbots and location-based services. ML algorithms can also process content from thousands of resources immediately and replace the conventional examination of merely a percentage of that data. AI applications can integrate data on user touch points, previous interactions, and behaviours to identify needs and develop high-quality and engaging experiences for library users. The aim is to produce personalized, accurate research suggestions and even harmonize search results with individual expertise to provide more effective and efficient information resources and services (Isiaka, 2023)

Helps Library Staff Achieve Their New Goals Application of AI cut down manual routines such as daily searches and referencing activities to minimum, Application of AI techniques will minimise human inaccuracies and inefficiencies. These intelligent systems can allow library personnel to engage in more valuable tasks, like supporting library users in drawing up reading lists, educating users to improve their scientific research, building library information resources, and other tasks (Tella, 2020)

Establish Libraries at the Centre of the New Scholarly Information Landscape AI technologies have facilitated interdisciplinary harmonization within scholarly research by helping to find associations that had previously been unnoticed in massive datasets. In addition, libraries can contribute to the on-going flow of data and research across all fields and disciplines by linking to Open Publishing institutions and creating research tools that work with other organizations. Their collections become more searchable, explorable, and analyzable, eventually assisting an extensive, universal resource network of high-quality (Adetayo, 2023)

Though the benefits of adopting AI in marketing of library and information services are well-documented, several challenges complicate their implementation in the federal university libraries in Kaduna state, Nigerian. According to Adebayo and Aina (2019) they stated that despite the increasing interest, the widespread adoption of AI is hindered by several factors, including limited funding, infrastructural challenges, and the need for specialized skills among library staff.

It was reported by Okafor and Adebayo (2019) that one of the most significant challenges is the lack of sufficient funding they said that academic libraries in Edo State, like many others in Nigeria, often face budget cuts, limiting their ability to acquire new resources, upgrade technological infrastructure, or employ skilled personnel. Oden (2021) also opined that, the economy of the nation is threatening therefore the funds from the government are shrinking. Finance is very crucial in the implementation of AI, so the library have to budget their funds, as little as it may be, for the adoption of AI. One possible problem that will not make this work is corruption because though most libraries have been budgeted for a long time, there is still no visible change. This affects the services of the library and this problem also reflect in the level of funds allocated to it by the government. The possible solution here is to make each library stand independent from any organizational body collecting funds for it from the government, lay down organizational charts in line with the library budget and then affix offices that would be held responsible if the budget affixed for a project is left undone within the stipulated period of time. (Muiz, 2018).Furthermore, poor internet connectivity, unreliable power supply, and limited access to modern computer hardware are common issues faced by many libraries. This limits the full integration of digital resources and hampers the effectiveness of online learning tools (Amuta, 2021).

It was also observed by Adetoro and Olatokun (2020) that insufficient training and professional development opportunities for library staff is another challenge faced in the application of AI for marketing library and information services. Many academic libraries face staffing shortages and lack the necessary technical expertise to manage emerging technologies effectively. Professional development programs, particularly in areas like digital librarianship, are essential for equipping staff to meet the demands of modern library services. In relation to that, Adebayo and Aina, 2019 also opined that most library staff members were trained in traditional library practices, and there is a pressing need for professional development programmes that focus on AI, machine learning, and data science. Without these skills, libraries and librarians may struggle to make the most of AI's potential**.**

Furthermore**,** lack of user awareness possess a challenge to the application of AI in marketing library and information services. While libraries offer a wealth of resources, there is often a lack of awareness among students and faculty about the full range of services available including the use of AI tools in carrying out certain services in the library. This lack of awareness can hinder effective use of library resources, including online databases, e-journals, and other digital content. Promoting information literacy and encouraging greater engagement with library resources remain ongoing challenges (Oladejo, 2019).

Over time, Librarians are reluctant with the adoption of AI because of a certain myth they heard, that once AI is put in place it begins to produce results itself and so leads to loss of jobs. Rather, the path to AI success takes time, thoughtful planning, and a clear idea of the deliverables you want to accomplish. You need a strategic framework and an iterative approach to avoid delivering a random set of disconnected AI solutions. Without people involved in the planning and the implementation of AI, it can't work. There is so much to learn from working with AI. Librarians however should not be over reliance on AI, by focusing too much on the emerging AI technologies rather than learning itself. When librarians have learnt from their relationship with AI, not only learning but also implementing it in their daily activities, this will improve the services that are provided by the library to their users.

Methodology

The study adopted quantitative research methodology, using survey research design with the use of 140 academic librarians as the population of the study. Questionnaire was used as the data collection instrument. Total enumeration method was adopted for sample selection since the population comprised of 140 academic librarians from the four Federal Universities in Kaduna state. The Federal Universities in Kaduna State are Ahmadu Bello University, Zaria, Federal University of Education Zaria, Nigerian Defence Academy Kaduna, and Air Force Institute of Technology, Kaduna. The data collected was analyzed, using frequency counts, percentage and mean score, with a benchmark of 3.0.

Data Presentation and Analysis

The data collected are presented, analyzed and discussed using frequency count, simple percentage and mean score. Only 110 copies out of the 140 questionnaire administered was returned and found usable, giving a response rate of 78.6%.

Table 1: Distribution of Questionnaire to Academic Librarians in the federal Universities in Kaduna state

Federal Universities	Academic librarians	Copies of questionnaire distributed	Copies of questionnaire returned	Percentage response (%)
Ahmad Bello University, Zaria	95	95	73	52.1
Nigeria Defence Academy Kaduna	11	11	7	5
Air Force Institute of Technology, Kaduna	9	9	9	6.4
Federal University of education, Zaria	25	25	21	15
Total	140	140	110	78.5

Source: field survey, 2025

Table one revealed that out of the 140 questionnaire distributed in the Federal Universities Libraries in Kaduna State, 110 were duly returned giving a percentage of 78.6 which was found usable for this study.

Objective 1: Types of Artificial Intelligence application tools used by academic libraries in Federal Universities in Kaduna State.

The respondents were provided with options and were asked to indicate the types of Artificial Intelligence (AI) application tools used for marketing library and information services in the respective libraries. The Responses to the objective presented are in table 2:

Table 2: Types of AI application tools used for marketing library and information services in Federal Universities in Kaduna State

Types of AI application tools used in marketing library and information services	Frequency	Percentage
Chatbots & Virtual Assistants	96	88.1
Personalized Recommendations	70	64.2
Predictive Analytics	16	14.7
Automated Content Creation	34	31.2
Sentiment Analysis	17	15.6
Machine Learning (ML) & Data Analytics	61	56
Natural Language Processing (NLP)	71	65.1
Optical Character Recognition (OCR)	25	22.9
Automated Indexing & Classification	62	56.9
AI-Powered Digital Libraries	57	52.3
Speech Recognition & Voice Search	34	31.2

Field Survey, 2025

Table 2 shows that Chabot's and Virtual assistance are the highly used AI application tools for marketing Library and Information services in Federal Universities in Kaduna State with the frequency of 96 (88.1%). So also, Natural Language Processing (NLP), with frequency of 71 (65.1%), Personalized Recommendations 70(64.2%), Machine Learning (ML) & Data Analytics, with frequency of 61(56%), Automated Indexing and Classification 62(56.9%), AI-Powered Digital Libraries with frequency of 57(52.3%) are also utilized by Federal Universities in Kaduna State. While Automated content creation, Speech recognition and voice search with frequency of 34 (31.2%), optical character recognition 25(22.9), sentiment analysis 17(15.6%) and predictive analytics with frequency of 16(14.7%) respectively are the least AI tools used by Federal Universities in Kaduna State in the marketing of Library and Information Services. This implies that academic librarians in Federal Universities in Kaduna State studied are more conversant with the Chatbot and Virtual assistance. This indicates that with the use of this AI application tools, libraries can streamline their activities and respond to users' information needs at the right time and also stay abreast with the 21st century challenges on the use of emerging technologies. This is Consistent with Waghmare et. al. (2024) and Mulimani, (2024) who listed Chatbots and Virtual Assistance, Personalized Recommendations, AI-Powered Digital Libraries, Natural Language Processing (NLP) and Machine Learning (ML) & Data Analytics as types of AI tools used in marketing library and information services.

Objective 2: Impact of Artificial Intelligence in marketing library and information services in Federal Universities in Kaduna State

This objective of the study is to determine the impact of AI in marketing library and information services in Federal Universities in Kaduna State. The responses are presented in table 3 below

Table 3: **Impact of Artificial Intelligence in marketing library and information services.**

VARIABLES	SA	A	N	SD	D	Mean score
AI analyzes user behavior to suggest relevant books, journals, and resources	50(55%)	37(40.7%)	19(20.9%)		4(4.4%)	4.2
AI-powered bots provide instant assistance, improving accessibility and user satisfaction.	35(38.5%)	49(53.9%)	16(17.6%)	1(1.1%)	9(9.9%)	3.9
Enables voice search and OCR for digitized books, making information more accessible.	29(31.9%)	50(55%)	16(17.6%)	1(1.1%)	14(15.4%)	3.7
AI helps libraries tailor marketing campaigns based on user preferences.	35(38.5%)	50(55%)	12(13.2%)	1(1.1%)	12(13.2%)	3.9
AI analyzes trends and user interactions to optimize content strategy.	37(40.7%)	44(48.4%)	20((22%)	1(1.1%)	8(8.8%)	3.9
AI-generated newsletters, blog posts, and event announcements boost engagement.	33(36.3%)	43(47.3%)	22(24.2%)	1(1.1%)	11(12.1%)	3.8

AI speeds up classification and indexing of materials.	40(44%)	46(50.6%)	13(14.3%)		11(12.1%)	3.9
Helps libraries anticipate book demand and optimize stock.	25(27.5%)	49(53.9%)	20(22%)	3(3.3%)	13(14.3%)	3.6
AI tools (e.g., Turnitin, iThenticate) ensure content originality and support research.	50(55%)	37(40.7%)	17(18.7%)		6(6.6%)	4.1
AI automates repetitive tasks like answering FAQs, indexing, and metadata tagging.	36(39.6%)	52(57.2%)	14(15.4%)	1(1.1%)	7(7.7%)	4.0
AI-driven insights help libraries allocate funds effectively.	35(38.5%)	42(46.2%)	24(26.4%)	1(1.1%)	8(8.8%)	3.9

Field Survey, 2025

SA: Strongly Agree, A: Agree, N: Neutral, SD: Strongly Disagree, D: Disagree

Table 3 assesses the impact of AI in the marketing of library and information services in Federal Universities in Kaduna State. The findings reveals that an overwhelming majority of respondents strongly agree that AI analyzes user behavior to suggest relevant books, journals, and resources with a mean score of 4.2, it also indicates that majority of respondents strongly agree that AI tools (e.g., Turnitin, iThenticate) ensure content originality and support research with a mean score of 4.1. Furthermore, it reveals that majority of the respondents agree that AI automates repetitive tasks like answering frequently Asked Questions (FAQs), indexing and metadata tagging and also speeds classification and indexing of materials with mean scores of 4.0. It also indicated that majority of the respondents agree that AI-powered bots provide instant assistance, improving accessibility and user satisfaction, AI helps libraries tailor marketing campaigns based on user preferences, AI analyzes trends and user interactions to optimize content strategy, and AI-driven insights help libraries allocate funds effectively with mean score of 3.9 each. It also shows that majority of the respondents agree that AI Enables voice search and OCR for digitized books, making information more accessible with mean score of 3.6 and also AI help libraries anticipate book demand and optimize stock with a mean score of 3.6 respectively.

This implies that majority of the respondents believe that AI has really impacted the library positively by easing the daily routine activities and services rendered in the library. This is in line with the opinion of Cox *et al.* (2019) who stated that AI improves operational effectiveness and efficiency and that, the most significant use of AI in the discipline of Library and Information Science (LIS) has been the development of expert systems. Expert systems have shown to be helpful not just in performing routine but also in boosting productivity and assisting library professional's decision-making processes.

Objective 3: Determining the challenges encountered in using AI application tools for marketing library and information services in Federal Universities in Kaduna State

This research objective sought to determine the challenges encountered by academic librarians in the application of AI tools for marketing library and information services. The responses are presented in the table 4 below

Table 4: **Challenges encountered by academic Librarians in the Application of AI tools for marketing Library and Information Services**

VARIABLES	SA	A	N	SD	D	Mean score
Difficulty in understanding AI recommendations	40(44%)	32(35.2%)	23(25.3%)	5(5.5%)	10(11%)	3.8
Technical glitches in AI system	43((47.3%)	33(36.3%)	16(17.6%)	4(4.4%)	14(15.4%)	3.8
Lack of human librarian interaction	35(38.5%)	35(38.5%)	19(20.9%)	3(3.3%)	18(19.8%)	3.6
Privacy concern with AI driven library tools	20(22%)	40(44%)	31(34.1%)	11(12.1%)	8(8.8%)	3.5
Data privacy and security risk	24(26.4%)	36(39.6%)	31(34.1%)	6(6.6%)	13(14.3%)	3.5
Job displacement due to automation	28(30.8%)	33(36.3%)	31(34.1%)	9(9.9)	9(9.9)	3.6
Limited amount of AI experts of library automation vendors	33(36.3%)	39(42.9%)	21(23.1%)	7(7.7%)	10(11%)	3.7
Epileptic power supply	56(61.6%)	18(19.8%)	18(19.8%)	6(6.6%)	12(13.2%)	3.9
No adequate funds	51(56.1%)	23(25.2%)	14(15.4%)	7(7.7%)	15(16.5)	3.8
Lack of technical skills by library staffs	41(45.1%)	34(37.4%)	13(14.3%)	6(6.6%)	16(17.6%)	3.7

Field Survey, 2025

SA: Strongly Agree, A: Agree, N: Neutral, SD: Strongly Disagree, D: Disagree

Table 4 presented the responses on the challenges encountered in the application of AI tools in marketing library and information services in Federal Universities in Kaduna State. The findings shows that majority of the respondents strongly agree that Epileptic power supply with a mean of 3.9 is the major challenge hindering application of AI for marketing Library and Information services in Federal University in Kaduna State. It further revealed that majority of the respondents strongly agree that No adequate funds, difficulty in understanding AI recommendations and technical glitches in AI system with mean score of 3.8 each are part of the challenges encountered in the application of AI for marketing Library and Information services. This study also revealed that majority of the respondents agree that Lack of human librarian interaction, Limited amount of AI experts of library automation vendors and lack of technical skills by library staff with mean score of 3.7 each are other challenges encountered. It also showed that Job displacement due to automation with mean score of 3.6, Data privacy and security risk, Privacy concern with AI driven library tools with mean score of 3.5 each are challenges encountered in applying AI tools in Federal Universities in Kaduna State.

The implication of this finding therefore is that majority of these challenges hindered librarians from successful marketing library and information services in Federal Universities Libraries under study. This is in line with the work of Okafor and Adebayo (2019) and Oden, (2021) that one of the most significant challenges is the lack of sufficient funding and epileptic power supply. It was also stated by Adetoro and Olatokun (2020) that insufficient training and professional development opportunities for library staff is another challenge faced in the application of AI for marketing library and information services.

Conclusion

It can be concluded from the findings of this study that AI has a significant positive impact on the marketing of library and information services in federal universities. Chatbots and virtual assistants are the most widely adopted AI tools for marketing library and information services in federal universities in Kaduna State. This suggests a growing trend and recognition of AI's potential in enhancing user engagement and improving service delivery in academic libraries. Furthermore, the automation of classification, indexing, and routine tasks such as answering frequently asked questions emphases AI's role in enhancing operational efficiency and user satisfaction. However, challenges such as epileptic power supply, inadequate funding, and lack of technical skills among library staff should be carefully addressed. The AI powered library is a symbol of progress, a witness to our ability to harness innovation in service of knowledge and society.

Recommendations

1. Federal universities should further integrate AI technologies beyond chatbots, especially in areas like NLP and Data Analytics, to automate cataloging, personalize user experiences, and improve decision-making.
2. Given their high impact, libraries should prioritize the deployment and continuous improvement of AI-powered bots to enhance user accessibility and satisfaction.
3. Government and university management should invest in stable power supply solutions, such as solar or hybrid systems, to ensure uninterrupted access to AI-based services

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Impact of Emerging Technologies on Skills and Roles of Librarians in the 5IR

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Abstract

This research investigates the impact of emerging technologies on skills and roles of librarians in the 5IR. Employing a descriptive research design, the study targeted over 3000 librarians who are members of the Nigerian Library Association. 90 librarians were selected using proportional allocation from three state chapters of the Nigerian Library Association: Bayelsa, Niger, and Ekiti state (Bayelsa: 24, Ekiti: 30, Niger: 36), ensuring representation from diverse regions: Bayelsa (South-South zone), Ekiti (South-West zone), and Niger (North-Central zone). A structured questionnaire served as the primary data collection instrument. The instrument underwent face and content validity assessment by experts in library and information science. A Cronbach's alpha reliability test yielded a coefficient of 0.82, indicating strong internal consistency. Data were analyzed using mean scores and standard deviation to analyze the questionnaire items. The findings revealed that the 5th Industrial Revolution is significantly transforming the roles of Nigerian librarians. Beyond traditional curatorial functions, librarians are increasingly becoming information navigators, digital literacy trainers, data analysts, and community engagement specialists. Essential new skills identified include proficiency in digital technologies, data management and analysis, information architecture, knowledge management, and instructional design. The study also found that librarians perceive these changes as both challenging and empowering, offering opportunities to enhance library services and elevate their professional standing. The study concluded that the 5th Industrial Revolution necessitates a paradigm shift in librarianship, requiring librarians to embrace new technologies, acquire new skills, and adapt their roles to meet the evolving information needs of users. The study recommends that library schools in Nigeria integrate training on emerging technologies and related skills into their curricula. Furthermore, libraries should invest in continuous professional development programs to equip librarians with the necessary competencies to thrive in the 5th Industrial Revolution.

Keywords: *5th Industrial Revolution, libraries, librarians, Nigeria, skills, roles, competencies, professional development, technology, artificial intelligence.*

I. Introduction

The global landscape of work is rapidly evolving under the influence of the 5th Industrial Revolution (5IR), a paradigm characterized by the fusion of advanced technologies with human-centric approaches (Enakrire, Scholtz & Yakobi, 2024). Unlike the Fourth Industrial Revolution, which emphasized automation and digitalization, the 5IR focuses on collaboration between humans and intelligent machines to create more meaningful and personalized experiences. In the library and information science sector, this transition is becoming particularly evident, with artificial intelligence (AI), robotics, the Internet of Things (IoT), and blockchain technologies reshaping how library services are delivered (D'Souza, 2024). As Nigeria continues to integrate into the global knowledge economy, understanding the 5IR's implications for libraries becomes crucial, especially considering the role of libraries as enablers of information access, research advancement, and lifelong learning.

Traditionally, librarians in Nigeria and elsewhere were primarily custodians of physical materials, overseeing cataloging, reference services, and circulation tasks (Agim & Oraekwe, 2019). However, the advent of disruptive technologies has led to a redefinition of these roles, with librarians now expected to become digital curators, data analysts, information literacy educators, and technology facilitators. Technologies such as machine learning-driven search engines, augmented reality interfaces, and automated metadata generation

tools demand new competencies from library professionals, including digital literacy, coding skills, ethical reasoning, and data stewardship. According to Apriliyanti and Ilham (2022), the 5IR emphasizes not just the adoption of technology but the meaningful integration of human values, creativity, and empathy into these processes, thus further complicating the skillsets required of modern librarians.

Despite these significant shifts, many librarians in Nigeria are grappling with the challenges posed by the 5IR due to systemic issues such as inadequate technological infrastructure, limited training opportunities, and lack of supportive institutional policies (Humayun, 2021). Furthermore, there remains a cultural inertia in several library environments that prioritize traditional practices over innovative transformation. In the face of these challenges, there is a growing call for a strategic reassessment of librarians' roles and professional development frameworks to align with the demands of the 5IR. Notably, the emphasis is not only on acquiring technical skills but also on cultivating a human-centric approach that ensures inclusivity, ethical standards, and societal relevance in library services

II. Statement of the Problem

The current skills and roles of librarians in Nigeria are increasingly challenged by the demands of the Fifth Industrial Revolution (5IR), which emphasizes a human-centric integration of advanced technologies such as artificial intelligence, big data analytics, and the Internet of Things. While previous research has extensively covered the Fourth Industrial Revolution's impact on librarianship, there is a significant gap in empirical studies that specifically address how 5IR reshapes librarians' competencies and responsibilities. Librarians now require not only traditional information management skills but also competencies in digital literacy, data curation, emotional intelligence, and collaborative problem-solving to effectively operate in this new era (Demir & Ercan, 2019; Owolabi et al., 2024). However, many librarians in Nigeria face challenges in acquiring these emerging skills due to limited training opportunities, inadequate infrastructure, and insufficient institutional support. This deficiency limits their ability to harness 5IR technologies fully, thereby constraining their evolving roles as facilitators of knowledge creation, personalized user engagement, and inclusive service delivery (Ekwueme, 2024; Nurminen & Koponen, 2020). Consequently, there is a pressing need to investigate the specific skill gaps, role transformations, and strategic interventions necessary to prepare Nigerian librarians for the demands of the 5IR, enabling them to contribute effectively to education and information access in a rapidly changing technological landscape.

Research Questions

1. What are the key technologies driving the 5th Industrial Revolution relevant to library services?
2. How are these technologies changing the traditional roles of librarians in the 5th Industrial Revolution?
3. What new skills and competencies are required by librarians in the 5th Industrial Revolution?
4. What is the perceived impact of these changes of the 5th Industrial Revolution on the skills and roles of librarians?

III. Literature Review

Emerging Technologies Driving the 5th Industrial Revolution

The Fifth Industrial Revolution (5IR) is characterized by the fusion of advanced technologies with a human-centric approach, and several emerging technologies are central to this transformation. Artificial Intelligence (AI) continues to lead as a disruptive force, enabling machines to perform cognitive functions such as learning and decision-making, thereby enhancing personalized services across industries including library services (Ibinaiye & Jiyane, 2021). Complementing AI are technologies like Robotics, which are increasingly collaborative and designed to work safely alongside humans, leading to a new era of "cobots" or collaborative robots. The Internet of Things (IoT) also plays a critical role by connecting physical devices and systems to the internet, allowing real-time data sharing and smarter decision-making processes (Zhang, Wang & Liu, 2020). Furthermore, blockchain technology is revolutionizing data security and transparency, particularly in records management, authentication, and decentralized data storage. Augmented Reality (AR) and Virtual Reality (VR) are enhancing immersive learning and user experiences, transforming traditional service models into more interactive and engaging ones (Ziatdinov, Atteraya & Nabiyev, 2024). These technologies collectively signify a shift toward more intelligent, interconnected, and user-focused service ecosystems essential for the future of information management.

The interconnectedness of these emerging technologies drives the transformation at the core of the 5IR, with each offering specific capabilities that extend and enhance human skills rather than replace them. For instance, AI algorithms support librarians in refining search results and predicting user needs, while IoT enables the development of smart libraries capable of automating energy use, monitoring book circulation, and improving user navigation within library spaces (Cox & Mazumdar, 2023). Blockchain can ensure the authenticity and security of digital academic records, promoting trust and accountability in information services (Enakrire, et

al, 2024). Similarly, AR and VR provide new opportunities for librarians to design immersive educational programs and exhibitions, thus expanding the traditional library's scope. By integrating these technologies, the 5IR champions not only technological advancement but also a stronger emphasis on ethical responsibility, inclusivity, and enhancing human welfare, which makes understanding these technologies essential for librarians aiming to remain relevant and proactive in the evolving landscape.

Traditional Roles of Librarians before the 5th Industrial Revolution

Before the onset of the Fifth Industrial Revolution (5IR), librarians traditionally served as custodians of information, managing the acquisition, organization, preservation, and dissemination of knowledge resources. Their core responsibilities included cataloging books and journals, managing circulation services, providing reference assistance, and maintaining archives for research and educational purposes (Agim, Mohammed & Obande, 2024). Librarians also played a critical role in information literacy, guiding users in locating, evaluating, and using information effectively. Collection development, user education, and physical maintenance of library spaces were integral to their professional duties (Zhang, et al, 2020). During this period, the use of technology was limited mainly to integrated library systems (ILS) for cataloging and circulation, with minimal reliance on digital platforms or automated processes (Oladokun, et al, 2024). The librarian's expertise was deeply rooted in traditional bibliographic skills, interpersonal communication, and service-oriented practices aimed at supporting the academic and research communities.

The traditional role of librarians was closely linked to the physicality of information sources and the human mediation of information retrieval. Librarians were gatekeepers of knowledge, responsible for ensuring that users had access to accurate and credible information, often through print collections and face-to-face reference services (Obiekwe & Agim, 2021). These roles emphasized personal engagement, deep subject knowledge, and mastery of classification systems like Dewey Decimal and Library of Congress systems. Collaboration was mainly internal, involving faculty members, researchers, and students within institutional boundaries. Unlike the dynamic, technology-driven environment of today, pre-5IR librarianship was defined by relatively stable competencies that evolved slowly over decades. However, the limited exposure to emerging digital innovations during this period left a skills gap that later posed significant challenges when disruptive technologies began reshaping information landscapes (Tella, Segun, Titilola & Ayodeji, 2023). Understanding these traditional roles is essential for appreciating the magnitude of changes and the new skill sets demanded by the 5IR.

Transformation of Librarians' Roles in the 5th Industrial Revolution Era

The emergence of the Fifth Industrial Revolution (5IR) has fundamentally transformed the roles of librarians, shifting them from traditional custodians of print materials to dynamic facilitators of digital knowledge ecosystems. In the 5IR era, characterized by human-machine collaboration, librarians are increasingly involved in managing digital repositories, curating big data, and leveraging artificial intelligence (AI) tools to enhance information discovery (Nwobu, Dumbiri, Ibia & Oladokun, 2024). The integration of AI, robotics, blockchain, and Internet of Things (IoT) technologies into library services has necessitated a redefinition of core competencies, where data literacy, digital curation, and technological proficiency are now as essential as traditional information management skills (Oladokun, et al, 2024). Librarians today are not only information specialists but also digital strategists, metadata analysts, and research support experts, actively contributing to institutional digital transformation initiatives. These new responsibilities highlight the evolving expectation that librarians must anticipate technological trends and foster user-centric innovations that bridge the human-technology divide.

Moreover, the transformation has emphasized a stronger need for interdisciplinary collaboration and user empowerment. Librarians are now expected to collaborate with IT departments, academic researchers, and industry stakeholders to design and implement smart library services that personalize user experiences through predictive analytics and machine learning models (Ajani, Dunmade, Tella & Adeniran, 2023). Professional development initiatives increasingly focus on skills such as coding, data management, AI ethics, and digital rights management, positioning librarians as central players in the knowledge economy (Cox & Mazumdar, 2023). In the 5IR, emotional intelligence, creativity, and adaptability are seen as critical attributes for librarians as they mediate complex human-technology interactions and advocate for equitable access to information. This transformation underscores the urgent need for continuous upskilling and institutional support to prepare librarians for sustainable leadership roles in a rapidly evolving information landscape.

New Skills and Competencies Required by Librarians in the 5th Industrial Revolution

The 5th Industrial Revolution (5IR) demands a new set of skills and competencies from librarians, primarily emphasizing digital fluency, data analytics, artificial intelligence (AI) literacy, and human-centered technology integration. Librarians are now required to develop advanced digital skills to manage big data,

implement machine learning tools, and curate digital content effectively (Nwobu, et al 2024). Beyond technical proficiency, librarians must also cultivate strong ethical reasoning abilities, particularly concerning data privacy, algorithmic bias, and intellectual property rights in an AI-driven environment. These competencies ensure librarians not only manage technology but also uphold the ethical standards necessary in a complex digital information ecosystem (Ibinaiye & Jiyane, 2021). The ability to apply critical thinking to technology adoption decisions, coupled with a deep understanding of user experience design, has become crucial in ensuring that library services remain accessible and equitable in the 5IR era

In addition to technical and ethical skills, soft skills such as adaptability, creativity, emotional intelligence, and interdisciplinary collaboration are becoming indispensable for librarians. As technology reshapes information access and dissemination, librarians must demonstrate agility in learning new systems, innovative problem-solving in service delivery, and empathy in supporting diverse user needs (Nwobu, et al, 2024). Professional development programs now advocate for librarians to engage in continuous learning, including workshops on coding, data visualization, AI ethics, and digital storytelling, to stay relevant in the rapidly evolving information landscape (Enakrire, et al, 2024). Furthermore, leadership and advocacy skills are crucial as librarians play an increasing role in advising institutions on digital strategy and promoting equitable access to emerging technologies. These new competencies align librarians closely with the broader goals of the 5IR, where technology is designed to augment human capabilities rather than replace them.

Challenges Facing Nigerian Librarians in Adapting to the 5th Industrial Revolution

Nigerian librarians face significant challenges in adapting to the demands of the 5th Industrial Revolution (5IR), with infrastructural deficits being a major obstacle. Poor access to cutting-edge technologies such as artificial intelligence (AI) tools, machine learning platforms, and high-speed internet significantly hampers the ability of libraries to modernize their services (Ajani, et al, 2023). Additionally, inadequate funding further constrains the acquisition of technological resources, leading to a persistent digital divide between Nigerian academic libraries and their global counterparts (Agim, et al, 2025). Compounding these issues is the lack of robust institutional policies and strategies to support continuous professional development in AI and emerging technologies, leaving many librarians without the necessary training to transition effectively into 5IR environments. Consequently, many Nigerian librarians remain stuck in traditional service models, struggling to meet the evolving expectations of 21st-century information seekers.

Beyond infrastructure and funding, skill gaps and resistance to change also present serious challenges for Nigerian librarians in the 5IR era. According to Apriliyanti and Ilham (2022), many librarians are not yet proficient in digital competencies such as AI integration, data analytics, or digital content management. Moreover, a significant proportion of library staff exhibit technophobia or skepticism towards emerging technologies, driven by fears of job redundancy or inadequate understanding of technology's potential to enhance, rather than replace, professional roles (Ayandokun & Nworu, 2022). This reluctance to embrace change often leads to missed opportunities for innovation and relevance in the fast-evolving information landscape. Without targeted efforts to address these barriers—including structured capacity-building programs, motivational incentives, and change management initiatives—Nigerian librarians may find it increasingly difficult to position themselves as critical players in the human-centric 5IR movement.

IV. Methodology

This study will employ a descriptive survey research design, which is well-suited for exploring the impact of emerging technologies on the skills and roles of librarians in the 5th Industrial Revolution (5IR). The survey design facilitates systematic collection of data from a large number of librarians to understand their current competencies, challenges, and perceptions regarding new technologies. The population consists of over 3000 professional librarians who are members of the Nigerian Library Association (NLA) (NLA Membership Directory, 2024). A stratified random sampling technique will be used to select respondents proportionally from the three state chapters. Stratification ensures that librarians from each state are fairly represented according to their population size. Specifically, the study will focus on librarians from the Bayelsa (South-South zone), Ekiti (South-West zone), and Niger (North-Central zone) state chapters of the NLA. According to NLA membership records, Bayelsa has approximately 40 librarians, Ekiti about 50, and Niger around 60, totaling roughly 150 librarians across the three states. These states were selected to represent diverse geopolitical zones in Nigeria, ensuring the study captures regional variations in infrastructure, technology adoption, and professional development opportunities. This zonal representation enhances the generalizability of findings across Nigeria's varied socio-economic and cultural contexts. From this, a sample size of 90 librarians will be selected using proportional allocation (e.g., Bayelsa: 24, Ekiti: 30, Niger: 36). This sample size balances statistical reliability with practical feasibility for data collection and analysis (Okogwu & Dike, 2017; NLA Membership Directory, 2024). Data will be collected primarily through a structured questionnaire distributed electronically and physically to the sampled librarians. The instrument adapted the

–point scales of SA- Strongly agree, A = agree, D = Disagree and SD = Strongly disagree. 2.50 was the cut off mean for decision to agree while mean score below 2.50 was regarded as disagreed. The instrument underwent face and content validity assessment by experts in library and information science. A Cronbach's alpha reliability test yielded a coefficient of 0.82, indicating strong internal consistency. Data were analyzed using mean scores to determine the level of agreement with the questionnaire items

V. Results and Discussion

Research Question 1: What are the key technologies driving the 5th Industrial Revolution relevant to library services?

Table 1: Key technologies driving the 5th Industrial Revolution relevant to library services

S/N	Item	Mean	SD	Decision
1	Artificial Intelligence (AI) is crucial for library service automation.	3.30	0.62	Strongly Agree
2	Internet of Things (IoT) enhances library resource management.	2.85	0.77	Agree
3	Blockchain technology supports secure digital transactions in libraries.	2.91	0.75	Agree
4	Robotics plays a role in automating physical library operations.	2.78	0.81	Agree
5	Virtual Reality (VR) and Augmented Reality (AR) are transforming library learning environments.	3.15	0.68	Strongly Agree
6	5G connectivity improves access to real-time library services.	2.90	0.74	Agree
7	Big Data analytics enhances user-centered library services.	3.05	0.70	Strongly Agree
8	Cloud computing facilitates remote access to library resources.	2.95	0.73	Agree
9	Quantum computing will impact future library information processing.	2.88	0.79	Agree

Grand Mean = 2.97

The table reveals that six of the items—specifically IoT, blockchain technology, robotics, 5G connectivity, cloud computing, and quantum computing—received mean scores between 2.50 and 2.99, indicating that librarians agreed that these are key technologies driving the 5th Industrial Revolution relevant to library services. Meanwhile, three technologies—artificial intelligence, virtual/augmented reality, and big data analytics—received mean scores between 3.00 and 3.49, showing that librarians strongly agreed these are critical drivers of the 5IR era in library settings. The grand mean score of 2.97 suggests an overall positive and moderately high perception toward the adoption and impact of technologies such as AI, IoT, blockchain, big data, and VR/AR within academic library contexts

Research Question 2: How are these technologies changing the traditional roles of librarians in the 5th Industrial Revolution?

Table 2: How these technologies are changing the traditional roles of librarians in the 5th Industrial Revolution

S/N	Item	Mean	SD	Decision
1	Librarians now serve as digital literacy instructors due to emerging technologies.	3.20	0.65	Strongly Agree
2	Librarians increasingly manage digital and virtual collections instead of physical ones.	2.91	0.71	Agree
3	Librarians act as data analysts and curators for big data resources.	2.88	0.78	Agree

4	Librarians now provide support for AI-based information retrieval systems.	3.05	0.69	Strongly Agree
5	The role of librarians has expanded to managing cybersecurity and digital ethics issues.	2.95	0.74	Agree
6	Librarians design and manage makerspaces and innovation hubs.	3.15	0.68	Strongly Agree
7	Librarians participate actively in virtual reality (VR) and augmented reality (AR) educational initiatives.	3.10	0.72	Strongly Agree
8	Librarians collaborate more with IT specialists and researchers on interdisciplinary projects.	2.92	0.76	Agree
9	Librarians are now involved in personalized information services powered by AI algorithms.	3.25	0.63	Strongly Agree

Grand Mean = 3.04

The interpretation of Table 2 shows that four items—managing digital and virtual collections, acting as data analysts and curators, managing cybersecurity and digital ethics, and collaborating with IT specialists—had mean scores between 2.50 and 2.99, indicating that librarians agreed that these represent key changes to their traditional roles in the 5th Industrial Revolution. Meanwhile, five items—serving as digital literacy instructors, supporting AI-based information retrieval, managing makerspaces, participating in VR/AR initiatives, and offering AI-driven personalized services—scored between 3.00 and 3.49, revealing that librarians strongly agreed these were significant role transformations. With a grand mean of 3.04, the findings confirm a strong positive perception that emerging technologies are redefining librarianship towards data management, digital literacy instruction, AI-support services, and collaboration with technology professionals

Research Question 3: What new skills and competencies are required by librarians in the 5th Industrial Revolution?

Table 3: New skills and competencies required by librarians in the 5th Industrial Revolution

S/N	Item	Mean	SD	Decision
1	Data analytics and interpretation skills	3.20	0.65	Strongly Agree
2	Artificial intelligence (AI) and machine learning literacy	3.15	0.68	Strongly Agree
3	Digital content creation and management skills	2.91	0.72	Agree
4	Virtual reality (VR) and augmented reality (AR) application skills	2.89	0.76	Agree
5	Cybersecurity and digital ethics management	3.10	0.70	Strongly Agree
6	Advanced information literacy instruction	2.94	0.73	Agree
7	Programming and coding knowledge for information systems	3.18	0.69	Strongly Agree
8	Cloud computing and database management skills	3.05	0.71	Strongly Agree
9	Communication and collaboration skills for interdisciplinary projects	3.22	0.66	Strongly Agree

Grand Mean = 3.07

The interpretation of Table 3 reveals that three items—digital content creation and management skills, VR/AR application skills, and advanced information literacy instruction—had mean scores ranging between 2.50 and

2.99, indicating agreement among librarians that these are important new skills for the 5th Industrial Revolution. On the other hand, six items—data analytics and interpretation, AI and machine learning literacy, cybersecurity and digital ethics, programming and coding knowledge, cloud computing and database management, and communication and collaboration skills—had mean scores between 3.00 and 3.49, suggesting strong agreement that these competencies are highly crucial. The overall result of Table 3, with a grand mean of 3.07, shows a strong consensus among academic librarians that mastering new technological tools and competencies, particularly in areas like AI, cybersecurity, programming, and data analytics, is essential for surviving and thriving in the 5th Industrial Revolution

Research Question 4: What is the perceived impact of these changes of the 5th Industrial Revolution on the skills and roles of librarians?

Table 4: Perceived impact of these changes of the 5th Industrial Revolution on the skills and roles of librarians

S/N	Item	Mean	SD	Decision
1	The 5th Industrial Revolution has enhanced the technological competence of librarians.	3.25	0.68	Strongly Agree
2	The 5th Industrial Revolution has led to the automation of traditional library processes.	3.10	0.74	Strongly Agree
3	Librarians now need more advanced digital skills to meet user expectations.	3.05	0.70	Strongly Agree
4	The traditional role of librarians as information gatekeepers has diminished.	2.85	0.78	Agree
5	Librarians now need to focus more on data analysis and interpretation.	3.20	0.66	Strongly Agree
6	The 5th Industrial Revolution requires librarians to adopt new roles such as digital curators.	3.30	0.65	Strongly Agree
7	Librarians are now more involved in interdisciplinary collaboration with non-library professionals.	2.75	0.80	Agree
8	The 5th Industrial Revolution has improved the efficiency of library services and user experiences.	3.15	0.72	Strongly Agree
9	The increased use of AI and machine learning has reduced the need for manual cataloging in libraries.	3.40	0.67	Strongly Agree

Grand Mean = 3.11

The table reveals that two items - "The traditional role of librarians as information gatekeepers has diminished" and "Librarians are now more involved in interdisciplinary collaboration with non-library professionals"—received mean scores in the range of 2.50 to 2.99, indicating that librarians generally agree with the statement that the 5th Industrial Revolution has reshaped their roles. However, seven items had mean scores within the 3.00 to 3.49 range, demonstrating strong agreement on the perceived positive impact of these changes, particularly in terms of technological competence, automation, and digital skills enhancement. These items suggest that librarians view the 5th Industrial Revolution as a force that has advanced their roles, making them more involved in areas like digital curation, data analysis, and interdisciplinary collaboration. The overall result, with a grand mean of 3.11, reflects that the majority of librarians perceive the 5th Industrial Revolution as having a strong positive impact on their skills and roles

Discussion of findings

The result of the table 1 shows that librarians in academic libraries largely recognize the relevance of emerging technologies in transforming library services for the 5th Industrial Revolution. Supporting these findings, Cox & Mazumdar (2023) noted that artificial intelligence and big data are significantly influencing service delivery and user engagement in academic libraries in Nigeria. Similarly, technologies such as IoT, blockchain, and cloud computing are increasingly being integrated into Nigerian libraries to streamline resource management and enhance security. Furthermore, Ziatdinov, et al (2024) emphasized that VR, AR, and robotics technologies are being adopted globally to provide more interactive, immersive, and automated library experiences. These

studies collectively affirm the librarians' perceptions identified in this research regarding the pivotal role of emerging technologies in the evolving library landscape during the 5th Industrial Revolution.

The result of Table 2 indicates that librarians in academic libraries have moved beyond their traditional custodial functions to embrace more dynamic roles that align with technological advancements of the 5th Industrial Revolution. The findings of this table align with empirical evidence in recent studies. Nwobu, et al (2024) emphasized that academic librarians in Nigeria are increasingly involved in digital literacy training and management of AI tools to facilitate information retrieval. Librarians have embraced new roles as data curators, cybersecurity managers, and innovation facilitators, showing a shift from traditional cataloging functions. Furthermore, Ibinaiye and Jiyane (2021) found that the incorporation of VR and AR technologies has created opportunities for librarians to design immersive learning experiences and manage makerspaces in university libraries. These studies provide strong support that the 5th Industrial Revolution is reshaping librarianship into a technology-centered profession.

The responses from table 3 shows that skills in digital content management, VR/AR use, and advanced literacy teaching remain significant for transforming traditional library services into future-oriented, user-centered platforms. The findings of this table are supported by several empirical studies. A study by Zhang et al (2020) revealed that Nigerian academic librarians increasingly acknowledge the need for proficiency in AI, coding, and data management to remain effective in an evolving digital landscape. Librarians must adapt by acquiring skills in cybersecurity, VR/AR, and digital content development to meet emerging user demands and technological challenges. In addition, research by Oladokun, et al (2024) emphasized that interdisciplinary collaboration, digital ethics, and advanced information literacy skills are indispensable for librarians navigating the complexities of the 5th Industrial Revolution. Together, these studies affirm that the landscape of librarianship is being reshaped fundamentally through both technical and soft skills.

Overall, the results in table 4 imply that librarians are embracing technological shifts, though there remains an acknowledgment of the decreasing prominence of traditional roles like information gatekeeping. Several empirical studies support the findings of the table. According to Taj and Zaman (2022), Nigerian librarians acknowledge that the 5th Industrial Revolution has significantly increased the demand for advanced digital competencies, such as data analytics and digital curation, in academic libraries. A study by Ayandokun and Nworu (2022) further supports this, highlighting that librarians' traditional roles have been increasingly automated, allowing them to focus more on strategic tasks like content curation and data interpretation. Additionally, the integration of AI and machine learning has diminished the need for manual processes, such as cataloging, thereby empowering librarians to concentrate on higher-level skills, including interdisciplinary collaboration and digital resource management.

VI. Conclusion

The study has highlighted the profound impact of the 5th Industrial Revolution on the roles and skills of librarians in Nigerian academic libraries. The findings indicate a growing recognition of the need for technological adoption, with librarians embracing emerging tools such as AI, blockchain, big data, and VR/AR. This technological shift is not only enhancing traditional library services but also transforming librarians into data managers, digital literacy instructors, and collaborators with technology professionals. The evolving nature of librarianship in the 5th Industrial Revolution is reshaping the profession, enabling librarians to move beyond their custodial duties and take on more dynamic, multidisciplinary roles. Furthermore, the study underscores the importance of librarians mastering new technical competencies, including AI, cybersecurity, and data analytics, to remain relevant in the evolving landscape. The findings suggest that a combination of technological and soft skills is crucial for librarians' success in the digital era. Libraries must adopt strategies that foster continuous learning, cross-disciplinary collaboration, and integration of emerging technologies into library services to keep pace with the rapid changes. Overall, this study provides valuable insights into the need for a forward-thinking approach to librarianship, ensuring that academic libraries continue to thrive in an increasingly digital and technology-driven world.

VII. Recommendations

The study recommended the following:

1. Academic libraries should invest in continuous training and professional development for librarians to deepen their understanding of emerging technologies like AI, blockchain, and big data.
2. Libraries should partner with technology companies and research institutions to create pilot programs and proof-of-concept projects that integrate these technologies into library services.
3. Libraries should establish cross-disciplinary teams involving both librarians and technology professionals to jointly design and deliver services that leverage emerging technologies.
4. Academic institutions should incorporate data management and digital literacy into the core curriculum for librarianship programs.

5. Academic libraries should promote mentorship programs where experienced librarians can help guide newer staff members in mastering essential technological skills.
6. Academic libraries should prioritize creating online training platforms and offer certifications in essential areas such as cybersecurity, AI, and data analytics.
7. Libraries should focus on redefining traditional roles by establishing new job descriptions and responsibilities that align with the needs of the 5th Industrial Revolution.
8. To mitigate the diminishing role of information gatekeeping, libraries should develop new strategies to enhance their relevance.

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Influence of Emerging Technologies on the Transformation of Librarianship among Academic Librarians in Kaduna State University

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Abstract

Purpose: *This study investigates the influence of emerging technologies on the transformation of librarianship by academic librarians in Kaduna State University (KASU) Kaduna. It explores how the adoption and utilization of technological advancements have impacted library operations, service delivery, and professional practices while identifying potential challenges and proposing strategies to enhance the effective use of emerging technologies.*

Study Design/Methodology/Approach: *A survey research design was employed, utilizing a total enumeration of all 45 academic librarians in KASU. Data were collected using a validated, self-structured questionnaire designed to examine the extent of emerging technology adoption and its impact on librarianship. Descriptive statistics were used to analyze the data.*

Findings: *The study reveals that 78% of respondents indicated a high level of adoption of technologies such as integrated library systems, electronic databases, and digital repositories. However, 65% of respondents identified challenges such as insufficient training, inadequate funding, and poor technological infrastructure as barriers to optimal adoption. Recommendations include enhanced training programs, increased investment in technological infrastructure, and strategic planning to integrate emerging technologies into library operations effectively.*

Research Limitations: *The study is limited to academic librarians in KASU, and findings may not be generalizable to other institutions. The use of self-reported data may also introduce response bias.*

Practical Implication: *The findings underscore the need for academic libraries to prioritize the adoption and integration of emerging technologies into their operations. This can improve service delivery, enhance user satisfaction, and ensure the continued relevance of librarianship in the digital age.*

Social Implication: *The effective utilization of emerging technologies can promote knowledge accessibility and bridge the digital divide, contributing to societal advancement and lifelong learning.*

Originality/Value: *This study provides empirical evidence on the influence of emerging technologies on librarianship transformation in a developing country context. It offers practical strategies for overcoming challenges and optimizing the benefits of technological advancements in academic libraries.*

Keywords: *emerging technologies, librarianship transformation, academic librarians, digital innovation, library services.*

Introduction

Globally, emerging technologies are revolutionizing various sectors, including Library and Information Science (LIS) practices inclusive. The integration of digital technologies such as artificial intelligence (AI), blockchain, big data analytics, and cloud computing is significantly transforming library services and the role of librarians. In developed regions such as North America, Europe, and parts of Asia, about 80% of academic libraries have adopted emerging technologies to enhance user services and streamline library operations (Afolabi, Bada & Akinwumi, 2024). The United States leads in this transformation, with approximately 90% of academic librarians leveraging digital tools and AI-driven information systems to improve research support

and knowledge dissemination (Cheng, Yang & Liu, 2024). Similarly, in the United Kingdom, academic libraries have prioritized automation and digital resource management, with about 85% utilizing cloud-based technologies for effective information access and retrieval (Uko & Ezeani, 2023). China has also experienced a significant increase in technology adoption in libraries, with government-backed initiatives leading to a 70% surge in digital library services over the past decade (Obakiro et al., 2023).

In Africa, the adoption of emerging technologies in library operations is gradually increasing, although it is faced with several challenges, including inadequate funding, poor digital infrastructure, and limited technical expertise. Despite these obstacles, about 50% of academic libraries in sub-Saharan Africa are incorporating digital solutions such as institutional repositories, automated cataloging systems, and e-libraries to enhance access to scholarly resources (Igbokwe, Nwokocha & Madu, 2022). South Africa is at the forefront of this digital transformation, with approximately 75% of its academic libraries integrating artificial intelligence and machine learning tools into their research support systems (Adegbile & Ojo, 2023). Other African nations, including Kenya and Tanzania, have also embraced digital innovations through collaborative initiatives aimed at improving library automation and digital resource management (Cheng et al., 2024).

In West Africa, the use of emerging technologies in academic libraries is still developing, with countries like Ghana and Nigeria making considerable progress. Ghana has established strong digital library systems and research databases through institutional support and international collaborations. Nigeria, on the other hand, is making strides toward integrating digital technologies into library operations, although it still faces challenges such as inconsistent funding, inadequate ICT training, and limited access to digital resources (Iroha & Iwhiwhu, 2022). He futher stated that universities such as the University of Ibadan and Ahmadu Bello University have pioneered the adoption of emerging technologies in library services, facilitating access to digital resources and fostering research collaborations (Iroha & Iwhiwhu, 2022).

In Nigeria, academic librarians play a crucial role in facilitating digital transformation in university libraries. However, many Nigerian university libraries still rely on traditional methods of information management due to infrastructural deficits and limited technological training. Despite these challenges, Nigerian librarians are increasingly adopting digital tools such as electronic document management systems, digital preservation platforms, and online information retrieval systems to enhance research support and user experience (Obi & Aina, 2023). The National Information Technology Development Agency (NITDA) has also emphasized the importance of integrating technology into library operations to support national development (Federal Ministry of Education, 2020). However, issues such as funding constraints, cybersecurity threats, and resistance to technological change continue to hinder the full-scale implementation of digital innovations in Nigerian libraries (Agboola et al., 2022).

Focusing on librarians at Kaduna State University (KASU) is essential due to the institution's role in higher education and research development in Northern Nigeria. The KASU library serves a diverse academic community, providing critical information resources to students, faculty, and researchers. In recent years, KASU librarians have been at the forefront of digital transformation efforts, adopting electronic resources, digitization initiatives, and ICT-driven library services (Akanbi, 2023). However, challenges such as limited access to cutting-edge technologies, inadequate funding, and a lack of specialized ICT training hinder the full adoption of emerging technologies in library operations (Jibril et al., 2023). The need for digital literacy training and capacity-building programs for KASU librarians is evident, as these measures will enhance their ability to integrate and utilize emerging technologies effectively (Yahaya & Aminu, 2023).

This study aims to explore the influence of emerging technologies on the transformation of librarianship at Kaduna State University. It seeks to identify the extent of technology adoption among academic librarians, the challenges they face, and the opportunities available for improving digital library services. The findings will contribute to the ongoing discourse on the role of technology in academic libraries and provide recommendations for enhancing digital transformation efforts at KASU.

Additionally, the study will offer insights to policymakers, university administrators, and library professionals on best practices for integrating emerging technologies into library operations to improve access to information and support academic excellence (Olowojaiye & Oladele, 2022).

Statement of the Problem

Emerging technologies play a pivotal role in transforming librarianship, revolutionizing how library practices and services are delivered, managed, and accessed. In academic libraries, particularly in institutions like Kaduna State University (KASU), the adoption of emerging technologies is essential for enhancing information access, streamlining library operations, and fostering innovation in knowledge management. As libraries transition from traditional models to digital and automated systems, academic librarians must embrace and adapt to technological advancements to remain relevant in the evolving information landscape.

Globally, the integration of emerging technologies—such as artificial intelligence (AI), cloud computing, digital repositories, and virtual reference services—has become a key driver of modernization in Library and Information Science (LIS), equipping librarians with the tools necessary to meet the dynamic needs of users in the digital age.

However, despite the recognized importance of emerging technologies, the current state of librarianship at KASU reveals notable gaps in adoption and utilization. Many academic librarians face significant challenges in integrating emerging technologies into their professional practices. These challenges may include inadequate technological infrastructure, limited digital literacy skills, lack of institutional support, and resistance to change. Additionally, constraints such as funding shortages, insufficient training opportunities, and workload pressures further hinder the seamless adoption of transformative technologies (Adetunji et al., 2024). While global trends emphasize the critical role of technology in modern librarianship, KASU librarians continue to struggle with outdated systems and minimal exposure to innovative digital tools. This disconnects between technological advancements and actual practices at KASU limits the efficiency, accessibility, and overall impact of library services within the university.

Based on the above statement, the study will investigate the influence of emerging technologies on the transformation of librarianship by academic librarians in Kaduna State University (KASU), Kaduna.

Research questions

The following research questions is set out to guide the study

1. What types of emerging technologies are being adopted by academic librarians at Kaduna State University,
2. **What is the extent of emerging technology adoption by** academic librarians in KASU?
3. What challenges do academic librarians at KASU face in using emerging technologies?

Literature Review

Types of Emerging Technologies Adopted by Academic Librarians in KASU

Academic librarians at KASU have adopted various emerging technologies to enhance service delivery. One notable technology is the implementation of Integrated Library Systems (ILS) that streamline cataloging, circulation, and acquisition processes. These systems facilitate efficient management of library operations and improve user access to resources (Owolabi et al., 2022).

Additionally, KASU librarians utilize digital repositories to manage and disseminate institutional research outputs. These platforms support the preservation of scholarly works and promote open access, thereby increasing the visibility and impact of the university's research. The adoption of such repositories aligns with global best practices in academic librarianship (Agboke & Oladokun, 2025).

The use of artificial intelligence (AI) and machine learning tools is gradually gaining traction among KASU librarians. These technologies assist in automating routine tasks such as metadata generation, information retrieval, and user behavior analysis. By leveraging AI, librarians can provide personalized services and improve resource discovery for users (Achugbue, 2024).

Furthermore, KASU librarians have embraced virtual reference services through platforms like email, chat, and social media. These tools enable librarians to engage with users remotely, providing timely assistance and support. The integration of virtual services reflects the library's commitment to meeting users' evolving needs in a digital environment (Nwankwo, 2023).

Extent of Emerging Technology Adoption by Academic Librarians in KASU

The extent of emerging technology adoption among academic librarians at KASU varies across different services and departments. While some librarians have fully integrated digital tools into their workflows, others are at preliminary stages of adoption. Factors influencing this variation include individual digital literacy levels, availability of infrastructure, and institutional support (Owolabi et al., 2022).

Training and capacity-building initiatives have played a crucial role in facilitating technology adoption at KASU. Librarians have participated in workshops and seminars aimed at enhancing their ICT competencies. These efforts have led to increased confidence and proficiency in using digital tools, thereby improving service delivery (Agboke & Oladokun, 2025).

Despite these advancements, challenges such as limited funding and inadequate infrastructure hinder the widespread adoption of emerging technologies. Some librarians face difficulties accessing necessary hardware and software, which affects their ability to implement technology-driven services effectively (Adeyeye & Oladokun, 2024).

Nevertheless, the commitment of KASU's library management to embracing technological innovations is

evident. Strategic plans have been developed to guide the integration of emerging technologies, and collaborations with other institutions are being explored to share resources and expertise. These initiatives demonstrate a proactive approach to enhancing library services through technology (Owolabi et al., 2022).

Challenges Faced by Academic Librarians at KASU in Using Emerging Technologies

Academic librarians at KASU encounter several challenges in adopting and utilizing emerging technologies. A primary concern is the lack of adequate funding to procure and maintain technological infrastructure. Budget constraints limit the acquisition of necessary tools and hinder the implementation of innovative services (Ifijeh & Yusuf, 2020).

Another significant challenge is the limited technical expertise among some librarians. While training programs have been initiated, there remains a skills gap that affects the effective use of advanced technologies. Continuous professional development is essential to equip librarians with the competencies required to navigate the evolving digital landscape (Nwankwo, 2023).

Resistance to change also poses a barrier to technology adoption. Some librarians are apprehensive about transitioning from traditional practices to digital methods, fearing job displacement or increased workload. Addressing these concerns through inclusive change management strategies is vital to foster a culture of innovation (Agboke & Oladokun, 2025).

Furthermore, inconsistent power supply and unreliable internet connectivity disrupt the seamless operation of technology-driven services. These infrastructural challenges impede access to electronic resources and affect the delivery of virtual services. Investing in stable infrastructure is crucial to support the sustainable integration of emerging technologies in academic libraries (Adeyeye & Oladokun, 2024).

Research Methodology

This study adopted a survey research design to assess the influence of emerging technologies on the transformation of librarianship among academic librarians at Kaduna State University (KASU), Kaduna. The choice of this design was informed by its effectiveness in capturing data at a specific point in time, enabling the researcher to analyze current trends and patterns in technology adoption. The study population comprised all 45 academic librarians in KASU, and a total enumeration sampling technique was employed to ensure full participation. This approach was considered appropriate, given the relatively small population size of relatively less than 100, allowing for a comprehensive assessment of how emerging technologies are being integrated into librarianship.

Data were collected using a validated, self-structured questionnaire for data collection. For data analysis, both descriptive and inferential statistical methods were employed. Descriptive statistics such as frequency distributions, means, and standard deviations were used to summarize and present the data effectively.

Results and Discussion of Findings

This section presents the findings of the study on the adoption of emerging technologies among librarians at Kaduna State University (KASU). The analysis is based on data collected from all 45 academic librarians using a validated, self-structured questionnaire. The study examines the extent of technology adoption, the specific areas of librarianship transformed by these technologies, and the barriers to full adoption. Descriptive statistics are used to highlight the frequency and percentage of responses, along with standard deviations to illustrate variability in opinions. These findings provide insights into the role of technology in modern librarianship in KASU, identifying areas of strength and potential challenges.

Research Question 1: What types of emerging technologies are being adopted by academic librarians at Kaduna State University?

Table 1: Types of Emerging Technology Adoption

Emerging Technology Adoption	Frequency (N)	Percentage (%)	Standard Deviation
Use of integrated library systems	35	78%	0.42
Utilization of electronic databases	33	71%	0.45
Management of digital repositories	30	67%	0.48
Implementation of virtual reference services	28	62%	0.50
Adoption of cloud -based library services	25	56%	0.52
Use of artificial intelligence in library functions	20	44%	0.55
Training on emerging technologies	18	40%	0.58

The data reveals that academic librarians at Kaduna State University (KASU) have adopted several key emerging technologies, with the highest uptake in integrated library systems (78%), electronic databases (71%), and digital repositories (67%). This suggests a strong emphasis on automating traditional library functions, improving access to scholarly resources, and enhancing digital archiving practices. Moderate adoption levels were observed for virtual reference services (62%) and cloud-based library services (56%), indicating a gradual shift toward remote service delivery and scalable digital infrastructure.

However, the adoption of more advanced technologies like artificial intelligence (44%) and ongoing training in emerging technologies (40%) remains relatively low. The higher standard deviations in these categories suggest variation in exposure and proficiency among staff, possibly due to limited training opportunities or insufficient institutional support. These findings highlight a critical need for strategic investments in professional development and technological infrastructure to ensure that librarians not only adopt but also effectively utilize emerging technologies in their evolving roles.

Table 2: Extent of Emerging Technology Adoption

Emerging Technology Adoption	Frequency (N)	Percentage (%)	Standard Deviation
Use of integrated library systems	35	78%	0.42
Utilization of electronic databases	33	71%	0.45
Management of digital repositories	30	67%	0.48
Implementation of virtual reference services	28	62%	0.50
Adoption of cloud -based library services	25	56%	0.52
Use of artificial intelligence in library functions	20	44%	0.55
Training on emerging technologies	18	40%	0.58

The results indicate a high level of adoption of emerging technologies in librarianship at KASU, with 78% of respondents actively utilizing integrated library systems. This suggests a strong commitment to modernizing library operations and improving service delivery through automation. The utilization of electronic databases (71%) and management of digital repositories (67%) further demonstrates the increasing reliance on digital tools for information storage and retrieval. However, the adoption of more advanced technologies, such as artificial intelligence (44%) and cloud-based services (56%), remains relatively low. This may be due to a lack of technical expertise or inadequate institutional support for implementing these innovations. Training on emerging technologies is also low (40%), highlighting a potential gap in capacity building.

The standard deviations across the responses indicate some variability in librarians' engagement with different technologies. The lower standard deviations in areas such as integrated library systems (0.42) and electronic databases (0.45) suggest a higher consensus among librarians regarding their adoption. Conversely, the higher deviations in artificial intelligence (0.55) and training (0.58) indicate differing levels of experience and familiarity with these newer technologies. These findings underscore the need for targeted training programs and infrastructural investment to enhance technology adoption.

Table 3: Barriers to the Adoption of Emerging Technologies

Barriers	Frequency	Percentage (%)	Standard Deviation
Lack of sufficient training	29	65%	0.50
Inadequate funding for technological upgrades	28	62%	0.52
Poor technological infrastructure	27	60%	0.54
Resistance to change among librarians	22	49%	0.56
High cost of maintaining digital resources	20	44%	0.58
Limited institutional support for innovation	18	40%	0.60

The findings reveal significant barriers to the full adoption of emerging technologies in librarianship at KASU. Insufficient training is the most frequently cited challenge, with 65% of respondents indicating that they lack the necessary skills to effectively utilize new technologies. This suggests a pressing need for continuous professional development programs to equip librarians with relevant competencies. Inadequate funding (62%) and poor technological infrastructure (60%) also emerge as major constraints, limiting the ability of the library to invest in and maintain modern digital systems.

Additionally, resistance to change among librarians (49%) indicates that some professionals may be reluctant to embrace new technologies, possibly due to a lack of confidence or fear of job displacement. The high cost of maintaining digital resources (44%) and limited institutional support (40%) further compound these challenges. The relatively high standard deviations across these barriers suggest variability in responses, indicating that some librarians may experience these challenges more acutely than others.

The study's findings highlight the urgent need for targeted interventions to address these barriers. Institutional policies should prioritize increased funding for library technology, as well as structured training programs to build technological proficiency among librarians. Efforts should also be made to enhance infrastructure, improve internet connectivity, and foster a culture of technological innovation within the library. By addressing these challenges, KASU can fully leverage emerging technologies to enhance the efficiency and effectiveness of its library services.

Discussion of Findings

The findings from this study reveal significant insights into the adoption of emerging technologies among librarians at Kaduna State University (KASU). The data indicate a high level of engagement with integrated library systems, electronic databases, and digital repositories, reflecting a growing reliance on digital tools to enhance library operations and service delivery.

Research Question 1. The findings from this study show that academic librarians at Kaduna State University (KASU) have made significant strides in adopting a range of emerging technologies, particularly those essential for digital resource management and automated library services. The high adoption of integrated library systems (78%), electronic databases (71%), and digital repositories (67%) demonstrates that core digital technologies have become an integral part of library functions at KASU. These technologies support streamlined cataloguing, digital archiving, and efficient access to scholarly content, aligning with global trends in academic librarianship (Ani, Okon, & Ahiauzu, 2018). Their widespread use suggests a shift toward a more technology-enabled library environment, reflecting the influence of global digital transformation agendas on higher education institutions (Ifijeh & Yusuf, 2020).

However, the relatively lower adoption of artificial intelligence (44%) and cloud-based services (56%), alongside limited training (40%), points to a digital skills gap and infrastructural constraints. These findings resonate with past studies that highlight limited ICT competencies and poor funding as persistent barriers in Nigerian academic libraries (Owolabi & Ajiboye, 2021). The high standard deviations observed in these categories indicate that some librarians are more engaged than others, which may result from unequal access to professional development and varying levels of technological awareness. This imbalance hinders uniform technology adoption across the library system. As emerging technologies continue to redefine the expectations and competencies required of academic librarians, it becomes essential for institutions to prioritize continuous capacity building and allocate funding to expand technology adoption (Dadzie, 2024).

Research Question 2. The results show that 78% of librarians actively utilize integrated library systems, followed by 71% using electronic databases and 67% managing digital repositories. This high level of adoption aligns with previous studies that emphasize the transformative impact of digital technologies on library efficiency and accessibility (Aqil & Ahmed, 2021). The substantial use of digital repositories suggests that KASU librarians recognize the importance of digital archiving in preserving and disseminating academic resources (Ani, Okon & Ahiauzu, 2018). However, the relatively lower adoption of artificial intelligence (44%) and cloud-based services (56%) indicates potential barriers in implementing advanced technologies, which may limit the library's capacity to leverage cutting-edge innovations for improved service delivery (Dadzie, 2024).

Research Question 3. The study identifies several barriers to the full adoption of emerging technologies, with 65% of respondents citing insufficient training as a major challenge. This finding underscores the critical need for continuous professional development to equip librarians with the necessary skills for effective technology utilization (Brafi & Arthur, 2023). Additionally, inadequate funding for technological upgrades (62%) and

poor technological infrastructure (60%) were significant constraints, highlighting the necessity for increased institutional investment in digital resources (Ajala, Adegun, & Oyewumi, 2020). Moreover, the resistance to change among librarians (49%) suggests that cultural and organizational factors may also play a role in hindering the adoption of emerging technologies. Implementing structured change management strategies and awareness programs can help address these concerns and encourage a more receptive attitude toward innovation (Angello, 2020).

The findings indicate that while there is a strong engagement with certain emerging technologies among librarians at KASU, there remain significant challenges in adopting more advanced digital tools. Addressing these barriers through targeted training programs, increased funding, and strategic policy initiatives will be essential for fostering a technologically advanced library environment. By overcoming these obstacles, KASU can further enhance its library services, ensuring greater accessibility, efficiency, and innovation in the digital age.

Conclusion

The study clearly reveals that while librarians at Kaduna State University (KASU) have demonstrated a strong commitment to adopting emerging technologies such as integrated library systems, electronic databases, and digital repositories, there are still noticeable gaps in the adoption of more advanced innovations like artificial intelligence and cloud-based services. Key barriers identified include insufficient training, inadequate funding, poor infrastructure, and resistance to change among librarians. These challenges highlight the critical need for targeted interventions such as continuous professional development, improved funding, and infrastructural upgrades. Addressing these issues will enable KASU librarians to fully leverage emerging technologies, enhance service delivery, and position the library as a modern, innovative hub that meets the dynamic information needs of its users.

Recommendations

Based on the findings, the following recommendations are made:

1. KASU implement structured and continuous **training programs** on emerging technologies for its library staff. These programs should focus on building practical skills in artificial intelligence tools, cloud-based systems, and digital reference platforms. Such capacity-building initiatives will not only enhance staff confidence and competence but also ensure more uniform adoption of technologies critical to modern academic library services.
2. Implement Comprehensive Training Programs on Emerging Technologies: Given the low percentage of librarians trained on emerging technologies (40%) and the high reporting of insufficient training (65%), KASU should develop and implement continuous professional development programs. These training initiatives should focus on practical skills in areas like artificial intelligence applications in libraries, cloud-based services, and digital repository management. Workshops, certifications, and collaborations with ICT experts can build staff capacity, boost confidence, and increase the adoption rate of advanced technologies.
3. Increase Funding and Infrastructure Support for Technological Innovation: Since inadequate funding (62%) and poor technological infrastructure (60%) are major barriers, KASU should prioritize allocating more financial resources toward technological upgrades in the library. This includes investing in faster internet services, modern digital equipment, updated software, and regular system maintenance.

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Integration of Artificial Intelligence for Effective Information Service Delivery in Libraries

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Abstract

Artificial Intelligence is a technology that enables machines to perform cognitive tasks similar to those of the human brain. The integration of AI into library services is a necessary move to be considered by all types of libraries, considering its importance on how it will enhance efficiency in library services, aid library visibility and also prepare the library for global competitiveness. It is crucial therefore to have a thorough overview of this evolving technology and how it impacts on the future of libraries. The paper mainly centred on how AI-driven tools and technology are used in different areas of library operations. The methodology used entails a broad review of current advances in AI applications within and outside Nigerian library and information sector. The review process includes article / papers published between 2010 and 2024. These selected papers explained the utilization of AI software tools and technologies. The article survey how the various models like Natural Language Processing (NLP), Radio Frequency Identification (RFID), Expert System (ES), AI-Powered Indexing Tools, Chatbots and other AI tools and techniques that could change library services and operations in the future, with the prospect to improving user's satisfaction. A thorough examination of the benefits, problems, and innovative uses of AI tools and technology in libraries was explored. The findings from the literature reviewed, indicate that AI will enhance library operations in various sections of the library such as the circulation section, cataloguing section and collection development section of the library. It will enhance metadata and reduce time spent on manual task. The paper concluded by stating that Librarians must reposition themselves towards the adaptation of AI by acquiring relevant skills and knowledge needed to function effectively. The significance of AI to the future of libraries cannot be overemphasised, because AI is shaping the library into a dynamic hub of discovery. Recommendations were also made to proffer solution to the identified problems posing as a threat against the use of AI in Nigeria libraries.

Keywords: *Artificial Intelligence (AI), Libraries, Information, Technology*

Introduction

Libraries have traditionally been known as a repository for printed information resources that are arranged and made available to users. However, in the modern era, its function has evolved from that of a traditional storehouse to that of a digital online platform where information is accessible from anywhere at any time. According to Tella (2020), contemporary libraries are increasingly serving as providers of digital services rather than only repositories of printed materials. The extensive usage of computer systems, ongoing dependence on computer networks, the quick development of the web and Internet, and the rise in both the quantity and quality of information may all be attributed to this trend. This has led to the adoption of novel information storage, retrieval, and distribution techniques by a number of libraries. As a result, several libraries have adopted new methods for storing, retrieving, and disseminating information. The library has changed from being a traditional, analog library to one with a more modern and digital interface enabling users to access information resources quickly and easily. This has increased the library's visibility and recognition throughout the world. According to Oyetola et al. (2023), a number of networked libraries have been created as a result of libraries and information hubs switching from analog to digital. According to Owolabi et al.(2022), this technique assists with resource creation, sharing, and utilisation on several categories. Several advances, like artificial intelligence (AI), have been made possible by these advancements in information technology (IT). As a result, in order for the library to stay relevant as an information hub, it must get up to date on modern technologies. A new era of efficiency, accessibility, and creativity is being launched forward by artificial intelligence (AI), which is transforming the library scene.

The term "artificial intelligence" refers to a variety of software and IT systems, including computing, creation of software that imitates human intelligence in ability to accept and transfer data as well as information dissemination. According to Jackson (2019) and Ashley (2017), artificial intelligence is the foundation upon which many computer science and technology topic areas were built..

It is worthy of note that artificial intelligence is here at a time when libraries are no longer limited to physical locations where patrons can access resources; instead, they now have digital spaces that store resources that patrons may access at any time and from any location. Like all professions in the 21st century, librarianship is open to continuing change. Instead of being physically present in the library building, today's library users choose to use the library from anywhere. According to Adebayo and Adekunjo (2013), the emergence of digital libraries and the development of ICT have altered the role of librarians and information practitioners. This has led to a rise in the expectations and demands of both library patrons and librarians, and as a result, artificial intelligence (AI) offers an exciting future for libraries.

Concept and significance of Artificial Intelligence (AI)

Today a lot of businesses and organizations use artificial intelligence to increase their visibility and make their data and information systems more efficient. As a result, libraries in Nigeria must be proactive about utilizing this rapidly evolving technology to avoid being left behind. According to Ilori and Owolabi (2020), libraries must adapt to changes periodically in order to deliver services that are satisfactory to users. Artificial intelligence (AI) is defined by CILIP (2021) as machines that mimic human reasoning, learning, and decision-making abilities. AI is also defined by Holmes et al. (2019) as computer programs that carry out activities that call for human intellect. Benhamou and Janin (2018) define artificial intelligence (AI) as a group of technologies that enable robots to function with a high degree of intellect equivalent to that of humans. Additionally, according to Arias (2022), artificial intelligence (AI) is a scientific field where various disciplines—such as computer science, computer engineering, philosophy, psychology, mathematics, neuroscience, linguistics, biology, and others, converge to create agents that can learn, create models from their learning, make predictions based on those models and new data, and then make decisions on their own (or assist humans in making decisions) based on those predictions and any other environmental data. AI's human-like capabilities are enhanced through experience-based learning and gradual adaptation.

According to Koushal et al. (2012), artificial intelligence (AI) includes fuzzy logic, artificial neural networks, evolutionary algorithms, case-based reasoning, image processing, natural language processing, robotics, speech recognition, and an expert system.

Artificial intelligence is currently being used in every facet of human endeavor, including banking, education, health, and more. It resulted in new advantages for competition and adjustments in a number of industries, institutions, and organizations. Like any other sector, artificial intelligence in libraries contributes to broadening the range of services offered and improves patron satisfaction. Talley (2016) found that American students embraced the idea of AI adoption and application in their libraries, supporting this viewpoint. The reason can be that technology makes it easier to obtain information in a seamless way. It is user-friendly and provides fast, easy access to up-to-date information. According to ExLibris (2019), claims that libraries can leverage on the advantages of artificial intelligence to achieve their own goals and objectives, such as improving operational efficiency, offering unique services, and simplifying processes. This paradigm shift is best characterized by the application of artificial intelligence in library operations, the conversion of hard copy information resources to soft copies in the form of databases, digital information resources, and other library automation methods. This suggests that AI improves patron satisfaction in libraries.

Significance of Artificial Intelligence (AI) in library operations

Artificial intelligence has become more popular in libraries and information centers, and it has improved library's efficiency and effectiveness. The advantages of AI for libraries and information centers are discussed by Woods and Evans (2018), AI has the potential to transform library operations in three main ways; i) Intelligent library automation (ii), innovation in libraries (iii), and increased productivity for librarians and library patrons. Yusuf et al. (2022) discovered that the advantages of integrating AI into library services include ease of use, limitless potential, the capacity to manage challenging jobs etc.. Libraries can do jobs with speed using AI than when they are completed by humans. AI is utilized to solve problems like the library's lack of space and there is decrease in human error. Ridge (2019), listed some advantages of AI such as the enhancement of user experience, collaborations, system enhancements, process and digitization expertise, gathering of current descriptive metadata as a result of project outcomes, and operational efficiency in libraries. According to Tella (2020), AI increases the operational efficiency of libraries by streamlining collection analysis, preservation, and visualization while lowering service delivery costs.

The financial constraints arising from manual labour can be taken care of by the use of AI, it may simplify activities, increase productivity and facilitating technology integration (Robinson, 2018). The United Nations (2018) also mentions the advantages of AI in libraries, stating that it would help libraries overcome operational inefficiencies, technological disadvantages, and the difficulty to prove value benefits to all users. AI gives libraries and librarians a strong foothold in the new scholarly information landscape, helps them accomplish their new goals, improves user experience to reach wider audiences, and integrates effortlessly with current workflows and infrastructure. Moreover, Owolabi et al. (2021) stated that, in order to achieve the goals and objectives of libraries as well as the needs of their patrons, AI will greatly enhance the normal services that librarians may offer. AI in university libraries for example enables improved dataset analysis, particularly for huge datasets utilized for analysis across various datasets (Sivarajah et al., 2017). It also aids in the removal of tedious and repetitive task. This implies that using AI in library operations enables libraries to improve their capabilities beyond what humans are capable of. The primary advantage of implementing artificial intelligence systems in libraries is that, in contrast to humans, they are less likely to make mistakes and can work around the clock without getting tired, therefore giving librarians time to perform other tasks. 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.

Summary of the benefits and significance of AI to library operations

- ✓ AI will improve the high job productivity of librarians and facilitate the flexible use of the library by patrons;
- ✓ it will speed up the efficient delivery of innovative library services;

- ✓ it will eliminate task repetition;
- ✓ it will bring the library closer to patrons by guaranteeing a user-friendly experience; it will eliminate task performance errors;
- ✓ it will eliminate the problem of space lack in the library due to the automated systems in the library;
- ✓ it will lower the financial risks associated with manual operations in the library;
- ✓ it will lessen job stress for librarians, who are accustomed to performing tasks by hand; etc.

Artificial Intelligence (AI) tools and areas of application in library operations

Artificial Intelligence tools for library Services

Technical programs (software) that allow AI machines to do tasks in accordance with requirements are known as artificial intelligence (AI) tools. A tool is a device used to do tasks. Utilizing technologies that are appropriate for its purpose, AI machines perform their tasks. Because each machine has a particular specification, not all machines can perform the same task, and there are several kinds of tools. According to Sridevi and Shanmugam (2017). The following are among the AI tools that can be utilized in library systems; robotics, pattern recognition, expert systems, natural language processing (NLP), and others, All facets of human endeavours can benefit from the application of AI, from machine translation and speech recognition to replacing librarians with robots. Natural Language Processing (NLP) enables computers to comprehend the fundamental linguistic concepts present in questions and responses. Building and developing computers that can automatically understand, analyze, and generate human language is the aim. Sophisticated information retrieval technologies are used by libraries nowadays to facilitate rapid and innovative information access. "Web search engines, electronic databases, the Online Public Access Catalogue (OPAC), and robotic equipment specifically made for book distribution and retrieval are some examples of these resources. Nowadays, a lot of contemporary web search engines, like Google, have speech recognition capabilities. Search engines will utilize Natural Language Processing (NLP) to enter and process the data before displaying the results when users use this feature to say aloud the words or phrases they wish to search. These AI tools and features are discussed below:

Natural Language Processing (NLP): is the process by which computers generate and analyze natural language text. The objective is to make it possible for widely recognized natural languages, like English or French, for instance, to be utilized as the object that a computer system processes or as a communication medium. Natural language processing (NLP) can be utilized in libraries to create intelligent expert reference or information retrieval systems that allow users to communicate with the system directly. The computer receives natural language as input, evaluates and processes it, and then provides the necessary information in response. NLP has been utilized as an object/input for processing in automatic text translation or text, as well as a medium of interaction in database management systems. "Language barriers can be reduced through the application of natural language processing,(Asemi and Asemi 2018). To study in Japan, for example, one must learn Japanese. The presence of Natural Language Processing technologies in their libraries can help international students comprehend and translate Japanese. Additionally, multilingual databases can be searched for information with the use of natural language processing tools.

Radio Frequency Identification (RFID: 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.

Robots: The study and practice of controlling perception and movement is known as robotics, and it is a subfield of artificial intelligence. A robot is a machine that employs artificial intelligence techniques to perform complex tasks and automated activities either autonomously (independently) or under human supervision while adhering to a predetermined program. Tredinnick (2017) defines a robot as a group of computing science technologies and techniques that may modify its logic in response to shifting external conditions. In recent years, using robots to perform tasks is one creative way that libraries take advantage of artificial intelligence. According to Harisanty et al. (2020), robotic technologies have been incorporated into library operations in a number of areas, including security, outreach and public relations (PR) through library tours, information illiteracy training, shelving and finding library materials, and answering repetitive reference and directional queries. Automated storage and retrieval systems, which have made library management easier, also benefit from the use of robots. Examples of innovations that attempt to address this issue include robotic bookshelves and retrieval devices. starting a series of steps that guide the robot to retrieve the desired object, the user first selects the content they want to read or retrieve. A second robotic device then opens the item and automatically turns pages using optical character recognition, scanners, and automated indexing software. Users may now view, search for, and analyze the full-text generated from scanned photos.

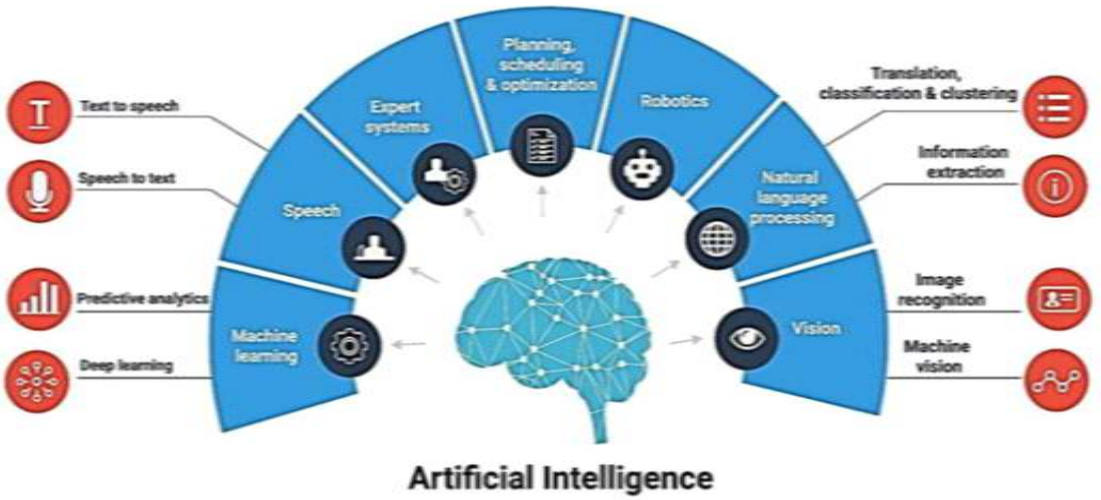
BookBot: Libraries are now using BookBot technology, a robotic book retrieval system that has been used in industry for some times now. Upon request, the bookBot, an automated book-transport system, retrieves volumes from the library's automated catalogue. After receiving a request, a bookBot robotic crane

quickly locates the item and delivers it to the designated unit, either inside or outside the library. The user's borrowing process is accelerated as a result. This machine is either AI-enabled or automated, and it is designed to perform certain activities either with or without human assistance. To take books off shelves, this may mean using robotics, such the automated arm or robots that can remove volumes from libraries (McCaffrey, 2021).

Chatbots: Chatbots are tools, software, or applications that artificial intelligence (AI) employs to have a discussion (or chat) with a human through a messaging service, website, weblog, smartphone app, or Android smartphone. Both Hopkins and Maccabee (2018) and Mckie and Narayan (2019) agrees that voice assistants and chatbots can be utilized in the library and information services sector in the same way that they are in other spheres of life. The fundamental elements of library operations are impacted by AI technology. Among other things, chatbots can be used to notify users of new arrivals, notify users when a book loan is due, and direct users to relevant information.

AI-Powered Indexing Tools: AI indexing makes use of concept identification and keyword assignment. This AI technique enhances quality and consistency, by transcending human capacities and assisting librarians in their work, its automation aids in the discovery of new literature across disciplines. And this technique guarantees speed and efficiency, because traditional manual indexing is typically time-consuming and lacks interdisciplinary depth. Librarians' indexing tasks are made simple and seamless with the usage of AI power indexing tools.

Expert System (ES): they are software that encodes one or more subject-matter based on experts' knowledge. Following creation of the knowledge base, the program assists users, typically non-experts by offering a solution based on the information provided regarding a particular issue. In order to develop an expert system, "knowledge engineers" interview experts in a chosen field of study and incorporate their expertise into the system's knowledge base. These systems are highly focused on certain issues and knowledge bases. As stated in Arias (2022), Expert systems describe the computer's capacity to replicate human decision-making processes. Through interactions with those who pose questions, the system uses the responses as input to support the choice made. A human specialist creates the system by gathering data from pertinent knowledge and, most often, heuristics. ESs have proven to be effective in a variety of sectors, including trade, law, education, computer science, geology, medical, mathematics, engineering, and more. Some of the prerequisites for the development of expert systems include the presence of an expert on the topic, the availability of expert time for the project, the feasibility of creating an expert system, the experts' capacity to elaborate on their methods, the fact that the problem is not very complicated or poorly understood, the need for only cognitive skills, and the measurability of results with expert agreement.



***A schematic representation of AI tools and their areas of operations in library service delivery (Adopted from* Bairagi and Lihitka 2024)**

In order to enhance library services, artificial intelligence (AI) can be applied to a number of library operations areas, such as book shelving, circulation, and cataloguing. AI technology can also be used to help with non-textual search and to assign metadata. The following are some areas of applications for AI technology.

Collection Development: Artificial intelligence systems can oversee the Library's resource development and collection procedures. Collection development refers to a systematic process of building the library collections. it includes item selection, verification and acquisition. Library materials are primarily acquired through donations or purchases. Following the selection of the desired books, a library would usually transmit a list to book dealers and vendors, who will then supply pricing details based on quality and format. Omame and Alex-Nmecha (2020), stated that leveraging on information from previous transactions, an intelligent

system can produce a list of items for purchase while taking into account the performance of book dealers or vendors. According to Romero (2018), artificial intelligence systems are able to make recommendations based on user interests or previous purchases. This is a calculated approach to facilitate the acquisition of library materials and improve the user experience by suggesting books, journals, periodicals, authors, and other items.

Reference section: The library's reference section is where patron inquiries are received and where answers are provided to queries. Users can find the information resources they need in the library with the help of the reference section. According to Liu (2011), expert systems in the reference section of academic libraries can be used to create artificial intelligence by suggesting to patrons the resources that will best answer their questions. According to Sridevi and Shanmugam (2017), an expert system's knowledge base comprises advanced structured and unstructured data, and the interface engine subsystem applies logical rules to the knowledge base to iteratively decode new data. It is possible to create expert systems to operate in the library's reference section. Since a team of the most knowledgeable and experienced specialists in the subject contribute to the Expert System's knowledge base, it can actually answer users' questions more effectively than a single librarian. As they say, "two heads are better than one." The Expert System's response to a user's question is determined by the keywords or phrases that are included in the query. The system answers to the user intelligently if specific keywords or phrases appear in the query.

Circulation section: Retrieval of information is another area of libraries and information that artificial intelligence has successfully managed. According to Croft, Metzler, and Strohman (2015), library information retrieval is the process of retrieving information or resources from a file or database. It includes retrieving information from the Internet, a library's collections, and information centers. A robot that uses artificial intelligence has developed the ability to both store and retrieve books from shelves. For instance, Suthakorn, Lee, Zhou, Choudhury, and Chirikjian's 2002 improved robotic library system for off-site stocking provides complete access to printed materials on shelves and pulls volumes from the shelves to an off-site scanning station.. The robotic system was created to provide users with off-site, comprehensive, on-demand access to printed library resources via a web interface. After the user selects the content they want to read or acquire, a series of actions will be taken that will ultimately cause the robot to obtain the requested item. Through the use of scanners, optical character recognition, and automatic indexing software, another robotic system will then open the item and turn the pages automatically. This will enable the user to read thoroughly the content, search, and examine the full-text produced from the item's scanned images. The bookBot technology is an additional robotic book retrieving device. This technology has long been in use and utilized in the industry, but it is currently being used in libraries, argues (Stone 2019). Many libraries, especially in industrialized nations, have implemented artificial intelligence (AI) for a variety of library functions, including circulation and reference services, (Grant and Camp 2018). As a center for information storage, the library has an extensive collection of information resources, and as time goes on, the collections expand at an exponential rate. Therefore, retrieval tools that facilitate the smooth retrieval of materials must be developed. This resulted in the development and application of computerized and artificial intelligence retrieval systems to make it easier to search and retrieve information from the library's collection, whether it be electronic or paper-based.

Cataloguing and classification section*:* With the help of artificial intelligence (AI), robotic systems have been created specifically for the Online Public Access Catalogue (OPAC), an online search engine, to retrieve and deliver books. The majority of search engines on the internet today, including Google, have speech recognition built into their system. By using Natural Language Processing (NLP), this allows users to speak the word or phrase they wish to search for, and the web search engines will type it into the search box before searching and showing the results. In order to classify, catalog, and index library items, artificial intelligence and expert systems are employed (Vijayakumar and Vijayan, 2011). The system is able to get the bibliographic records of books and categorize them appropriately by using optical character recognition and neural networks. Furthermore, robotics technology is being employed to remove barriers to space and provide consumers with easy access to information resources, according to Murphy (2015). For instance, the University of Technology, Sydney (UTS) has acquired massive automated storage and retrieval systems. The system, which is made up of robotic cranes, looks after thousands of packed book bins in the library, and on user request, the robotic cranes store and retrieve materials from the online book catalogue. The robotic crane will automatically look for the item and collect it from the relevant bin for the library staff member in charge. The library staff will then retrieve the requested book and deliver it to the library's hold shelf so the user may pick it up.

Automation: Echedom and Okuonghae (2021) state that AI can improve automated storage and retrieval systems, which have helped with the administration of library space. Library automation is the process of converting hardcopies of library materials to digital copies. Automation's primary benefits to the library are space conservation, material preservation, and increased global visibility.

Conservation of library materials*:* Conservation is the management of protecting library materials from destruction and preserving them for posterity. According to Tella, (2020), AI can be used in collection analysis, digitisation, conservation, and general service delivery.

In a nutshell Omame and Alex-Nmecha (2020) identified the following area in which library information services can benefit from the use of artificial intelligence:

1. Optical Character Recognition (OCR) for automatic cataloguing and classification
2. Using Natural Language Processing (NLP), documents in foreign languages are automatically translated.
3. Using expert systems for automatic indexing
4. Optical character recognition and speech recognition for audiovisual materials retrieval. The library's collections of music and images may be retrieved just as quickly as printed documents, adding a new level of management and storage for knowledge.
5. Interactive teaching of bibliography through a variety of media
6. Perceptive portals to internet resources,
7. An ecosystem of user-structured information
8. Handheld computer reader services for people with disabilities9. Intelligent Document Delivery Services (DDS)

Artificial Intelligence (AI) and Nigerian library services in the future.

New benchmarks for providing effective and efficient library services are being set by the application of artificial intelligence AI in libraries and information centers. Fernandez (2016) highlights the potential benefits of artificial intelligence (AI) in library operations, while examining the future of libraries in the context of AI, naming the areas of big data analysis, metadata creation, search item translation, and search item integration across contents,. AI can also be utilized in libraries to create programs for efficient reference services, proficient textbook scanning, and topic category recognition. Additionally, through automated library services and intelligent tutoring systems, AI technology can help library patrons find the materials they need. AI acceptance and use in libraries, according to Owolabi et al. (2021), will enable better information processing and, concurrently, better information search, which will appeal to library staff and patrons alike because information will be easier and faster to access. According to Fernandez (2016), AI in libraries will aid in large data analysis, metadata creation, and search translation. Using AI in libraries will thereby increase the availability and accessibility of library materials and enable staff to respond to user inquiries about AI use. Luckin et al. (2016), stated that librarians can learn to use AI in three different ways, according to Personal learning, intelligent support for collaborative learning, and intelligent virtual reality are the three methods.

In the future, all library operations will be completely automated. Reference services, shelf reading and organization, circulation operations (material registration, charging, and discharging), library statistics generation, cataloguing and classification, and other tasks will be handled by robots and intelligent machines in libraries. The way that libraries are currently shaped will be drastically altered by artificial intelligence. The ideal librarian will be able to answer to users' reference requests using speech recognition, natural language processing, and neural networks; library items will be processed quickly, effectively, and efficiently; and patrons, even those who are located far away, will receive state-of-the-art service. Instead of avoiding new technology, libraries in the future will respond to it and adjust to it (Stone, 2019). According to American Library Association (ALA), The Center for the Future of Libraries aims to identify trends that are pertinent to libraries and the communities they serve, promote futuring and innovation techniques to assist librarians and library professionals in determining their future, and establish connections with experts and creative thinkers to assist libraries in addressing new issues. This is a way forward to making sure that hindrances to incorporating into the use new technologies by librarians are indentified and resolved. The Nigeria Library Association can also take an initiative from ALA in proffering solutions to the challenges that librarians may encounter in the use of AI in libraries.

Artificial Intelligence (AI) and the future of librarians

Before ICT was introduced into the library, library services were performed manually using analog data. Today, however, library services are being performed electronically using tele-communication technologies to access and retrieve information from the World Wide Web (WWW). This paradigm change is essential if the library is to remain relevant to its patrons; they must acknowledge that we live in a virtual world where library services are available online and unaffected by hours of operation. Today's library patrons expect to get what they need, when they need it, and wherever they may be. Because roles define and determine job obligations, professional librarians' responsibilities likewise evolve along with their roles. Librarians' roles in libraries will probably shift as a result of the ways artificial intelligence (AI) is transforming those institutions. The growing usage of AI in libraries across developed nations has several significant implications for librarianship. Librarians have to meet a number of requirements in the future to be relevant in the new information, knowledge, and technology era. Some librarians possess the abilities required to further AI's practical application, according to Cox et al. (2019). Incorporating AI technologies into library operations enhances useful library use and encourages human thinking.

Libraries need to evolve from being regarded mainly as places for books to becoming places where people may easily access high-quality information from a range of sources of media and information. In order to help patrons locate and use information that may be available in electronic format from a variety of sources, including libraries themselves, the culture of libraries and their funding bodies must shift from one that is

primarily focused on ownership and control to one that aims to offer service and guidance in more beneficial ways. A crucial point was posed by Bourg (2017): "What happens to libraries and librarians when machines can read books?" The times are changing. Since a computer would have read every book and be better at analysis and decision-making, librarians might not need to read library books for gathering information to guide users or make decisions. Therefore, librarians should anticipate a continuous shift to a digital information environment. More formats than ever before are used to package information, regardless of where they are, end users are now receiving information without direct human intervention. In addition to increased competition from other information providers, retroactive contents are being digitized.

Libraries of today will soon be inundated with the influence and usefulness of new applications based on artificial intelligence, as demonstrated by the development of shelf reading robots by Li, Huang, Kurniawan, and Ho (2015) and others. Artificial intelligence can quickly answer a question, saving users from spending hours on library computers. Furthermore, consumers would not seek information from a human librarian when artificial intelligence might provide a superior result in just a little of the time (Johnson, 2018). But according to Bourg (2017) and Coleman (2017), important questions must be asked about how librarians, scholars, and others can develop and use their skill set to ensure an intelligent information system that incorporates the core values of libraries, such as diversity, privacy, intellectual freedom, social justice, and that encourages creativity, knowledge creation, and supports human learning as well; how libraries can create an interface between users and AI-generated information to ensure that it is accurate and relevant; and how texts can be best discovered by both humans and machines, particularly scholarly communication, so that intelligent machines can be trusted to provide "knowledgeable" answers to questions. Recently, ALA President Garcia-Febo (2019) pushed for artificial intelligence to be included in national discussions and the library profession's professional agenda so that these and other problems can be examined and addressed. The President added that while the wave of artificial intelligence, which includes machine learning and vice assistants, is still unknown in many domains, it has already achieved acceptance and been used in libraries. At this early stage of AI, libraries are using it to teach information literacy, critical thinking skills like computer programming, how to create questions for these machines and how to assess the answers, and how to use robotic cranes to access information resources remotely (Garcia-Febo, 2019).

The implementation of artificial intelligence will be beneficial to modern libraries and librarians, according to the significant advancements made in library practices worldwide. Consequently, Jacknis (2017) asserts that the debate is never "either AI or libraries," but rather how libraries can leverage technology to provide user communities with the greatest services possible. The current trend in technological transformation, which is based on the use of artificial intelligence (AI) in various institutions, including libraries, has led to a high rise in inequality and a generalized fear of job losses (International Labour Organization, 2018).Korinek and Stiglitz (2017) and Méda (2016) maintain that advances in AI technologies could bring about job losses or job polarization. According to Korinek and Stiglitz (2017) and Méda (2016), job losses or job polarization may result from advancements in AI technologies. According to Bowles (2017), automation brought forth by AI adoption could result in a significant increase in inequality. In the next 20 years, AI is expected to replace roughly 35% of jobs in the UK and 47% of workers in the US, according to Frey and Osborne (2017). The World Bank (2016) asserts that because AI would result in a high incidence of job loss, developing nations may be unwilling to adopt it.

According to the analysis, AI adoption will result in 69% of employment losses in India, 72% in Thailand, 77% in China, and 85% in Ethiopia. According to all of these research, AI has the ability to completely destroy jobs and result in employment losses. However, according to Li, Huang, Kurniawan, and Ho (2015), this innovation will focus on difficult and lengthy library tasks like shelf reading and leave librarians to interact with patrons rather than ever replacing them. Murphy (2015) corroborated this assertion by arguing that, contrary to the idea that robots will cause a rift between librarians and their patrons, the usage of robots in libraries will strengthen the bond between the two groups. These factors make it clearly evident that librarians need to develop their knowledge and skills in response to the evolving information environment. To be able to play their roles and fulfill their responsibilities to the standards of users, they must become competent in three main areas: information technologies, librarianship, and organization management.

Potential Challenges in the use of AI in Nigeria libraries

While Artificial Intelligence represents a potential revolutionary innovation for a library services, artificial intelligence (AI) is not without its challenges. A number of issues may pose as challenges against the successful integration of these technologies into library and information services. Such challenges includes; unstable power supplies, a lack of technical expertise, reluctance on the part of librarians and library patrons to adjust to change, a lack of funding, insufficient professional development, a lack of analytical skills, and erratic internet connections, to mention a few. In view of this, Iqbal et al. (2020) assert that, AI are costly to design and maintain. The technological aspects will include creating a comprehensive map of the complete library so that the robot may travel about it and calculating and processing the distance between the robot and objects like books, shelves, tables, and people in order to predict changes in direction. Considering downside, AI technologies are expensive, and not all countries can afford them. Yusuf et al. (2022) also found that library

administration faces challenges in incorporating AI, because of issues such as lack of finance, technological constraints, job displacement, etc. Lexcellent (2019) asserts that before considering artificial intelligence, problem such as a lack of funding, a lack of interest on the part of institution administrations, a lack of knowledge about successful involvements in the field, and a lack of studies addressing assertions must be discussed and resolved. Another bottleneck is that implementing AI in a system can be very challenging. Nigeria is still a long way from embracing AI, and if it is to be used in Nigerian libraries, these issues must be resolved.

Recommendations

Based on the identified challenges, the following recommendations were made.

- Library management and its funding bodies should make it a priority to adequately plan for the adoption and use of AI in the library.
- There should be an AI maintenance policy plan put in place in the library.
- Librarians should acquire knowledge and skills through practical trainings on the use of AI in libraries to gain technical and professional skills in the use of AI in libraries.
- Library management should be involved in teaching AI literacy in libraries; educating library users on the use of AI, its application, ethical usage and as well as its limitation.
- A stable source of power supply such as solar or the use of inverter as an alternative source of power supply should be put in place.
- A stable internet supply should be adopted and the library should hire the services of an internet expert, who will be based in the library to give immediate attention to solve issues when the need arises.

Conclusion

The implementation of AI in libraries in the future requires librarians to become knowledgeable and thoughtful about how their services affect user satisfaction, by proactively providing more effectively services and resources to their users. If librarians are to remain a vital component of the society librarians and their establishing bodies, must understand that change is a constant variable and it move with the time. Librarians must realise that the demands of their users and how to access and retrieve information are changing and we must adapt to meet the changing needs, to ensure our collective viability in the system globally. As a result, librarians must be repositioned and adaptable to the future of AI in libraries. The library's goals and mission, librarians' job descriptions, and the qualifications needed to work as a librarian should all reflect this shift. The preparedness of AI in libraries should be reflected in usage trends of library facilities and expectations of a highly reliable work environment. Librarians will find that there are numerous ways that libraries can support technological innovation and stay relevant to the system by implementing this technology in our libraries if they carefully examine the environment and the library community they serve. Those librarians who are passionate about their work can uncover unexplored prospects through the use of AI.

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Integration of the 5th Industrial Revolution in the Management of Public Libraries for Effective Service Delivery in South East Nigeria

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Abstract

The purpose of the study is to investigate the integration of the 5th Industrial Revolution in the Management of Public Libraries for Effective Service Delivery in South East Nigeria. In view of the objective of this study, three research questions are formulated to guide the study. The researcher developed a questionnaire titled "Integration of the 5th Industrial Revolution in the Management of the Public Libraries for Effective Service Delivery in South East Nigeria Questionnaire (IIRMPLESDQ) which was used in this study for the purpose of data collection. A descriptive survey research design which allowed the collection of data from a large population through a sampling technique was also used for this research. The population of the study consisted of all the staff of public libraries in South East Nigeria. A total sample size of 113 respondents was selected using a simple random sampling technique. The data collected was analyzed using Mean (X) and Standard Deviations to answer the research questions. The findings revealed that the benefits of integrating the 5th industrial revolution in the management of public libraries for effective service delivery include creation of opportunities for a global connectivity; improvement of service efficiency; promotion of intelligent libraries in addition to the promotion of collaborative spaces. Also, the study revealed the challenges facing the integration of the 5th industrial revolution in the management of public libraries for effective service delivery include lack of necessary digital literacy skill and lack of equitable access to digital information by library users. However, the study revealed that allocation of adequate fund by the government in public libraries; embracing new technologies in public libraries; expanded roles in workshop and training as well as students' engagement and collaboration are all strategies for the integration of the 5th industrial revolution in the management of public libraries for effective service delivery.

***Key Words**: Integration, 5th Industrial Revolution, Management, Public Libraries and Effective Service Delivery.*

Introduction

While robots have performed dangerous, monotonous or physically exhausting work in manufacturing plants and other workplaces, Industry 5.0 extends this to allow them to work collaboratively with human workers. For example, instead of being fenced off for safety, a new generation of 'Cobots' that are able to work safely alongside people is creating new opportunities for businesses. The advent of the Fifth Industrial Revolution (5IR) which is characterised by the integration of digital technologies and artificial intelligence has brought about platforms where libraries can harness a spectrum of advanced technologies to navigate the 5IR thereby redefining their roles and expanding their scope.

Industry 5.0, also known as the Fifth Industrial Revolution, is a new and emerging phase of industrialisation that sees humans working alongside advanced technology and A.I.-powered robots to enhance workplace processes. This is coupled with a more human-centric focus as well as increased resilience and an improved focus on sustainability. Encompassing more than just manufacturing, this new phase builds upon the fourth industrial revolution (Industry 4.0) and is enabled by developments in I.T. that include facets such as artificial intelligence, automation, big data analytics, the Internet of Things (IoT), machine learning, robotics, smart systems, and virtualisation.

Libraries have experienced significant changes in their socio-economic and technological landscape over time (Byrkovych et al. 2023). However, the current revolution era is witnessing a new level of transformation with the rise of collaborative and user-generated content, with this shift happening at an unprecedented pace. 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 main drivers of these changes are the rapid advancements in technology and the increasing demand for closer collaboration between librarians and library users.

It is widely acknowledged that libraries leveraging emerging technologies have the potential to establish stronger connections with their communities on a global scale (Ajani et al. 2023). Thus, libraries worldwide are adopting various emerging technologies and approaches to tailor library services to the specific needs of their communities (Tella, Ajani, & Ailaku 2023). Hence the adoption of new ideas in the management of libraries such as cloud computing, robotics, artificial intelligence, virtual/augmented reality, the Internet of Things, blockchain etc.Libraries must be cautious not to inadvertently marginalize individuals who lack the necessary digital literacy skills or access to technology as they advance technologically in their management. Bridging this digital divide is a pressing challenge that demands steadfast attention to preserve the democratic principles upon which libraries are founded (Killoran, 2018).

Statement of Problem

The integration of digital technologies in the management of public libraries has become a necessity following the surge of information in the era of the 5th industrial revolution. Libraries worldwide are adopting the various emerging technologies and trends to be relevant in the face of a new paradigm shift in library management. The use of ICT has transformed and improved the operational service delivery in libraries as well as provide efficient services to the users' satisfaction. Public libraries that maintain websites interact more with the whole world and are networked not just within a geographical area or community but globally through national and international contact. Despite these trends in development however, the literature concerning the effective utilisation of ICT in public libraries in South East Nigeria show that public libraries are yet to integrate the 5th Industrial Revolution in the management of their information resources. As a result of this, there is a need for a proper integration of the 5th Industrial Revolution in the management of public libraries for effective utilisation. However, if this new approach in library management is not properly examined and adopted in public libraries, it may stand as a barrier in national and sustainable development and the values of these libraries may also be highly jeopardized. Consequently, public libraries may not have any impact in the country's social-cultural and economic sustainable development. On this note therefore, the problem of this study put in a question form is: To what extent has the public libraries integrated the 5th Industrial Revolution in the management of their libraries for effective service delivery in South East Nigeria.

Objectives

1. To examine the benefits of the integration the 5th industrial revolution in the management of public libraries in South East Nigeria.
2. To find out the challenges facing the integration of the 5th industrial revolution in the management of public libraries for effective service delivery in South East Nigeria.
3. To suggest the strategies for the integration of the 5th industrial revolution in the management of public libraries for effective service delivery in South East Nigeria.

Literature Review

Human and machine workers operating side-by-side allow people to focus on value-adding processes to take personalisation of products to a new level. The 5IR is taking us into an era of remarkable technological advancements and societal transformations (Ajani et al. 2022; Tella, Amuda, & Ajani 2022; Moll 2023). At this critical juncture, it's essential to scrutinize the role of libraries, institutions deeply associated with knowledge preservation, in a world marked by rapid digitalization and automation. We need to ask ourselves what 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. Following the challenges of the industrial revolution 5.0 by utilizing information technology, libraries must also be ready to adapt to the current trends as it has an important role to play in information and development of knowledge. Used libraries are still conventional to be converted into digital libraries. In essence, this development represents the desire of library users for faster and more accurate information to facilitate their activities. Therefore, if the library does not want to be abandoned by its users, the library must be more innovative using information technology to provide excellent service (Apriliyanti & Ilham, 2022).

Saur (2001) cited in Ogbu (2020) maintained that a successful public library is a dynamic organization working with other institutions and with individuals to provide a range of library and information services to meet the varied and changing needs of the community. To be effective, it requires experienced, flexible and well trained managers and staff able to use a range of management techniques to achieve organizational goals. In common with many other organizations, public libraries are going through a period of unprecedented and ongoing change as a result of the rapid development of information technology, social and demographic change. This presents tremendous opportunities for the public libraries, as information provision is one of its primary roles. It also presents challenges to managers and staff to ensure that change can be introduced with the maximum effectiveness and the least stress on staff and the organization. Library managers must be away of the issues arising from continuous and fundamental change and establish methods of dealing with them.

According to Ogbu (2020), management is a process "consisting of planning, organizing, actuating and controlling, performed to determine and accomplish the objectives by the use of people and other resources". According to this definition, management is a process – a systematic way of doing things. The four management activities included in this process are: planning, organizing, actuating, and controlling. Planning means that mangers think of their actions in advance. Organizing means that managers coordinate the human and material resources of the organization. Actuating means that managers attempt to ensure that there is no deviation from the norm or plan. From this definition, managers use people and other resources. If some part of their organization is on the wrong track, managers take action to remedy the situation. It states that management involves the act of achieving the organization's objectives.

According to Adigun, Ajani, & Enakrire, (2024), the Fifth Industrial Revolution is ushering 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, public libraries must adapt to these changing dynamics of the digital world while preserving their core principles. These researchers studied the strategic integration of advanced technologies, aiming to redefine the

mission of libraries in the face of complex challenges. The Fifth Industrial Revolution 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 (Adigun, Ajani, & Enakrire, 2024). 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. This research employs 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.

The study carried out by Hamad, Al-Fadel, & Fakhouri (2023) examined the implementation of smart services in academic libraries and the associated challenges. The research highlighted the need for libraries to adapt to emerging technologies to meet the changing needs of users, and found moderate levels of smart service implementation in Jordanian academic libraries, with challenges such as resistance to change, privacy concerns, financial constraints, and limited staff training. Overcoming these challenges is crucial for enhancing smart services in academic libraries and meeting user demands in the digital era. Recent research indicates a global trend of libraries adopting intelligent technologies to provide innovative services and unrestricted access to electronic information (Cao, Liang, & Li 2018). Gul & Bano (2019) further support this trend, emphasizing the role of intelligent technologies in aligning library services with evolving user needs.

The incorporation of intelligent libraries into our knowledge systems presents a host of intricate challenges that require meticulous examination and resolution. One primary concern revolves around the imperative of ensuring equitable access and inclusivity in an increasingly digitized library landscape. Furthermore, there is a significant financial hurdle to surmount. The implementation and maintenance of intelligent library systems entail substantial costs, from the acquisition of cutting-edge technology to the ongoing training and support of staff members. Given that libraries frequently operate within tight budget constraints, prudent financial planning and the judicious allocation of resources are imperative to navigate these fiscal challenges (Berman et al. 2021).

Methodology

A descriptive survey design was adopted by the researcher for this study which was carried out in polytechnic libraries in South East Nigeria.The population of the study comprised 113 staff working in public polytechnic libraries in South East Nigeria which were purposively sampled for this study. The instrument for data collection was a self-designed online questionnaire titled "Integration of the 5th Industrial Revolution in the Management of Public Libraries in South East Nigeria" Questionnaire. The instrument for data collection was validated by three lecturers, two from the Department of Library and Information Science and one from Science Education (Measurement and Evaluation Unit), all from the University of Nigeria Nsukka. Data from the questionnaire were analysed using a descriptive statistical technique such as Mean (X) and Standard Deviation (SD)while real limit of number was arrived at the decision as follows:

3.50 – 400 Strongly Agree/Very High Extent (SA/VHE)
2.50 – 3.49 Agree/High Extent (A/HE)
1.50 – 2.49 Disagree/Low Extent (D/LE/)
0.50 – 1.49 Strongly Disagree/Very Low Extent (SD/VLE)

Result and Discussion

1) Table 1: Benefits of integrating the 5th industrial revolution in the management of public libraries

	Benefits of integrating the 5th industrial revolution in th management of public libraries.			**Decision**
S/N		**Mean**	**SD**	
1	Knowledge creation and dissemination	**3.49**	**92**	**Positive**
2	Financial income generation	**3.40**	**1.07**	**Positive**
3	The revolution improves service efficiency	**3.67**	**.67**	**Positive**
4	Enhance users experience	**3.64**	**.65**	**Positive**
5	Digital transformation	**3.64**	**.68**	**Positive**
6	Promotion of intelligent libraries.	**3.67**	**.48**	**Positive**
8	Increase community engagement	**3.64**	**.61**	**Positive**
9	Create opportunity Sustainable practices	**3.58**	**.62**	**Positive**
10	Create opportunities for a global connectivity	**3.80**	**.40**	**Positive**
11	Others (specify) - promote collaborative spaces			

The data analyzed in Table 1 above reveals that all the items dealing with the benefits of integrating the 5th industrial revolution in the management of public libraries for effective service delivery were all ranked positive with the mean responses above 2.50. The item dealing with Create opportunities for a global connectivity has the highest mean of 3.80.This was followed by other items such as "the revolution improves service efficiency (3.67) and Promotion of intelligent libraries (3.67). In addition, the respondents added that the integrating of the 5th industrial revolution in the management of public libraries promotes collaborative spaces.

Table 2: Challenges facing the effective integration of the 5th industrial revolution in the management of public libraries

S/N	Challenges facing the effective integration of the 5th industrial revolution in the management of public libraries	SA	Mean	Decision
1	Lack of necessary digital literacy skill by library staff	**3.75**	**.44**	**Positive**
2	Issues of cultural adaptation in public libraries.	**3.50**	**.61**	**Positive**
3	High cost of building digital facilities and infrastructures	**3.28**	**.78**	**Positive**
4	Change resistance in public libraries.	**3.44**	**.72**	**Positive**
5	Issues of technical know-how	**3.69**	**.47**	**Positive**
6	Lack of equitable access to digital information by library users	**3.71**	**.46**	**Positive**
7	Poor power supply .	**3.64**	**.48**	**Positive**
8	Environmental factors	**3.60**	**.50**	**Positive**
9	Poor sustainability and maintenance issues.	**3.53**	**.63**	**Positive**

Table 2 above reveals the challenges facing the integration of the 5th industrial revolution in the management of public libraries for effective service delivery. The analysis of data presented shows that all the items listed are accepted by the respondents as challenges facing the effective integration of the 5th industrial revolution in the management of public libraries. The analysis indicates that the respondents rated lack of necessary digital literacy skill and lack of equitable access to digital information by library users with their corresponding mean as 3.75 and 3.71 respectively as highest challenges.

Table 3: Strategies for integration of the 5th industrial revolution in the management of public libraries

S/N	Strategies for integration of the 5th industrial revolution in the management of public libraries	Mean	SD	Decision
1	Embracing new technologies in public libraries	**3.69**	**.56**	**Positive**
2	Engagement in knowledge creation and dissemination	**3.58**	**.69**	**Positive**
3	Improvement in power supply	**3.63**	**.66**	**Positive**
4	Expanded roles in workshop and training	**3.69**	**.46**	**Positive**
5	Constant workshops and training to acquire new skill	**3.65**	**.55**	**Positive**
6	Libraries can improve student engagement and collaboration	**3.69**	**.58**	**Positive**
7	Expansion of library services	**3.53**	**.63**	**Positive**
8	Allocation of adequate fund by the government in public libraries	**3.72**	**.45**	**Positive**
9	Introduction of new technologies, such as artificial intelligence in public libraries	**3.62**	**.54**	**Positive**
10	Others (specify)			

The data analyzed in Table 3 above reveals that all the items dealing with the strategies for the integration of the 5th industrial revolution in the management of public libraries were all ranked appropriate with the mean responses above 2.50. The item dealing with the allocation of adequate fund by the government in public libraries has the highest mean of 3.72. This is followed by embracing new technologies in public libraries; expanded roles in workshop and training as well as libraries can improve students' engagement and collaboration which all have their respective mean as 3.69.

Recommendation

1) Government should prioritize the provision of adequate fund in public libraries because of the gigantic cost in installing digital technologies and other ICT facilities.
2) Library staff working in public libraries should engage in critical thinking and adaptability while still taking advantage of the 5th industrial revolution.
3) Public libraries should redefine their roles and incorporate technological innovations and its impact on their day to day activities for effective service delivery.
4) While redefining their roles, libraries can harness a spectrum of advanced technologies to navigate the Fifth Industrial Revolution and expanding their scope.

Conclusion

The 5th Industrial revolution allows humans to intervene where required and moves away from excessive automation to incorporate critical thinking and adaptability. While still taking advantage of the revolution, it is imperative to address challenges related to the integration of the 5th Industrial Revolution in the management of the public libraries for effective service delivery. However, 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.

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Leveraging Artificial Intelligence in Archives and Records Management for Cultural Preservation

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Abstract

The study explores academic literature review examining artificial intelligence in archive and record management for cultural preservation. Artificial intelligence (AI) is cutting-edge software that excels in performing tasks requiring human mental prowess at a rapid pace. The capability of AI is enormous and has potential to transfigure the field of archives and records management, providing new opportunities for the preservation, organisation, and user-friendly accessibility of cultural heritage. AI machine tools such as machine learning, natural language processing, and computer vision, are enhancing the efficiency of digitisation processes. They automate the classification and indexing of historical records, and enhance the searchability of extensive archival collections. This task is done via analysing and extracting valuable metadata from textual, visual, audio materials, AI not only enhances the preservation of delicate documents but also enables the reconstruction of deteriorated or incomplete records. Besides, AI-driven tools facilitate multilingual translations and provide more inclusive access to different categories of cultural resources. However, application of AI in cultural heritage preservation comes with challenges which include data privacy, need for equity in maintaining the integrity and authenticity of historical materials. The development of ethical standards is crucial to enhance fairness, equity, and accountability in use of AI in archives and cultural preservation. This paper reveals AI technologies such as deep learning, machine learning, computer vision, natural processing language as a tools used, and the growing role of AI in retrospective digitisation processes, classification and cataloguing of archives and historical records, highlighting its challenges and ethical issues working against the implementation.

Keywords: *Archive, Artificial intelligence, Cultural Preservation, Record Management*

1.0 Introduction

Cultural preservation is a fundamental component of human dignity, covering and safeguarding of historical documents, tangible material objects, and intangible customs. However, the sheer amount of cultural assets, along with the problems of deterioration and digital obsolescence, has required new approaches of managing archives and records the present digital dispensation. Cultural preservation is a form of effort galvanized together to usher unprecedented methods of protecting and accessing historical human identity such as artifacts, artwork, traditional songs, and customs. The preservation of cultural heritage is essential for protecting historical legacies and maintaining cultural diversity, and the advent of artificial intelligence (AI) has brought about innovative and efficient methods for safeguarding these treasures (Akyol and Avcı, 2023).

As a result of the astronomical growth of data, the need for effective information retrieval, and the convergence of Internet of Things (IoT) and artificial Intelligence (AI) technology in the archives and records management sector possesses potential capability to enhance cultural preservation (Laohaviraphap and Waroonkun, 2024). AI has the potential to completely change how archival records are maintained, accessed, and managed because of its capacity to analyze enormous volumes of data, automate procedures, and enhance decision-making. Omigie et al. (2023) Artificial intelligence is a significant piece of software technology created to effectively manage and regulate production, management, research, security, and development that forbids human intervention in its operations.

Archives are records that have been chosen as result of permanent cultural preservation which play pivotal valuable role in human historical legacy. Archives are collections of current and historical materials that are methodically kept for scholarly, academic research, community heritage, and legacy purposes '–(Jo and Gebru, 2020). It is a valuable entity that is created or received which has administrative, informational, legal and historical value as evidence of discharging responsibility. According to Lv and Shi (2020) refers to archive as historical records of bearing different kinds, carriers, and other forms such as text, graphics and audiovisual that is significantly requires protection for next generation use. The digital transformation is reshaping archives by converting both historical and contemporary records into data, driving the adoption of artificial intelligence (AI) to scale traditional recordkeeping and innovate in capturing, organizing, and accessing archives. In general, data and information in records are crucial to the orderly and effective management of an organization's daily functional operations. Because of this, maintaining records and archives became a necessary and unavoidable procedure for management. Colavizza et al. (2022)AI tools are acquired to process and organise archives in order to market their large data to external organisations. In particular, no country can advance without occasionally consulting its records and archival materials (Omigie et al., 2023). The advent of artificial intelligence (AI) has progressively transformed archive and record management into data hub. This is made possible as a result of AI capability to create new data from existing old one, organising, indexing and facilitating the accessibility through automation.

Westenberger and Farmaki (2025) archival cultural heritage is being completely transformed by artificial intelligence (AI), which is improving access to, interaction with, and protection of collections and heritage places. Therefore, using this machine for records and archive materials would undoubtedly be a novel way to stop the numerous depressing limitations of records and archiving management problems that have been documented in various Nigerian literary works.

Its implementation in Nigeria's administrative records and archiving control system would offer a fresh, sustainable model for the country's records and archival management system and public groups in the nation. Even if there are currently certain software programs available for managing documents and archives, they are not impervious to human modification. Large volumes of an organization's records will benefit from a new AI-RAMS's improved, accurate, and safe storage capacity standard, which will also make it simple to access the records from a single, appropriate location. A self-controlled mechanism that can communicate with records and archival users, forbid alteration and destruction, and employ algorithms to identify any kind of records espionage might be built into the machine. AI-RAMS enables records to be automatically optimized in the portal, permits Internet access via the log-in app, and provides users with a direct answer via the login PIN. Security, speed, error-free, interactive, and operationally cost-effective records would all be ensured by AI record processing.

1.2 Scope of the Study and Research Questions

The study aims at assessing artificial intelligence leveraged in archives and records management for cultural preservation. The study focus on AI leverages on key areas such as digitisation, organisation, restoration, predictive, preservation, and natural language processing for historical texts.

- RQ1: What are emerging AI technologies leverage in archive and record management for cultural preservation?
- RQ2: What is the archive and record management functions executed using AI in cultural preservation?
- RQ3: What are ethical challenges of leverage AI in archive and record management for cultural preservation?

2.0 Literature Review

2.1 AI Technologies

AI technologies are the focus of current attention; artificial intelligence is a broad field with a long history. Vast text, image, audio, and video datasets were used to train these machine learning models. AI generative technologies are used in archive and record management functions which include image recognition, information extraction, translation, summarisation, captioning, categorisation, transcription, analysis, and ideation. AI technologies such as machine learning algorithms (J48 decision trees and XGBoost) and deep learning models (Mask R-CNN), play a crucial role in processing numerous datasets gathered through Internet of Thing devices (Laohaviraphap and Waroonkun, 2024). Machine learning and deep learning machine algorithms are among AI technologies widely used in cultural heritage(Zhang et al., 2022). Pahl (2025) AI 3D models increase accessibility and engagement, and develop virtual exhibits that prolong the lifespan and reach of physical exhibits. "Musembe et al. (2025) studied Kenya National Archives and Documentation Services readiness to adopt VR and AR technologies and examined their vital attributes and application in cultural management. In a systemic literature conducted by Shinde et al. (2024) classified AI technologies used in natural language processing into Handwritten Text recognition (HTR), Information Retrieval (IR), Named Entity Recognition (NER), and Named Entity Disambiguation (NED).

2.2 Application of Artificial Intelligence in Archives and Records Management (ARM)

Artificial intelligence (AI) is transfiguring archives and records management by improving productivity, efficiency, accessibility, and steering long-term preservation of cultural material legacy. AI-driven technologies automate the categorisation, digitisation, and retrieval processes, therefore ensuring historical records are safeguarded for future generations. Integration of AI in archives and records management for cultural preservation enriches and enhances optimisation of routine operations.

2.2.1 Digitization and Metadata Generation:

In archival and records management, providing accurate metadata and digitising physical tangible and intangible cultural heritages are laborious processes. These procedures are streamlines using AI, which increases accessibility, accuracy and efficiency. AI facilitates the digitization of cultural items and physical documents, enabling search and accessibility using tools like Optical Character Recognition used for scanning and converting hand written or printed text into machine-readable format, Automated Metadata Tagging for analyzing images documents, audio and video to generate descriptive metadata and Language Translator to translate documents and records into multiple languages to increase access across cultures. In the Beridse (2025) research revealed that deep learning, machine learning, and virtual reconstruction technologies are applied to cultural preservation, restoration, digitisation, and the creation of immersive experience through virtual reality, while challenges such as data biases and ethical implications of AI remain. Hariri, (2021) archive and record digitisation encompasses activities of transitioning archival materials from tangible and intangible forms to digital forms utilizing AI technologies for cultural preservation.

2.2.2 Content Classification and Organization:

Deployment of emerging technologies such as AI, blockchain technology and internet of a thing in the field of archives and records management promised to enrich accuracy, efficiency and searchability of cultural preservation. The mechanical accuracy of AI tools play a vital role in many cultural heritage functions such as cataloguing and organising enormous cultural collections, streamlining the management of human legacy resources for present and future use (Tiribelli et al., 2024). Large amounts of archival material can be automatically categorized, classified, and tagged records with metadata using AI algorithms and Machine Learning (ML) models reducing manual effort. Machine language for classification identifies trends in data to

classify documents into appropriate groups such as colonial, religious, and legal. Natural language processing (NPL) comprehends and arranges information according to themes, subjects, and entities like names, events. While clustering similar items aids in organizing linked records even those from disparate sources. NLP empower semantic search, enabling users to locate records through conversational queries. This makes for easy organization and access to cultural records. It is also enhances user friendliness.

2.2.3 Preservation and Risk Mitigation:

Preservation of cultural instinct involves meticulous tasks of maintaining and safeguarding the cultural materials such as artifacts, traditions, and history of a community for next generation (Yusuf, 2024). By anticipating dangers and facilitating sustainable storage, artificial intelligence (AI) guarantees the long-term preservation of cultural data. Predictive maintenance identifies hazards in digital or physical storage like data corruption and mold in manuscript digital. Beyond time and location, artificial intelligence technology can be used to protect and improve the preservation of our varied cultural legacies (Abu Eyadah and Odaibat, 2024). Obsolesce management assists in moving files to more recent formats when older ones are no longer supported while anomaly detection detects anomalous alterations or harm to digital archives, which could be the result of meddling or corruption. These ensure long term survival of cultural contents.

2.2.4 Restoration and Reconstruction: AI can assist in repairing cultural records that are damaged or lacking. Image and video restoration uses artificial intelligence (AI) to colorize black-and-white materials, enhance vintage images, and eliminate noise. Text reconstruction forecasts lines or words that are missing from damaged manuscripts while reconstruction of oral history enhances audio archives by using transcription correction or voice synthesis. This application of AI to cultural preservation revives damaged and aged cultural records. –Boboc et al. (2022) stated that augment reality technology are used in cultural heritage in key areas such as digital heritage, virtual museums, gamification, 3D reconstruction of cultural artefacts and intangible legacy

2.2.5 Accessibility and Engagement: AI such as augmented reality and virtual reality enhances and improves how communities and researchers interact with archival materials. Chatbots and virtual assistant assist users in conversationally searching and comprehending archival content. Artificial intelligence such as augmented reality (AR) and Virtual Reality (VR) assists immersive experiences of historical events or locations. Augmented reality (AR) and virtual reality (AR) are emerging technology with monumental ability, revolutionising archives and records management by improving accessibility, engagement, preservation and 3D archival interaction. These enable homogenise virtual and real-life environments possible, providing user-friendly approaches to digital archival resources." Musembe et al. (2025) referred to augmented reality and virtual reality as facilitate cutting-edge technologies uses immersive storytelling, digital record access, and virtual archival tours access to archival materials. Virtual reality and augmented reality have been developed into an approachable and user-friendly tool for archives and special collection. Augmented reality is a well-established technology that expands the real world by superimposing computer-generated content on top of it for archival cultural preservation –(Boboc et al., 2022).

These applications bring archives closer to the researchers, educators and general public at large.

2.3 Ethical and Professional Considerations for the Future Implementation of AI for Cultural Preservation

2.3.1 Cultural Sensitivity and Respect: Careful management of AI is necessary to uphold cultural values and prevent the reinforcement of preconceived notions. The values, meanings, and ownership that communities attach to their cultural artifacts must be acknowledged and respected by AI. This prevents harm and misrepresentation.

2.3.2 Bias, Equity and Representation: AI must not perpetuate prejudices or historical injustices present in cultural collections. Steer clear of adjectives in AI-generated metadata that are insulting, out-of-date, or Eurocentric which ensures fair representation.

2.3.3 Data Ownership, Privacy and Consent: It is essential to respect intellectual property and communities' rights to manage their cultural assets. Obtain consent before using community materials for AI projects while making sure that local and indigenous groups continue to have authority over the use of their data to protect the community rights

2.3.4 Transparency: When applied in cultural contexts, AI systems need to be transparent and comprehensible. There should be a clearly record of the data used, the training process for AI models, and the decision-making process.

2.3.5 Professional Standards and Training: AI implementation ought to follow best practices for archiving and cultural resources. Ethical codes should follow global standards from UNESCO, ICA, IFLA etc. for cultural stewardship and digitization. Professionals should be equipped with skills to responsibly implement and monitor AI systems to promote responsible innovation.

2.4 Challenges Associated with AI in Archives and Records Management for Cultural Preservation

Despite the fact that artificial intelligence a lot of benefits to different sectors but accompanies with numerous challenges such as privacy infringement, accountability, transparency and bias in data management. AI has a lot to offer in the cultural sector, there are a number of hazards and ethical issues that could arise (Tiribelli et al., 2024). According to —Jaillant et al. (2025) stated that currently, inadequate collaboration between

archivists, librarians and other experts in cultural preservation and AI technology developers are among challenges being faced by the adoption of emerging technology in the sector.

2.4.1 Undermined Authenticity: Artificial intelligence-generated works are likewise impacted by the authenticity issue (Nakonieczna and Szczepanski 2023) given that a piece of art's legitimacy is directly related to who created it and AI-automated planning systems that produce cultural offerings based on customer tastes and preferences provide another authenticity concern, undercutting cultural institutions' instructional mission. By providing only what audiences find appealing (popular content), possibly leaving out less well-known and mainstreaming works of art. This technology can lessen the arts' ability to be provocative and critical, as well as erode the diversity of creative output, which could result in more impactful and more standardized aesthetics.

2.4.2 Biased interpretation

Two ethical standards for the use of AI are diversity and non-discrimination which are described in (UNESCO, 2023)guideline for using AI. UNESCO proposed guidelines to control or regulate the use of GenAI tools including mandating the protection of data privacy, ethical norms and considering an age limit for their effective use in education. The broad AI ethics principle of justice and fairness, which is included in practically all AI frameworks created to date, is the source of these high-level requirements (Jobin et al., 2019). To reduce the possibility of culturally constrained or biased interpretations, these considerations must be taken into account when implementing AI in assets. Art reviewers' cultural and epistemological backgrounds frequently influence their perceptions, despite the fact that specialists frequently attempt to establish impartial standards for evaluating artistic creations. When using AI models to interpret a work, the most prevalent and easily accessible information from the works data reading is always selected.

2.4.3 Digitization as a Justification for Devastation

Even while these technologies have been essential to the preservation of historic places, it's vital to weigh the dangers of depending just on digital preservation. The usage of digital techniques potentially lead to the loss of material novelty that frequently have great identity value for the reference group and serve as justification for the physical destruction of cultural heritage. Furthermore, there are substantial human and environmental degradation associated with the use of AI in cultural assets, which usually in conflict with social and ecological sustainability goals (Suyash Pasi, 2025). For instance, the creation of AI systems demands the use of technology infrastructure, space such as data centers, and environmental resources, all of which can have a negative impact on regions that are essential to the preservation and well-being of particular historical, natural, and cultural sites. This could lead to the degradation of these environments and a reduction in their historical and cultural significance.

2.4.4 Socio-Economic and Cognitive Accessibility

The sector-specific framework created for utilizing AI in the context of cultural heritage acknowledges accessibility as a fundamental concept, building upon the core AI ethics premise of justice and fairness (Pansoni et al., 2023). Ensuring equal opportunities for access to and enjoyment of these technologies, irrespective of various audiences and institutions, is crucial. Spreading knowledge and literacy about these technologies among target audiences and domain experts is essential to ensuring that they are available to everyone. Furthermore, evaluating AI-generated recommendations or comprehending intricate interfaces are frequently necessary for AI applications. These features could be difficult for inexperienced users, which could result in them abusing or underusing AI tools. In addition, without proper or personalized training, people with disabilities or older adults may find it particularly difficult to use AI technologies, limiting their access to art and cultural education. These are just a few examples of risks that can occur. Therefore, as outlined in the UNESCO recommendations, the development of AI systems must be accompanied by processes of education and literacy about how these technologies work by improving their accessibility.

3.0 Discussion

RQ1: The present study reveals that artificial intelligence is a science and engineering which created computer software platform to solve complex problems that requires human intelligence. The review found popular AI technologies used in cultural preservation to include complex algorithms models, deep learning, machine learning, generative AI model, augmented and reality, Natural Language Processing (NLP) and Computer Vision (CV), which are particularly suited for managing the extensive textual and visual data found in both paper archives and electronic records. Al-Amri et al. (2024) revealed AI technologies such as machine learning, natural language processing, and image recognition used in cultural heritage.

Although many studies focus on digitisation, and organisation (cataloguing and classification) through AI techniques, practicality remains a significant topic of debate.

RQ2: As detailed in the review, AI has been applied to most archives and records management functions. Modiba (2025) revealed that AI can effectively and proficiently perform all archive and record management functions via the entire records lifecycle.

Within records management, the most common function being performed by AI is organisation (classification and cataloguing), digitisation, predictive and risk assessment. Considering that cataloguing and classification is the organisation of records into categories according to a specific scheme of work, this function can be easily

carried out by AI, explaining the predominance of literature on the organisation. It does not seem, however, that AI has been used to carry out functional analysis, the identification of the activities of an organization on which a classification schema is based. Within archives, AI has been fairly and evenly applied to both appraisal and arrangement and description functions, with five and six papers on the subjects, respectively. Most of the literature, though, addresses the access and use of records, a function that occurs in both records management and archives. The use of AI for searching and retrieving records is by far the most prevalent used, with several papers on the subject. Consequently, this suggests that, to date, the accessibility of records has been one of the primary problems addressed by AI.

RQ3: The challenges associated with the use of AI in archive and record management involve grappling with issues of authenticity, navigating the simplicity of sharing alongside metadata manipulation. The application of AI in the conservation of cultural heritage marks a significant transformation in preservation approaches, heralding innovative solutions, challenges, and complex ethical dilemmas–(Ghaith, 2020) . As organisations increasingly rely on AI to automate process such as data classification, retrieval, and preservation, they must confront several critical concerns. The cultural organisations, museums, film production companies and the music sector, are spending a lot of money digitising their collections and thus producing a large amount of metadata and data that, although technically accessible, are difficult to use because of legal barriers (Pasikowska-Schnass & Lim, 2023).

Undetermined authenticity of records: AI systems can inadvertently alter or misinterpret data, leading to questions about the integrity of archived materials. For instance, if an AI algorithm modifies metadata or misclassifies documents, it could compromise the historical accuracy and reliability of records. Archivists must develop robust validation mechanisms to verify that AI-generated outputs maintain fidelity to original documents. The use of AI can enhance the efficiency of data retrieval and organisation, it raises concerns about data integrity, privacy, and the potential for misinterpretation. Artificial intelligence-generated works are likewise impacted by the authenticity issue (Nakonieczna and Szczepanski 2023).

Adulterated metadata: AI systems process vast amount of information. Automated tagging and categorisation can streamline workflows, but they may also introduce errors or biases if not carefully monitored. This necessitates a robust framework for validating Al-generated metadata to maintain trust in archival records. Moreover, the ease of sharing information facilitated by AI tools can lead to unintended consequences. Sensitive or confidential records might be inadvertently exposed during automated sharing processes, highlighting the stringent for access controls and ethical guidelines governing data dissemination. Archives must strike a balance between accessibility and security to protect sensitive information while still promoting collaboration. AI has a lot to offer in the cultural sector, there are a number of hazards and ethical issues that could arise(Tiribelli et al., 2024).

The economic investments required for implementing AI in archive management can be daunting. Institutions must weigh the costs against potential benefits, considering not only financial implications but also the value of preserving such cultural material.

Cultural and historical biases- AI systems are often trained on datasets that may reflect existing societal biases, leading to outputs that perpetuate stereotypes or overlook marginalized voices. Cultural institutions must critically assess their data sources and actively work to mitigate these biases to ensure that AI serves as a tool for inclusivity rather than exclusion. This involves engaging with communities to understand their histories and values, thereby creating a more equitable archival landscape.

Justifying destruction actions-such as the decision to deaccession or digitise materials demand transparency and ethical considerations. Stakeholders must be involved in these decisions, with clear rationales provided for why certain record may be altered or removed from physical collections. Suyash Pasi (2025) stated substantial human and environmental degradation associated with the use of AI in cultural assets, which usually is in conflict with social and ecological sustainability goals.

Attributing responsibility: one of the foremost ethical issues is determining who is accountable for the actions and decisions made by AI systems. When an AI generates content or makes recommendations, it can be difficult to pinpoint responsibility. This ambiguity can complicate legal and ethical frameworks within which cultural institutions operate.

Conclusion

Artificial intelligence (AI) is reshaping and restructuring archives and records management by enhancing digitisation, classification, and accessibility of cultural heritage. Through machine learning, NLP, and computer vision, AI improves metadata extraction, multilingual access, and preservation of fragile documents. However, challenges such as data privacy, authenticity, and ethical considerations must be addressed. Establishing ethical standards or frameworks will ensure responsible AI use in cultural preservation, balancing novelty with integrity. This paper elucidates AI"s potential while emphasising the need for equitable and accountable implementation in archival practices.

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Leveraging the 5th Industrial Revolution for Sustainable Library Service Delivery

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Abstract

The 5th Industrial Revolution characterized by the fusion of Artificial Intelligence (AI) Blockchain and the Internet of Things (IoT), presents unprecedented opportunities for the transformation of libraries' service delivery. This paper, "Leveraging the 5th Industrial Revolution for Sustainable Library Service Delivery," examines ways the 5th industrial Revolution can strengthen and sustain library service delivery. The paper is an analytical review of literature censoriously retrieved from Google scholar, Proquest Research Library and ResearchGate on Leveraging the 5th Industrial Revolution for Sustainable Library Service Delivery. As libraries continue to play inestimable vital role in promoting literacy, lifelong learning, and community engagement, embracing the technology of the 5th Industrial Revolution can help achieve the libraries' mission in more sustainable and effective manner. The 5th Industrial Revolution offers libraries a unique opportunity to redefine service delivery and promote sustainability in the following ways: reduced energy consumption, increased accessibility to information, improved resource sharing and enhanced user engagement. As libraries continue to evolve and adapt to the changing information landscape, leveraging the technologies of the 5th Industrial revolution will be crucial to libraries' success and sustainability.

Keywords*: Library Service Delivery, 5th Industrial Revolution, Sustainability*

Introduction

The next phase in industrial and societal development is referred to as the 5th Industrial Revolution (IR), following the 4th Industrial Revolution, which is characterised by the integration of digital technologies like Artificial Intelligence (AI), Internet of Things (IoT), and robotics into industry. While 4th IR focused on automation and efficiency, the 5th Industrial Revolution emphasizes collaboration between humans and machines, with a robust focus on human-centric values.

In this transformative era, libraries, traditionally repositories of knowledge, are swiftly adapting to meet evolving needs, transitioning into dynamic centers actively engaged in curating, organizing, and disseminating knowledge. The role of libraries is undergoing a significant transformation, requiring librarians to manage extensive digital repositories, navigate complex information landscapes, and facilitate access to a variety of resources. Leveraging the technologies central to the 5IR presents both opportunities and challenges for achieving sustainable library service delivery.

The 5th Industrial Revolution well-branded by the blend of Artificial Intelligence, blockchain and the internet of things, presents unprecedented opportunities for the transformation of libraries' service delivery. Some of these opportunities come in terms of reduced energy consumption, increased accessibility to information and improved resource sharing, which are unparalleled potentials for leveraging function and services of modern libraries, expedited by comprehensive embrace of the influence of AI, blockchain and IoT.

Artificial intelligence can revolutionalise library services by providing personalized recommendations, automating routine tasks, and enhancing the overall user experience. AI-powered chatbots can assist patron with queries, freeing up librarians to focus on more complex and high-value tasks. Additionally, AI-driven analytics can help libraries gain insights into user behaviour, preferences, and needs, enabling them to tailor their services and collections accordingly.

Blockchain technologies offer libraries a secure and transparent way to manage access to digital resource, protect user data, and ensure the authenticity of digital collections. By utilizing blockchain-based system, libraries can create decentralized, community-driven network for sharing knowledge and resources, promoting collaboration and innovation.

The Internet of Things enables libraries to create smart, responsive environments that support the diverse needs of their users. IoT sensors and devices can monitor and adjust lighting, temperature and noise levels, creating comfortable and conducive study space. Additionally, IoT-based system can track the location and availability of library materials, streaming the circulation process and reducing wait times.In line with this, Obim, Ukwueze and Nwadike (2023) indicated that Blockchain technology is a very high innovation that librarians can leverage on for better library circulation services delivery.

As libraries continue to play their vital role in promoting literacy, lifelong learning, and community engagement, embracing the technology of the 5th IR can help achieve the libraries' mission in more sustainable and effective manner.

Sustainable Library Service Delivery through the 5th Industrial Revolution

The Fifth Industrial Revolution (5IR) is characterized by the convergence of advanced technologies such as artificial intelligence (AI), and the Internet of Things (IoT), with a renewed emphasis on human-centric values, sustainability, and ethical innovation. In this context, libraries must strategically integrate emerging technologies to remain relevant and impactful in a rapidly changing digital landscape (Adigun, Ajani, & Enakrire, 2024). This includes adopting AI for personalized services, using IoT for smart resource management, and leveraging cloud computing for scalable access to information.

Fifth Industrial Revolution

Industrial revolutions have historically marked significant turning points in human development. From mechanization in the First Industrial Revolution to the digital transformation of the Fourth, each phase has redefined productivity and societal structures. The Fifth Industrial Revolution emerges as a response to the limitations of Fourth IR, particularly its overemphasis on automation and efficiency at the expense of human values. Fifth IR seeks to harmonize technological advancement with human well-being, sustainability, and ethical innovation.

Callaghan (2022) conceptualizes 5th IR as a "Knowledge Productivity Revolution," where the exponential growth of knowledge and innovation drives productivity. This revolution is not merely technological but epistemological, redefining how knowledge is created, shared, and applied. It emphasizes the role of human intellect and creativity in shaping technological progress, moving beyond the mechanistic focus of previous revolutions.

A defining characteristic of 5th IR is its human-centric approach. Crnobrnja et al. (2023) argue that Fifth IR aims to restore the balance between humans and machines by integrating human intelligence with smart technologies. This integration enhances human roles in decision-making, creativity, and problem-solving, fostering a collaborative relationship between humans and machines rather than a competitive one.

Sustainability is a core pillar of 5th IR. The revolution addresses the environmental and social shortcomings of 4IR by embedding sustainable practices into industrial processes. This includes promoting circular economies, reducing carbon emissions, and ensuring ethical AI deployment. The emphasis on resilience also prepares industries to adapt to global challenges such as climate change, pandemics, and geopolitical instability

Sustainability and Library Service Delivery

Sustainability in library service delivery extends beyond environmental concerns to include digital inclusion, equitable access, and long-term viability. Libraries are increasingly seen as community anchors that bridge the digital divide by providing access to digital tools and literacy programs. According to Swetha Rama Kumar (2024), libraries must ensure that technological advancements do not exacerbate inequalities but instead foster inclusive access to knowledge.

The integration of AI and data-driven services raises significant ethical and privacy concerns. Libraries, as stewards of intellectual freedom and privacy, must navigate these challenges carefully. Adigun et al. (2024) emphasize the importance of maintaining user trust by implementing transparent data governance policies and ensuring that AI systems align with ethical standards.

The 5th IR compels libraries to redefine their roles from passive information providers to active facilitators of innovation, research, and community engagement. Smart libraries are envisioned as global knowledge hubs that support interdisciplinary collaboration, digital scholarship, and lifelong learning. This transformation requires not only technological upgrades but also a cultural shift in how libraries perceive their mission and impact.

Sustainable library function and services delivery are attainable leveraging the 5th industrial revolution technologies through reduced energy consumption, increased accessibility to information, improved resource sharing and enhanced user engagement in contemporary libraries.

Reduced Energy Consumption

The 5th Industrial Revolution offers libraries a unique opportunity to redefine service delivery and promote sustainability in the reduction of energy consumption in libraries particularly now that electricity tariff has tripled comparatively in recent months in Nigeria. Electricity supply in Nigeria has been a huge problem (Babatunde, Oyegbusi & Babatunde, 2020). There is continuous demand for increase in electricity tariff in the economic and political landscape of Nigeria (Madaki & Akanegbue, 2023). But smart library environments enabled by Internet of Things can optimize energy usage, reducing waste and minimizing the library's carbon footprint. IoT can be employed for the improvement in energy consumption of libraries for sustainable working environment facilitated by technology inform of lighting control and energy efficiency by engaging motion sensors to detect human movement and adjusting lighting in particular parts of a library (Shao et al., 2023). For example, serials and documents sections of an academic library are less utilized off academic sessions, motion sensors have the propensity to detect patrons' presence or not and regulate lighting in the sections as appropriate. Energy usage can be improved by utilizing the opportunities of contemporary cutting-edge technology of IoT (Humayun, Alsaqer, & Jhanjhi, 2022). Smart library environments enabled by IoT can optimize energy usage leveraging on IoT sensor and devices. For instance, lighting Sensors can automatically adjust lighting levels based on natural light availability, reducing the need for artificial lighting, temperature sensors will monitor and adjust temperature levels to maintain a comfortable range, reducing heating and cooling costs, motion sensors detect occupancy and adjust lighting, temperature, and other systems accordingly, eliminating unnecessary energy consumption, energy meters can monitor energy usage in real-time, providing insight into energy consumption patterns.

Also, IoT-based systems can be used to improve the entire operation of modern library. Building Management Systems (BMS) can integrate data from various sensors to optimize energy usage, automate routine task, and predict energy demand. Likewise, of importance is Energy Management Systems (EMS) which analyses energy consumption data to identity areas of inefficiency and provide recommendations for improvement, and

then Smart Heating Ventilation and Air Conditioning Systems(HVAC) to optimize heating, ventilation, and air conditioning system to reduce energy consumption and improve indoor air quality. Alternatively, Yaun, Zhang and Zhang (2023) proposed load model which distributes energy to users according to needs within a building. Park, et al (2019) also proposed lightlearn; an intelligent lighting system that uses reinforcement learning to tailor lighting conditions to occupants' preferences and surroundings, optimizing comfort and energy efficiency.

The benefits of IoT systems are that there is reduced energy consumption when deployed. IoT-enabled systems optimize energy usage, leading to lower energy bills from electricity distribution companies and reduced waste. Internet of Things contributes a great deal in the distribution of energy (Niu, et al., (2021). Correspondingly, IoT minimizes carbon footprint by reducing energy consumption, libraries can minimize their carbon footprint and contribute to more sustainable future, IoT-enabled systems ensure a comfortable and healthy indoor environment, enhancing the overall library experience. Another benefit of IoT systems is that it conveys data-driven decision-making; IoT-enabled systems provide valuable insight into energy consumption patterns, enabling data-driven decision making and continuous improvement. Internet of things has immense relevance in the energy sector (Diaz-Martinez, et al., 2024).By leveraging IoT technologies libraries can create smart environments that optimize energy usage, reduce waste, and promote sustainability.

Increased Accessibility to Information

AI-powered tools can revolutionize the way libraries support users with disabilities, promoting inclusivity and equal access to information. In this age of information explosion, AI will provide access to equal information and humanised library services at a reduced cost (Hussain, 2020). The 5th industrial revolution presents a much more improved quality of life for people with impairment through user-friendly technologies (Ziatdinov, Atteraya, & Nabiyev, 2024). AI-powered screen readers such as TypeaheadAI, AudioEye, and acesssiBe can convert digital text into audio, enabling users with visual impairments to access library resources in institutions with visual impaired course of study and students. AI-powered voice assistants, like Alexa or Google Assistant, can help users with mobility or dexterity impairments navigate library resources using voice commands. Panda and Kaur (2023) attested that digital libraries prioritise accessibility to empower individuals with diverse abilities, including those with visual, hearing, cognitive, or motor impairments, to independently access and utilise digital resources and services.

In order to make current relevant books and journals accessible to library users in academic libraries, purchases are made from foreign vendors even with experiences of fluctuating exchange rate. Nigeria struggles with exchange rate unpredictability (Adetayo, et al., 2024). But Blockchain-based currencies designed to provide a stable price point at all times can be employed for the purchase of books and journal from vendors and publishers by eliminating exchange rate instability (Emmanuel et al., 2023, p. 3).

Blockchain enhancement of library services does not end in facilitating financial transactions but encompasses other value-added services. As highlighted by Unwobuiko, (2025) blockchain technology holds immense potential beyond financial services, offering libraries a powerful tool to enhance service delivery, promote transparency, and build trust with library Patrons. Sanjay and Hasan (2020) confirmed that blockchain technology has the potential to enhance library operations in digital preservation and tracking, community-based collections to share objects, tools and services, inter-library loan and library verification of credentials. This confirmation highlights the versatility of blockchain technology and its potential application in libraries, emphasizing benefits such as improved service delivery, transparency and trust.

Improved Resource Sharing

Resource sharing among libraries can be improved to a great extend with the application of blockchain technology by creating a secure, transparent, and decentralized system for tracking and managing resources, facilitating efficient interlibrary lending, and promoting collaboration. But academic libraries, particularly university libraries are yet to deploy the openings offered by blockhain technology. Obim, Ukwueze and Nwadike (2023) revealed that there was no level of utilization of blockchain technology among the university libraries studied for recordkeeping, tracking of transactions of users, reservation of resources, charging and discharging ofinformation resources in university libraries in Southeast, Nigeria. Subaveerapandiyan (2023) mentioned finance, cost, shortage of expertise, an unstable power supply, and constrained employee training and acquisition budgets were the biggest obstacles to the application of AI in academic libraries in Nigeria.

In line with the opportunities of AI, Blockchain's immutable ledger ensures that all library services, including interlibrary loans, charging and discharging of collections, are recorded securely and transparently, building trust among participating libraries. This activity,according to Onwubiko(2025)ensures trail of borrowing and returning of library resources. Nwobu et al. (2024) lend credence to the fact that interlibrary loan network is one the collective initiatives that enable librarians to leverage collective expertise and resources to achieve common goal. Similarly, Emmanueletal. (2023, p.3) indicated that library patrons of libraries utilizing blockhain have control over their circulation records and manage their borrowing histories as patrons can lend library books to other patrons directly without having to return the books to the library facilitated by Libchain built in blockhain.

Further impact of blockchain in library services delivery is its decentralized nature which eliminates the need for a central authority, allowing libraries to directly manage their resources and share them with other libraries without relying on intermediaries. It creates a community engagement platform where libraries can share resources thereby encouraging a sense of belonging (Panda & Kaur, 2023).

Also, libraries can use blockchain to facilitate collaboration on projects like digital preservation, metadata

sharing, and resource discovery, fostering a more interconnected and efficient library ecosystem. However, Hodonu-Wusu (2024) who supported the importance of digital preservation of documents warned of its challenges such as cost, human resources, bias in selecting materials for digital preservation due to copyright and privacy issues. Mishra (2023) described the digital documents to be preserved by this state-of-the-art technology as delicate materials which include rare books and manuscripts. Digital preservation of rare materials is ascertained by keeping optimal environmental conditions which is also comfortable for patrons.

Privacy issue heralds security concern but blockchain's inherent security features protect sensitive user and resource data, ensuring data integrity and privacy, which is crucial for libraries. Blockchain can facilitate the access to information and resources by providing a secure and transparent way to share and manage digital collections. Data management, data privacy and security matters, patron access and control of personal data are highlights of Internet of Things (Mishra, 2023). In the same vein, "AI systems can keep an eye on network activity, spot oddities, and move quickly to stop possible security breaches, keeping library data safe. By being careful about hacking, the library not only protects its assets but also builds trust with its users, who know that their data is safe" (Sonawane, et al., 2024, p. 53).

Enhance User Engagement

AI-driven analytics and IoT-based systems can enhance library user engagement and promote exploration and discovery by personalizing user experiences, enhanced resource management and accessibility, fostering lifelong learning and providing timely information and recommendations, all while fostering a more accessible and engaging library environment.

1. Personalized User Experiences

Since library function and services are human centred, it is imperative to analyse library users' behavour and preferences to suggest relevant materials and resources for use enabled by AI –powered recommendations. Individual notification of overdue books with a library patron, new arrivals of library books and journals, and library events tailored to individual interests can be leveraged by AI-powered technologies. AI analyses library patron history of the use of library resources to recommend relevant materials to patron thereby creating an opportunity to discover new library resources for utilization (Gajhbiye, 2024). User experience is the outcome of human interaction with products or services in terms of user's perception, emotions, and behaviours.

The personalized user experience of these technologies extend to utilizing natural language processing (NLP) and machine learning (ML) to understand user queries and provide accurate, relevant results, offer instant access to information and assistance, answering user questions and guiding them through library resources enabled by chatbots and virtual assistants. Panda and Kaur (2023) attested that the integration of natural language processing and machine learning and artificial intelligence technologies in libraries is a great transformative and sustainable innovation for library users. Gajhbiye (2024) confirm that AI powered chatbox and virtual assistant work tirelessly to augment library users accessibility to library services and proven satisfaction of use.

2. Enhanced Resource Management and Accessibility

Library resource management and accessibility can be enhanced by analyzing library patron usage patterns to optimize collection development, resource allocation, and space management. Meakin (2024) affirm that generative AI leverage library users' way of accessing and utilizing library resources. The extended outcome of exploration of patron's use of resources is improved library service delivery. In furtherance of library resource management, AI is also used to automate library daily tasks like cataloguing and classification of library collections, content tagging to enable easy search and retrieval of library resources, and digital asset preservation; freeing up staff for more complex tasks. Computerization of library function and services is enhanced by integrating Artificial Intelligence (Schieseck, et al., 2024).In confirmation, Li and Qiu (2025) averred that libraries have ample opportunities by leveraging on AI transformative technologies in automating operations, stressing that libraries can gain more in intelligence service task like intelligent recommendations, automatic categorization, semantic search etc. Also, IoT sensors are used to track library items and monitor usage patterns, ensuring resources are available when needed, enable access to digital resources and learning materials from anywhere, promoting inclusivity and lifelong learning.

3. Fostering Lifelong Learning

AI-driven analytics and IoT-based systems develop personalized learning paths based on user interests and goals, encouraging exploration and discovery; utilize technologies like augmented reality (AR) and virtual reality (VR) to create engaging and memorable learning experiences. Lifelong learning tailored towards patron's interest is transformed by AI and immersive technological innovations in learning like augmented reality, virtual reality, and mixed reality (MR) thereby improving learner outcomes and accessibility (Dritsas & Trigka, 2025). Immersive learning condition improves learning ability, increase communication, and inspire enthusiasm (zhang, Shi & Bai, 2021). In place of AI, AR, VR, and MR, Saneinia et al., (2024) proposed metaverse; an integration of augmented reality and virtual reality, as new opportunity for lifelong learning, stressing it is a necessary component in lifelong learning.

Challenges and Strategic Responses

Despite its promise, 5th IR faces several challenges. These include technological inequality, data privacy concerns, and the need for robust policy frameworks. Ensuring that the benefits of 5th IR are equitably

distributed requires coordinated efforts from governments, industries, and civil society. In addition, libraries face challenges such as resource constraints, staff training needs, and resistance to change. Strategic responses include investing in digital infrastructure, fostering partnerships with tech providers, and developing policies that support sustainable innovation. Libraries must also advocate for supportive policies that recognize their evolving roles in national and global knowledge ecosystems.

Conclusion

The 5th industrial Revolution presents libraries with a transformative opportunity to reimagine library service delivery and promote sustainability. By embracing AI, Blockchain, and IoT, libraries can create personalize, inclusive, and responsive environments that support the diverse needs of users. As libraries continue to evolve and adapt to the changing information landscape, leveraging the technologies of the 5thIndustrial revolution will be crucial to success and sustainability.

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Librarians' Competencies for Sustainable Research and Development in Academic Institutions in South-South Nigeria: A Correlational Study

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Abstract

The study examined librarians' competencies for sustainable research and development in academic institutions in South-South, Nigeria. The study was guided by four (4) research objectives, which were to: determine librarians' digital scholarship competencies for research and development in academic institutions in South-South, Nigeria; assess librarians' collaboration skills for research and development in academic institutions in South-South, Nigeria; examined librarians' online search competencies for research and development in academic institutions in South-South, Nigeria; and ascertain librarians' data management skills for research and development in academic institutions in South-South, Nigeria. It adopted the correlational research design, with a population of one hundred and one (101) academic/professional librarians from Six (6) public university libraries in Akwa Ibom, Cross River and Rivers States. Total enumeration sampling technique was used to study the entire 101 academic/professional librarians. The researchers' developed structured and validated questionnaire, with a reliability coefficient of 0.78, was used for the data collection, which yielded a response rate of 93%. The data collected were analysed with the Pearson Product Moment Correlation (PPMC), while the null hypotheses were tested using simple linear regression at 0.05 level of significance. The findings of the study revealed that librarians' digital scholarship competencies, collaboration skills, online search competencies and data management skills have strong positive significant relationships with sustainable research and development. It showed that librarian competencies are not well-harnessed and effectively capitalized on in achieving sustainable research and development in academic institutions in South-South, Nigeria. It concluded that librarians' competencies are necessary requirement for improved, effective and sustainable research and development in academic institutions. Thus, it was recommended, among others, that management of academic institutions in conjunction with university libraries should provide training for librarians on digital scholarship paradigms and data management issues in order to enhance their competencies in line with emerging research and other academic responsibilities, while librarians in the academic institutions should be willing, conscious and self-motivated to upskill themselves in line with the dynamics of the modern technology-driven environment for enhanced research and academic activities.

Keywords: ***Librarians, Competencies, Research, Development, Academic Institutions***

Introduction

Academic institutions are pivotal for research and knowledge generation. They have the core mandate of galvanizing teaching and research, a process through which they contribute to sustainable societal and national development. As a matter of fact, academic institutions are operating in an environment that has greatly changed in the ways that teaching and research are carried out. The changes have brought about new expectations from librarians to be able to apply new innovations and emerging technologies, which in turn have challenged librarians to acquire new set of competencies for enhanced research activities.

Research is a product of ingenious enquiry for enhanced solutions to societal problems in all areas of life. Akwang and Udoh (2024) described research as the basis through which new discoveries, techniques, theories and solutions are made following conscious, meticulous and systematic investigations into an identified problem in academic, business, economic, cultural, religious and socio-political situations. Sustainable research is a paradigm that is more computational, collaborative, more data-intensive, and a scientific process that is focusing on solving real life problems through data driven investigation. It is essential in providing solutions to current and future problems by advancing social and economic equity, and contributing to global efforts to combat societal challenges through innovative research practices. Sustainable research and development require a broad range of competencies in emerging technologies to cope with emerging research processes by librarians. This implies that one of the most critical requirements for sustainable research and development is possessing the right competencies by librarians as purveyors of knowledge.

Librarians' competencies are indispensable in achieving sustainable research and development in the academic institutions. Shah (2021) defined competencies as a person's potential for action developed as a result of their exposure to the social world. Competencies are the abilities and skills possess by a person to use emerging technologies professionally and confidently in solving emerging problems. It involves the ability to

use innovative technologies such as social media, the internet, cloud computing technologies, artificial intelligence, block chain technologies, and other modern systems for the purpose of achieving sustainable research and development. Studies show that librarians' competencies cut across information and digital literacy skills (Emiri, 2015; Sakhawat et al., 2021; Udoh & Okafor, 2022; Umuhoza &Unegbu, 2021), research skills (Brit, 2022; Mydin et al., 2021), communication with effective writing and presentation skills (Atata-Akidi & Osedo, 2024; Moseley, 2023; Williams & Saunders, 2020), collaboration and networking skills (Amadi et al., 2024; Atkinson, 2019), leadership and marketing skills (Partridge et al., as cited in Idhalama et al., 2020), creative and innovative skills (Akpan-Atata et al., 2014; Mensa et al., 2023); as well as social media or Web 2.0 skills for use of social media handles like LinkedIn, GoogleScholar, Facebook, WhatsApp, X (formerly Twitter), YouTube, library blog, etc. (Akpan-Atata et al., 2015; Akwang & Udoh, 2024; Akwang, 2021; Saidu & Sani, 2022). These competencies are crucial for sustainable research and development by enhancing the possibility of sharing research findings and outputs. This underscores the position of Shao et al. (2018) who remarked that librarians' roles in contributing to research activities require skills and abilities in determining need-based research topic, emerging data collection and analysis processes, as well as emerging research publishing systems and protocols. Bedi and Walde (2017) concurred that to achieve sustainable research, librarians should be involved in learning new methods and approaches, while developing and integrating research teams to assist with research data management, documentation, and research data preservation.

From the above perspectives, it can be deduced that competent and skilled librarians are crucial assets in meeting the information and research needs of users in academic institutions in a world dominated by digital media and changing users' needs (Bell & Shank, as cited in Shahzad, et al.,2023; Cherinet, 2018). This is because competent librarians play fundamental role in ensuring that the academic institutions as pivot of knowledge generation live up to their expectations in research and effective knowledge dissemination. They have onerous tasks in the lifecycle of sustainable research and development in academic institutions, occupying a critical position in the promotion of research activities such as teaching research skills and encouraging research collaboration across faculties in their institutions and other institutions for increased research productivity (Akwang et al., 2024; Mbagwu & Oduagwu, 2023). This denotes that librarians' competencies are propellers of cutting-edge research and the attainment of the vision and mission of academic institutions.

In summary, librarians' competencies help in sustainable research and development by providing effective support for research data services, including research data preservation and digitization. It helps in supporting professional and intellectual activities for enhanced accessibility, research sharing and effective use of research data. It also facilitates the possibility of encouraging multidisciplinary research collaborations, as well as impact librarians' confidence dealing with the technology driven environment where research processes are taking new dimensions, especially with the advent of generative artificial intelligence (Gen AI) tools such as ChatGPT, Grammarly, ProWritingAid, ResearchRabbit, DataRobot, etc. Therefore, based on the above background, this paper investigated librarians' competencies for research and development in academic institutions in South-South, Nigeria.

Statement of the Problem

The need for librarians' conscious improvement of their competencies for research and development in academic institutions cannot be overemphasized. The global requirement for strong professional, technical and emerging competencies in the use of technologies for academic activities, including research and scholarship is irrefutable. According to Obinyan and Ugwuanyi (2022); Akwang and Udoh (2024), the growing prominence of digital technologies as the product of the 5th industrial revolution and their effects on all areas of professional, academic and research works require great rethinking of improved competencies by librarians. This is essential in a competitive and deeply technology-driven environment where new skills are needed to handle emerging tools for various job requirements. However, in spite of the importance of new competencies for emerging job requirements like research activities, it is observed by these researchers that most librarians seem to be lacking vital competencies for sustainable research and development. It is particularly observed that most librarians do not possess adequate online search skills and the ability to effectively engage in collaborative research activities. As a matter of fact, studies by Adam and Kiran (2019); Gbaje et al. (2018); Oguche (2018); Zhong and Jiang (2016), all reported insufficient skills and competencies of librarians with implications on research and development. The situation is further stressed by these researchers who observed that most librarians are not adequately aware of what constitute digital scholarship competencies and how possessing such competencies can impact the speed, accuracy and timeliness of sharing research findings across diverse research platforms. Thus, based on this backdrop, this study examined librarians' competencies for sustainable research and development in academic institutions in South-South Nigeria.

Research Objectives

The main objective of the study is to examine librarians' competencies for research and development in academic institutions in Nigeria. The specific objectives are, to:

i. Determine librarians' digital scholarship competencies for research and development in academic institutions in South-South, Nigeria.

ii. Examine librarians' collaboration skills for research and development in academic institutions in South-South, Nigeria.
iii. Assess librarians' online search competencies for research and development in academic institutions in South-South, Nigeria.
iv. Ascertain librarians' data management skills for research and development in academic institutions in South-South, Nigeria.

Hypotheses

Four null hypotheses were developed and tested at 0.05 level of significance.

$H0_1$: Librarians' digital scholarship competencies have no significant relationship with research and development in academic institutions in South-South, Nigeria.

$H0_2$: Librarians' collaboration skills have no significant relationship with research and development in academic institutions in South-South, Nigeria

$H0_3$: Librarians' online search competencies have no significant relationship with research and development in academic institutions in South-South, Nigeria.

$H0_4$: Librarians' data management skills have no significant relationship with research and development in academic institutions in South-South, Nigeria.

Literature Review

Librarians' Competencies

Competencies are the skills and abilities to perform professionally at a given task and in a given situation. In a broad perspective, librarians' competencies embody the whole gamut of knowledge, expertise, skills, and abilities required for effective professional engagement in libraries of all types. According to American Library Association (ALA, 2023), competencies refer to the basic, specialized and advanced knowledge and skills as well as attributes necessary for library professionals to create and support library collections, services, personnel, facilities, and programmes that foster equitable access to and participation of all people to use the library and its resources. With regards to sustainable research and development, Ruttenberg and Shearer (2016), observed that librarians need a diverse set of competencies to support research and scholarly communication, including expertise in publishing platforms, the full lifecycle of publishing, data management, and digital preservation. NASIG (2017); as well as Adam and Kaur (2021) suggested background knowledge, technical skills, outreach/instruction skills, strong communication skills, publishing skills, copyright skills, data management skills, assessment and impact metrics literacy, ability to advocate for open access and understand scholarly communication landscapes as the core competencies for research and scholarly communication. Meanwhile, librarians' competencies are fundamentally necessary for managing resources, serving users, and contributing to research and sustainable development in academic institutions. They enable librarians to discover, interpret, and generate research in relation to efforts that support their institutions, the profession, and/or their own professional development (ALA, 2023). Librarians' competencies also facilitate the possibility of librarians to apply research design and methods, as well as understand methods of data analysis and the application of research tools. They support librarians' ability to synthesize existing research using multidisciplinary approaches, as well as recognize and apply ethical conventions in generating, analysing, evaluating, presenting, utilizing and communicating or sharing research data and tools.

Sustainable Research and Development

Sustainable research is a global way of rethinking development in all areas of human life through quality and innovative research. According to Marr (2023), sustainable research and development focuses on creating innovative solutions that address pressing social, economic, and environmental challenges while ensuring long-term benefits for current and future generations. Sustainable research and development activities have direct and indirect impacts on the environment and society. Research significantly influences sustainable development by providing the knowledge, innovations, and evidence needed to address global challenges and achieve sustainable development (Jouda & Dan, 2022; Mohd et al., 2024). It helps in understanding complex issues, developing solutions, and monitoring progress towards sustainability. Research is essential in contributing directly and indirectly to the economic, social, health, and policy-related dimensions as well as academic advancement of the society (Australian Research Council, 2015; Edwards & Meagher, 2020; Sandes-Guimara˜es & Hourneaux, 2020). Sustainable research could manifest in the volumes of standard publications by librarians such as textbooks, book chapters, published articles in international peer review journals, published articles in peer review local journals, quality conference papers published in conference proceedings, abstracts, brainstorming sessions, lectures at symposiums and conferences, online lecture blogs/YouTube, etc. These research activities facilitate policymaking and problem-solving processes among professionals, as well as shapes the knowledge, understanding, and attitudes of policymakers and professionals, resulting in shifts in thinking about specific issues or decisions, while contributing to increased awareness (Peter et al., 2017). Through sustainable research and development, librarians can contribute to environmental and social responsibility that help in achieving educational, economic, socio-cultural and political viability and stability of the society. It further promotes the quality of teaching and learning while enriching academics, students and researchers for effective decision makings. However, sustainable research

and development by librarians require setting clear research goals, prioritizing the use of research materials and processes, applying critical thinking and training to understand the use of technologies in order to ensure continuous improvement in research practices.

Librarians' Digital Scholarship Competencies

Librarians' digital scholarship competencies are of great essence for sustainable research and development in modern academic institutions. Digital scholarship is described by Zhifang and Huifang (2018) as any scholarly activity that makes extensive use of one or more of the new possibilities for teaching and research resulting from the unique affordability (availability, accessibility and useability) of digital media. Digital scholarship embeds new forms of collaboration, new forms of publication, as well as new methods of data visualization and analysis (University of Washington Library, as cited in Zhifang &Huifang, 2018). It entails the creation, production, analysis, or dissemination of new scholarship using digital or computational techniques (Lewis et al., 2015). Digital scholarship involves scholarly activities that are born digital, multimedia, database technology-based, analysis of other born digital material, digital text and images, digital music or art, and data sets. It embraces both new research like the creation of new data set, and new tools like the design of new digital approach for extracting meaning from traditional sources of research works. Digital scholarship is a product of effective digital scholarship competencies, which is the ability, skill and expertise to fluently and effectively use digital tools and systems in research processes, including the ability to use google forms for data collection, use data analysis tools such as Python, SPSS, etc., as well as effectively share research findings in online platforms and communities. Digital scholarship competencies facilitate the ease of disseminating and preserve research works, while enhancing visibility and recognition in the scholarly community. Acquiring digital scholarship competencies requires adequate and regular training on emerging digital research processes and protocols by librarians.

Librarians' Collaboration Skills

Collaboration skills simply embed the ability to effectively engage in partnership for successful research outcome. Collaboration skill of librarians is very crucial in every stage of research and knowledge development. Librarians' collaboration skills refer to those abilities, attitudes or competencies required by librarians to effectively work together for the purpose of performing research tasks across multiple levels in order to meet set research goals (Akwang & Udoh, 2024). Similarly, Umar and Temboge (2024) described librarians' collaboration skills as the integral part of research activities enhancing the possibility of connecting knowledge domains, nurturing innovation, and enriching the scholarly community. Collaboration skills provide librarians the opportunity to partner, share or fine-tune thoughts, ideas and purposes, while developing strategies and tactics for multidimensional thinking towards achieving common and uniform research practices (Amadi et al., 2024). These critical interrelated skill sets help librarians in generating research ideas, building teams, collecting and analysing data, solving problems, and communicating research findings through various scholarly platforms and media. It essentially facilitates librarians' confidence in providing guidance on literature search, synthesizing research information, and actively extending their expertise and skills to other researchers.

Librarians' Online Search Competencies

Librarians' online search competencies are necessary requirements for sustainable research and development. According to Akwang and Udoh (2024), librarians' online search competencies are set of proficiencies used in constructing precise and vivid search queries by librarians for specific research information. Online search competencies are required to effectively and efficiently access, retrieve and use accurate and reliable information for various research processes. Librarians' online search skills involve the ability to use Boolean operators, phrase searching, proximity search, fuzzy search, stemming, truncation searches, and wildcard searches (Eke et al., 2014). It helps in constructing research topic, literature review, design of data collection tool, data analysis, and communication of research findings. It supports librarians in manipulating multiple search systems, exploring search engines, and in constructing multiple search queries. Librarians' online search skills are also vital in sustainable research and development by enhancing the ease of uploading and downloading research findings in the Internet.

Librarians' Data Management Skills

Librarians' data management skills constitute another set of critical competencies for sustainable research and development in academic institutions. Data management refers to the process of planning, selection, collection, storage, preservation, and sharing data for research purposes among researchers (Akwang & Chimah, 2021). Good data management culminates in data sharing, and serves as efficient way of storing data to facilitate future retrieval (Soundararajan & Mishra, 2023). It includes both raw and derived data, where raw data is available from the variables collected, while derived data is the product of the cleaned raw data that is used for analysis. It helps librarians to continuously access, retrieve and use data initially put in place for future research purposes. Data management is made possible if the librarians possess good data management skills. Data management skills involve a wide range of skills and competencies require in data planning, organization and documentation, storage and backup, sharing, archiving, analysis and visualization, security and privacy, governance and reproducibility. Data management skills facilitate sustainable research and development. It helps in actualizing research processes by allowing reliable verification of research results, while enhancing innovative solutions to challenges.

Review of Empirical Studies

Mubofu (2025) evaluating digital competencies for enhancing library services with insights from Tanzanian academic libraries. The study which took a convenience sample of 71 Tanzania Library and Information Association members, revealed that digital skills are necessary for effective library operations, including cataloguing, AI implementation, online research, and database navigation. It reported that significant challenges such as limited access to training, budget constraints, and staff resistance to adopting new technologies are substantial barriers hindering librarians' ability to leverage digital skills in practice. The study recommended the implementation of strategic training programs, providing managerial support for skill acquisition, and securing government backing for digital integration in libraries.

Akwang and Udoh (2024) conducted a correlational study on librarians' technology literacy skills with the use of electronic information resources for research activities in university libraries. The study revealed that librarians' online search skills and Web 2.0 skills had strong positive significant relationships with the use of electronic information resources for research activities, while librarians' online collaboration skills had a weak but positive relationship with the use of electronic information resources for research activities in public university libraries in South-East, Nigeria. It recommended that librarians should take advantage of online training opportunities to acquire and/or improve their online skills for effective research activities.

In another related study, Shahzad and Khan (2024) examined the effects of e-learning technologies on librarians' sustainable competence development and smart library services. The study showed a significant impact of e-learning technologies on sustainable competence development of librarians for smart library services. It specifically indicated that e-learning technologies turn librarians into skilled assets and innovative sustainable smart library services. This is also as Umar and Temboge (2024) in a study on the role of collaboration skills in shaping research productivity among librarians at the National Open University of Nigeria (NOUN), revealed a moderate level of collaboration skills and research productivity among librarians. They study showed that collaborative skills of librarians have a significant positive influence on their research productivity in writing book chapters, books, journal articles and conference papers. It recommended that librarians should attend workshops and conferences geared towards improving collaboration skills and research productivity.

A survey of research collaboration and partnership among academic librarians in universities in Federal Capital Territory (FCT), Abuja, Nigeria, was also investigated by Aliyu (2024). The findings of the study revealed that the importance of collaboration and partnership in academic settings to include innovation, knowledge exchange, and scholarship advancement. It showed that mentoring and peer review partnerships, joint research projects, collaboration on information literacy programs, cross-institutional training and workshops, joint development of digital repositories, exchange of scholarly resources and materials, and participation in professional associations and conference are the forms of research collaboration and partnership among academic librarians in universities in Abuja. The study identified lack of motivation, lack of funding and resources, time constraints and workload, communication barriers, differences in research interests and goals, limited access to collaborative tools and technologies, lack of training in collaborative research methods, as well as disconnect between academia and industry as the significant challenges facing collaborative research and partnership in universities in Abuja, Nigeria.

Furthermore, a study on research data management (RDM) competencies of researchers in selected public universities in South Africa was conducted by Mthembu and Ocholla (2024). The study adopted a post-positivist paradigm, using both qualitative and quantitative methodologies. The findings of the study revealed that participating institutions are still in the initial stages of providing RDM services, while most researchers are unaware of how long their institutions retain research data. It showed that the researchers store and backup their research data on personal computers, emails and external storage devices. It indicated that data management, research methodology, data curation, metadata skills and technical skills are critically important RDM competency requirements for both staff and researchers. It also showed that adequate infrastructure, human resources and capital are in short supply and have negative impact on research data management in the universities. The study indicated lack of specific capacity-building programmes for developing RDM skills and lack of data curation skills as the major challenges in providing RDM.

Moreover, Badenhorst and Raju (2023) investigated research data management competencies for academic libraries from the perspectives of two universities in South Africa. The study, which adopted semi-structured interviews for data collection revealed that information and data management practices, repository management, data curation, data collection management, understanding funders' policies and digitization skills are the key competencies for research data management. It identified the importance of robust training and self-development through online courses, webinars, and freely available materials as strategies to support and improve research data management competencies of librarians.

Akwang (2022) investigated the use of academic social networking sites (ASNSs) by professional librarians in public universities in Akwa Ibom State, Nigeria. The study revealed that professional librarians are familiar with many academic social media networking sites (ASNSs). They mostly use Google Scholar, ResearchGate, Academia.com, and LinkedIn to enhance their academic activities, especially in sharing their research publications within the scholarly community. The study showed that the frequency of visits to the ASNSs by professional librarians is low. It recommended that academic librarians should be upskilled and provided with opportunities for training to enhance effective use of ASNSs in the public universities.

Rabasa and Abrizah (2022) equally conducted a qualitative study of academic librarians' roles and competencies in research partnership. The study identified digital scholarship, systematic review,

reference/citation management, data curation and preservation, bibliometric/information evaluation and communication as the skills required for effective research partnership. It recommended the need for enlightenment programmes and activities for academic librarians that cut across training, workshops, and organising conferences in research areas for enhancing their successful research partnerships. Another study was conducted by Igbokwe et al. (2019) on the determinants of the quality of research outputs by librarians in selected university libraries in South East Nigeria. The study discovered librarians' research skills, editors' level of editorial competency and mentor-mentee relationships of librarians as the determining factors in achieving quality of research outputs by librarians. The study showed that inability to adopt appropriate research methods leads to poor quality research, while possessing the right research skills lead to producing quality research by librarians. It identified lack of appropriate research knowledge and poor information search and retrieval skills as the major hindrances to the production of quality research outputs in public university libraries.

In another related study, Bhardwaj (2017) investigated the research activities of Library and Information Science professionals in Indian higher educational institutions with emphasis on competencies, support and engagements. The study indicated that majority of the librarians engaged in various research activities such as reading research literature, and research-based articles. It revealed that majority of the librarians preferred disseminating research papers in conference proceedings, and publishing papers in refereed journals. The study showed further that theoretical and survey methods were majorly adopted by the librarians in conducting research. It identified lack of funding support, time constraints, and problems in data collection as the major constraints in carrying out research.

From the above reviews, it is clear that librarians' competencies are critical factors for sustainable research and development in academic institutions. Meanwhile, the available studies have not sufficiently dealt with the realities vis-à-vis librarians' competencies for sustainable research and development in academic institutions in South-South, Nigeria. It is therefore, in this light, that the study was conducted to fill the observed gap and contribute to the expansion of knowledge.

Methodology

The correlational research design was adopted for this study. The population of study was one hundred and one (101) academic/professional librarians from six (6) public university libraries in Akwa Ibom, Cross River and Rivers States. Akwa Ibom, Cross River and Rivers States are located in the South-South zone of Nigeria, in addition to Bayelsa, Delta and Edo states to make up the six (6) in the zone. The public university libraries investigated include Akwa Ibom State University (AKSU) and University of Uyo (UNIUYO) libraries from Akwa Ibom State; Cross River University of Technology (CRUTECH) and University of Calabar (UNICAL) libraries from Cross River State; as well as Rivers State University (RSU) and University of Port Harcourt (UNIPORT) libraries from Rivers State. The total enumeration sampling technique was used to determine the sample size for the study since the population was small and manageable. The population distribution and sample size were presented in the Table 1 below:

S/N	Institutions	Population	Sample Size
1	AKSU	27	27
2	UNIUYO	24	24
3	CRUTECH	7	7
4	UNICAL	13	13
5	RSU	10	10
6	UNIPORT	20	20
	Total	**101**	**101**

Data for the study were collected using the researchers' developed questionnaire with structured questions, designed on a 4-point modified Likert rating scale. The questionnaire was validated by three (3) research experts from Library and Information Science and Measurement and Evaluation disciplines from Akwa Ibom State University, Ikot Akpaden. It was further subjected to a reliability test with 10 academic/professional librarians from Michael Okpara University of Agriculture, Umudike, Abia State, while their responses were analysed using Cronbach alpha formula, which yielded a reliability coefficient of 0.78. The data distribution and retrieval process yielded a response rate of 93%, which represented 94 completed copies from a total of 101 copies distributed. The raw data were coded using the Statistical Package for Social Sciences (SPSS Version 29), and analysed with the Pearson Product Moment Correlation (PPMC), while the null hypotheses were tested using simple linear regression at 0.05 level of significance. The degree of the relationship between the studied variables was determined and interpreted using Creswell's (2014) correlation coefficient scale of (r) ±0.00 - 0.20 for very low relationship; ±0.21 - 0.40 for low relationship; ±0.41 - 0.60 for moderate relationship; ±0.61 - 0.80 for high relationship, and ±0.81 - 1.00 for very high relationship. The decision rule held the rejection of the null hypothesis when the p-value was less than the alpha value at 0.05 level of significance and acceptance of the null hypothesis when the p-value was more than the alpha value at 0.05 level of significance.

Results and Discussion of Findings

The results of this study were presented in tables according to the specific objectives and corresponding hypotheses, while interpretations were provided accordingly.

Research Objective 1: To determine librarians' digital scholarship competencies for research and development in academic institutions in South-South, Nigeria.

Table 1: Correlation coefficient of librarians' digital scholarship competencies for research and development in academic institutions in South-South, Nigeria

		LDSCs	RDAIs
LDSCs	Pearson's Correlation Sig. (2tailed)	1	0.074
	N	94	94
RDAIs	Pearson's Correlation Sig. (2tailed)	0.074	1
	R^2	0.005 (5%)	
	N	**94**	**94**

LDSCs=Librarians' Digital Scholarship Competencies
RDAIs = Research and Development in Academic Institutions
N = Number of Observations
R = Correlation Coefficient
R^2 = Coefficient of Determination

Data in Table 1 shows a very low degree of relationship between librarians' digital scholarship competencies and research and development in academic institutions in South-South, Nigeria, as indicated by the correlation coefficient (r) of 0.074, which is positive and falls within the correlation coefficient limit range of ± 0.00 – 0.20. The coefficient of determination (r^2) of 0.005 reveals that 5% of the variance observed in research and development in academic institutions in South-South, Nigeria, could be accounted for by librarians' digital scholarship competencies. The result implies that librarians' digital scholarship competencies to a very low extent but positively correlates with research and development in academic institutions in South-South, Nigeria. This result was validated by the test of hypothesis 1 as indicated in Table 2 below.

Hypothesis 1: Librarians' digital scholarship competencies have no significant relationship with research and development in academic institutions in South-South, Nigeria.

Table 2: Simple regression analysis of the relationship between librarians' digital scholarship competencies and research and development in academic institutions in South-South, Nigeria

Model	*Df*	*Sum of Square*	*Mean Square*	*F*	*Sig.*
Regression	1	2.179	2.179	0.501	0.481
Residual	93	395.778	4.349		
Total	94	397.957			

The data in Table 2 above shows a P-value of 0.481 which is numerically greater than the Alpha value of 0.05, but not statistically strong enough to enforce the acceptance of the null hypothesis. Thus, since the P-value of 0.481 was not statistically strong enough, the alternative hypothesis accepted and concluded that librarians' digital scholarship competencies have significant positive relationship with research and development in academic institutions in South-South, Nigeria.

Research Objective 2: To examine librarians' collaboration skills for research and development in academic institutions in Nigeria.

Table 3: Correlation coefficient of librarians' collaboration skills for research and development in academic institutions in Nigeria

		LCSs	RDAIs
LCSs	Pearson's Correlation Sig. (2tailed)	1	0.094
	N	94	94
RDAIs	Pearson's Correlation Sig. (2tailed)	0.094	1
	R^2	0.009 (9%)	
	N	**94**	**94**

LDSCs=Librarians' Collaboration Skills
RDAIs = Research and Development in Academic Institutions
N = Number of Observations
R = Correlation Coefficient
R^2 = Coefficient of Determination

The data in Table 3 indicates a very low degree of relationship between librarians' collaboration skills and research and development in academic institutions in South-South, Nigeria, as reflected in the correlation coefficient (r) of 0.094, which is positive and falls within the correlation coefficient limit range of ± 0.00 – 0.20. The coefficient of determination (r^2) of 0.009 shows that 9% of the variance observed in research and development in academic institutions in South-South, Nigeria, could be accounted for by librarians' collaboration skills. This means that librarians' collaboration skills to a very low extent but positively correlates with research and development in academic institutions in South-South, Nigeria. The result was confirmed by the test of hypothesis 2 as presented in Table 4 below.

Hypothesis 2: Librarians' collaboration skills have no significant relationship with research and development in academic institutions in South-South, Nigeria

Table 4: Simple regression analysis of the relationship between librarians' collaboration skills and research and development in academic institutions in South-South, Nigeria

Model	***Df***	***Sum of Square***	***Mean Square***	***F***	***Sig.***
Regression	1	3.230	3.230	0.807	0.371
Residual	93	363.996	3.999		
Total	94	367.226			

Data in Table 4 above shows a P-value of 0.371, which is numerically greater than the Alpha value of 0.05, but not statistically strong enough to cause an acceptance of the null hypothesis. Therefore, since the P-value of 0.371 was not statistically strong enough to cause an acceptance of the earlier stated null hypothesis, the alternative hypothesis was accepted, and concluded that librarians' collaboration skills have positive significant relationship with research and development in academic institutions in South-South, Nigeria

Research Objective 3: To assess librarians' online search competencies for research and development in academic institutions in South-South, Nigeria.

Table 5: Correlation coefficient of librarians' online search competencies for research and development in academic institutions in South-South, Nigeria

		LOSCs	RDAIs
LOSCs	Pearson's Correlation Sig. (2tailed)	1	0.147
	N	94	94
RDAIs	Pearson's Correlation Sig. (2tailed)	0.147	1
	R^2	0.022 (22%)	
	N	**94**	**94**

LOSCs=Librarians' Online Search Competencies
RDAIs = Research and Development in Academic Institutions
N = Number of Observations
R = Correlation Coefficient
R^2 = Coefficient of Determination

Data in Table 5shows a very low degree of relationship between librarians' online search competencies and research and development in academic institutions in South-South, Nigeria, as indicated by the correlation coefficient (r) of 0.147, which is positive and falls within the correlation coefficient limit range of ± 0.00 – 0.20. The coefficient of determination (r^2) of 0.022 reveals that 22% of the variance observed in research and development in academic institutions in South-South, Nigeria, could be accounted for by librarians' online search competencies. This means that librarians' online search competencies to a very low extent but positively correlates with research and development in academic institutions in South-South, Nigeria. This result was validated by the test of hypothesis 3 as presented in Table 5 below.

Hypothesis 3: Librarians' online search competencies have no significant relationship with research and development in academic institutions in South-South, Nigeria.

Table 6: Simple regression analysis of the relationship between librarians' online search competencies and research and development in academic institutions in South-South, Nigeria

Model	***Df***	***Sum of Square***	***Mean Square***	***F***	***Sig.***
Regression	1	11.766	11.766	2.007	0.160
Residual	93	533.524	5.863		
Total	94	545.290			

The data in Table 5 above shows a P-value of 0.160 which is numerically greater than the Alpha value of 0.05, but not statistically strong enough to enforce an acceptance of the earlier stated null hypothesis. Therefore, since the P-value of 0.160 was not statistically strong enough, the earlier postulated null hypothesis was rejected while the alternate hypothesis was accepted, and concluded that librarians' online search competencies have strong positive significant relationship with research and development in academic institutions in South-South, Nigeria.

Research Objectives 4: To ascertain librarians' data management skills for research and development in academic institutions in South-South, Nigeria.

Table 7: Correlation coefficient of librarians' data management skills for research and development in academic institutions in South-South, Nigeria

		LDMSs	**RDAIs**
LDMSs	Pearson's Correlation Sig. (2tailed)	1	0.246
	N	94	94
RDAIs	Pearson's Correlation Sig. (2tailed)	0.246	1
	R^2	0.061 (61.0%)	
	N	**94**	**94**

LDMSs=Librarians' Data Management Skills
RDAIs = Research and Development in Academic Institutions
N = Number of Observations
R = Correlation Coefficient
R^2 = Coefficient of Determination

Data in Table 7 shows a low degree of relationship between librarians' data management skills and research and development in academic institutions in South-South, Nigeria, as indicated by the correlation coefficient (r) of 0.246, which is positive and falls within the correlation coefficient limit range of ±0.21 - 0.40. The coefficient of determination (r^2) of 0.061 reveals that 61% of the variance observed in research and development in academic institutions in South-South, Nigeria, could be accounted for by librarians' data management skills. This implies that librarians' data management skills to a low extent but positively correlates with research and development in academic institutions in South-South, Nigeria. This result was affirmed by the test of hypothesis 4 as indicated in Table 8 below.

Hypothesis 4: Librarians' data management skills have no significant relationship with research and development in academic institutions in South-South, Nigeria.

Table 8: Simple regression analysis of the relationship between librarians' data management skills and research and development in academic institutions in South-South, Nigeria.

Model	*Df*	*Sum of Square*	*Mean Square*	*F*	*Sig.*
Regression	1	22.951	22.951	5.854	0.018
Residual	93	356.748	3.920		
Total	94	379.699			

The data in Table 8 shows a P-value of 0.018less than the Alpha value of 0.05. Thus, since the P-value of 0.018 was less than the Alpha value of 0.05, the earlier stated null hypothesis was rejected, while the alternated hypothesis was accepted, and concluded that librarians' data management skills have strong positive significant relationship with research and development in academic institutions in South-South, Nigeria.

Discussion of Findings

The findings of the study from Tables 1 and 2 showed that librarians' digital scholarship competencies are to a very low extent, but positively correlates with research and development in academic institutions in South-South, Nigeria. This implies that though librarians have fully recognized the essence of digital scholarship competencies in enhancing sustainable research and development in their academic institutions in South-South, Nigeria, but their digital scholarship competencies are not adequate enough in terms of creatingand sharing new research using digital tools such as Google forms for data collection; Python, SPSS, etc., for data analysis; as well as using digital platforms such as Google scholar, ResearchGate, Kudos, Web of Science, etc., for sharing research findings. This has the potential of negatively affecting librarians in effectively contributing to the emerging research needs for sustainable academic and professional growth of their institutions. This finding aligns withRabasa and Abrizah (2022), which identified digital scholarship skills as one of the critical skills required for effective research partnership.It also gives credence to Akwang (2022), which indicated that professional librarians are familiar with many digital scholarship tools such as Google Scholar, ResearchGate, etc., for enhanced sharing of research publications within the scholarly community.

The finding from Tables 3 and 4 revealed that librarians' collaboration skills is to a very low extent, but positively correlates with research and development in academic institutions in South-South, Nigeria. The implication of this is that though librarians have collaboration skills but they do not effectively leverage on such skills in building effective collaborative research teams in the academic institutions. This finding corroborates Umar and Temboge (2024), which studied the role of collaboration skills in shaping research productivity among librarians at the National Open University of Nigeria (NOUN), and reported a moderate level of significant positive influence of collaboration skills and research productivity in writing book chapters, books, journal articles and conference papers among librarians. It however slightly disagrees with Akwang and Udoh (2024), which revealed that librarians' online collaboration skills had a weak but positive relationship with the use of electronic information resources for research activities in public university libraries in South-East, Nigeria.

Regarding librarians' online search competencies for sustainable research and development in academic institutions in South-South, Nigeria, from Tables 5 and 6, the findings indicated that librarians' online search competencies to a very low extent but positively correlates with research and development in academic institutions in South-South, Nigeria. This portrays that though the librarians have general ability to navigate various search engines like Google, Chrome, Google+, Firefox, etc., they require advanced online navigation competencies to maximize the online environment for superior research services for enhanced professional and intellectual activities in their academic institutions. The finding is in line with Akwang and Udoh (2024), which showed that librarians' online search skills had strong positive significant relationships with the use of electronic information resources for research activities. It also affirmed the studies by Shahzad and Khan (2024), which revealed a significant impact of e-learning technologies on sustainable competence development of librarians for smart library services; as well as Mubofu's (2025) evaluation of digital competencies for enhancing library services in Tanzanian academic libraries that reported digital competencies as necessary for effective library operations, including AI implementation, online research, and database navigation.

The findings from Tables 7 and 8 also revealed that that librarians' data management skills to a low extent, but positively correlates with research and development in academic institutions in South-South, Nigeria. The result alludes to the librarians' significant recognition and possession of essential data management skills for data planning, data organization, data collection, data storage, data sharing. The finding aligns with Mthembu and Ocholla (2024), which reported that data management skills such as data curation skills, metadata skills, etc., are critically important competencies for data storage and backup even though institutions are still in the initial stages of providing data management services to researchers.

Conclusion

Librarians' competencies constitute a broad array of skills and abilities for quality and sustainable research and development in academic institutions. Librarians necessarily require adequate and constantly improved modern skills for use of emerging technologies for effective professional, intellectual and academic performances. In this study, it has been discovered that though librarians' digital scholarship competencies, collaboration skills, online search competencies and data management skills have strong positive significant relationships with sustainable research and development but these competencies are not well-harnessed and effectively capitalized on in academic institutions in South-South, Nigeria.

Recommendations

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

i. Management of academic institutions in conjunction with university libraries should provide training for librarians on digital scholarship paradigms in order to enhance their competencies in line with modern research and other academic responsibilities.

ii. Management of academic institutions in conjunction with university libraries should provide up-to-date technologies and training opportunities in order to improve librarians' collaborative skills and confidence for engaging in collaborative research and development activities.

iii. Management of academic institutions in conjunction with university libraries should provide digital technologies and regular retooling training opportunities for librarians in order improve their online navigation skills for emerging research and teaching needs.

iv. Management of academic institutions should emphasis on improved data management skills by librarians through the provision of relevant training opportunities as well as provision of data management technologies.

v. Librarians in academic institutions should be willing, conscious and self-motivated to upskill themselves in line with the dynamics of the modern technology-driven environment for enhanced research and academic activities.

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Librarians' Innovative Skills and Information Service Delivery in Federal University Libraries in South-South, Nigeria

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ABSTRACT

University library environment is constantly changing as information technology continues to make great in roads into the library changing the methods of service delivery. The capacity of librarians to deliver quality services is premised on their acquisition of innovative skills that can stand them out in the current dispensation. Therefore, it is of great importance to take a cursory look at how librarians have been able to acquire innovative skills that would improve information service delivery. The study determined the influence of librarians' innovative skills (research support skills, search skills and customer service skills) on information service delivery in selected federal university libraries in South-South, Nigeria. Quantitative method and descriptive survey research design was adopted for the study. The population and sample size for the study was 60 professional librarians in selected federal university libraries in South-South, Nigeria using total enumeration sampling technique. A researcher developed instrument titled: Innovative Skills and Information Service Delivery Questionnaire (ISISDQ) was used for data collection. Mean and Standard Deviation were used to answer the research questions while independent t-test was used in testing the hypotheses at .05 level of significance. The findings from the study showed that librarians innovative skills-research support skills, search skills and customer service skills influence information service delivery. Based on the findings from the study, it is concluded librarians' innovative skills have significant influence on information service delivery. Consequent upon the findings, it is recommended among others that university library management should take proactive steps in developing the research skills of librarians so as to better prepare them with the skills needed to position, expand and sustain information service delivery in the present dispensation.

INTRODUCTION

university libraries are indispensable institutions often regarded as the heart of any academic institution. They are charged with the mandate of supporting the teaching, learning and research activities of their parent institution through the provision of information resources and services that are in consonance with the information need of their parent institutions. The mode of provision of information resources and services have continued to evolve as a result of information technology and university libraries are assuming changing roles.

According to Akporhonor and Olise (2015), the advent of information technology in university libraries have necessitated the need for the adoption of technological tools which not only provide information resources but also ensure the promotion of the effective and efficient information service delivery. Similarly, Simisaye *et al.* (2018) asserted that the landscape of information service delivery in university libraries is shifting away from the traditional enterprise as a result of the emergence of Information Technology which has transformed information generation, storage, retrieval and dissemination in university libraries. With information technology, libraries are accessing images of book-form and other materials in digital forms as well as storing them for retrieval within and outside the library space.

In the current networked environment of information technology, manual methods of service provision have metamorphosed into electronic modes of delivery as library's traditional confines have collapsed into borderless access where users can connect to resources from remote locations (Emezie and Nwaohiri, 2017). Additionally, the library environment is changing from a noiseless zone to a user friendly and relaxing atmosphere where libraries are not only reading places but learning spaces where people gather to participate in group discussions, training, and conferences. In the view of Emezie (2018), libraries are transitioning to providing spaces where patrons can watch television, play games and listen to music. Also, beyond the physical visits, social media are employed to enable communication and provide interactive services. These innovations are products of the networked environment. Consequently, university libraries are stepping up the ladder to meet user expectations through innovative services and practices.

In response to the changing environment occasioned by the emergence and impact of information technology, Emezie (2018) stated that university libraries are leveraging on information technology to provide innovative services so as to respond to the changing needs of patrons and equally remain afloat in a technology saturated environment. Also, Etebu and Zacchaeus (2020) asserted that the emergence of information technology according to has greatly impacted on information service delivery as university libraries are adopting innovative technologies in order to promote information service delivery in university libraries. Similarly, Abubakar and Attahir (2018) opined that information technology prevalence in university libraries is used in providing innovative services such as virtual learning/e- library services, round the clock library services, instant messaging (IM), digital preservation and co-operation. Furthermore, Madukoma *et al.* (2021)

asserted that the current and emerging trends in library service provision include the use of increasing number of online tools- library websites, online public access catalogue (OPAC), social media, video conferencing, e-mail, RSS (Really Simple Syndication or Rich Site Summary), SMS, library blogs and wikis, the management of materials in new formats, providing multilingual options, developing metadata schemes, metadata creation, extraction and manipulation etc. These tools are used by university libraries to provide innovative services to meet users at the points of their varied needs.

According to Emezie (2018), university libraries are providing innovative services such as archiving research data, Compact shelving, OPAC services, Information commons, Institutional repository, e-journals publishing, shared digital repository, shared annexes for storage (so library space can be used in a different way), shelf-ready books as well as streaming video to classrooms. In a similar vein, Waghmare and Salve (2014) stated that information technology has provided libraries the opportunity for automation of different housekeeping operations of the library; providing OPAC as tool for browsing and searching the library collection; provision of services in electronic environment; developing Local Area Network; providing online access to leading e-journals and e-books to library users/readers at no cost; newspaper clipping depository; scanning the daily news, improving existing service conditions etc. Also, Etebu and Zacchaeus (2020) stated that innovative services provided through information technology are web design service, blogging service, podcasting service, electronic publishing services, online information search services, short message services, online training and workshops, digital references services, database production/distribution services, mobile application services and digital marketing service.

The effective and efficient provision of the above services cannot be attained without the availability of librarians with the requisite skills and competences in the use and management of information technology gadget for improved information service delivery. According to Amusa *et al.* (cited in Oden and Owolabi, 2021), librarians are the wheelers and dealers of all functions and services in the library as a result of their education and training in collection development, organizing information resources, user education and services. They are vested with the mandate of providing timely information services in the form of print and non-print materials to its users in a timely manner. In a similar vein, Umoh (2024) stated that librarianship as a profession is service-oriented and the provision of information service is the core mission of university libraries with librarians at the centre. This simply implies that information service delivery in university libraries is a justification for their existence and in support of this, Agbo (2015) asserted that librarians can only provide effective and efficient information services in the face of the prevalence of information technology in university libraries through the acquisition of innovative skills.

Innovative skills are simply skills needed to modify or improve existing services or products. According to Abubakar and Attahir (2018), the rapidly changing library environment occasioned by information technology require the implementation of new ideas to produce a new service or product and it is through the acquisition of innovative skills that librarians can provide innovative services. Research support skills are essential innovative skill needed by librarians in the providing of information service delivery. According to Das and Banerjee (2021), quality research is possible only through a resourceful and technically oriented library with access to quality information resources and sources and it is the duty of librarians to provide access to these information resources as well as provide guidance in the research process. Supporting this view, Esmailzadeh *et al.* (2020) stated that librarians and information providers can play a dual role in the research procedure. On one hand, they can promote the knowledge of librarianship, and on the other hand, they can help the development of human knowledge by guiding researchers in the process of research.

According to University of Kansas (2019), good research relies on well-developed search abilities and librarians can provide effective and efficient information service through the acquisition and knowledge of search skills. This skill is important because of the exponential growth of information and information sources and with the appropriate search skills, librarians would be handicapped in providing information service delivery especially as it relates to finding relevant information resources and sources needed for students' academic engagements. In the view of Obiadazie *et al.* (2020), search skills are inevitable in providing information service delivery because finding relevant information resources and sources necessitate the use of good search strategies. Also, Osisanwo and Josephs (2021) asserted that information search and retrieval remains a challenge to library patrons in search for information as they are often confronted with too many documents which can only be addressed through web search skills. So librarians imbued with good search skills are able to help library patrons in extracting only the most relevant information resources and sources by exploring different aspects of a topic, selecting proper keywords as well as employing Boolean searches and the like to information search more effective and efficient.

Customer service skill is also an essential innovative skill for librarians in the provision of effective and efficient information service delivery. It is regarded as indispensable in the growth and success of any business venture because it govern the way and manner in which employees interact with their customer by making them feel valued and appreciated as well as treated with fairness According to Adeniran (2018), the present dispensation of information service delivery necessitates that librarians have customer service skills through the acquisition of adequate and extensive knowledge of information resources and service and using them in providing the library patrons with professional, helpful, high quality service and assistance before, during and after the library patron's expectations are met. The growth and patronage of library resources depends to a large extent on the level of customer services provided by librarians and it goes a long way at justifying the existence of the library in the scheme of things within the educational system. In the view of Pundsack (2015), librarians and information workers need excellent customer service skills in providing effective and efficient information service delivery through the display of amiable personality and work ethics, being approachable, being an

active listener as well as the ability to provide prompt and accurate answers. This study takes a look at the influence of librarians' innovative skills on information service delivery in federal university libraries in South-South, Nigeria.

Statement of the Problem

The level to which students patronise the resources and services of university libraries are premised on the level of information services provided by librarians and library personnel. With the prevalence of information technology and its adaptation to library services, it is expected that librarians and library personnel have innovative skills that could be used to provide services in a more efficient and effective ways so as to keep the library users in tuned with the library. Innovative skill is simply the capacity to provide either a new service or a old service in a different light to the library users abreast with the library.

Observation has shown a moderate level of availability of information technology gadgets in the provision of information service. However, it is also noticed that information service delivery is not effective in the university libraries as some of the information technology gadgets like computers are merely gathering dusts on librarians' desk thereby raising concerns about either the functionality of the gadgets or the skills of librarians in the use of information technology gadgets.

This brings to the fore the question about how innovative are librarians and library personnel in providing information service considering the defective information service delivery earlier observed. The researcher is therefore curious to find out more about librarians innovative skills and as such, determine the influence of librarians' innovative skills on information service delivery in federal university libraries in South-South, Nigeria.

Research Questions

The following research questions guided the study:

1 What is the influence of librarians' research support skill on information service delivery in federal university libraries in South-South, Nigeria?

2 What is the influence of librarians' search skills on information service delivery in federal university libraries in South-South, Nigeria?

3 What is the influence of librarians' customer service skill on information service delivery in federal university libraries in South-South, Nigeria?

Research Hypotheses

The following hypotheses were formulated to further guide the study:

i. There is no significant influence of librarians' research support skill on information service delivery in federal university libraries in South-South, Nigeria.

ii. There is no significant influence of librarians' search skills on information service delivery in federal university libraries in South-South, Nigeria.

iii. There is no significant influence of librarians' customer service skill on information service delivery in federal university libraries in South-South, Nigeria.

Literature Review

Innovation according to Abubakar and Attahir (2018) is the modification or improvement of the existing services or products. Also, Anyanwu (cited in Fagbemiro *et al.,* 2022) asserted that innovation is the ability to apply new ideas that will enable librarians to undertake activities in a different form. This can be achieved through initiatives, imagination, intuition and insight as the rationale for innovation in library profession is to improve and sustain the quality of library and information services. Innovation in libraries and information centres has become imperative due to the technological revolution and prolific growth of electronic information of late that necessitate the need libraries and librarians to adapt and trigger innovative ideas so as remain at the frontiers of knowledge rather than mere passive observers.

According to Okeke and Chibueze (2020), the library space is a hub for innovation in relation to information service delivery and the tools required for innovative services in the library space are ask a librarian, email, frequently asked questions (FAQ), blogs, library website, OPAC, social media, text messages, video conferencing among others. The capacity to delivery innovative services as stated above require the acquisition of librarians' innovative skills. Innovative skills are seen as skills that librarians can leverage on to enhance library services as well as adapt to ever changing information needs of library patrons such as digital literacy, technological proficiency, and data analysis, communication, collaboration and problem-solving skills. According to Abubakar and Attahir (2018), the innovative skills needed by librarians for information service delivery include the following:

i. Leadership skill, including skills in influencing others. This skill is to enable library and information science professionals to demonstrate their ability to lead others in discharging their duties especially in dissemination of information. Leadership skill is important as good quality leadership help libraries and librarians create new services.

ii. Interpersonal relationship skills, focusing on collaborative skills of working with others to achieve common goals which include creating new products and services. This skill is important as it enable

library staff to collaboratively work together as a team. In this age of information technology interpersonal skill is needed for development of libraries especially university libraries.

iii. Technological awareness and understanding skills, including experience as a user of new software, hardware, online services, and electronic performance support systems. Library and information science professionals need to understand the current technological advancement in information field. In this era of information explosion librarians must brace up to use the technological appliances for creation and innovation of new services and products.

iv. Problem-solving skills, especially the analysis skills of identifying gaps in people's performance and facilitating the closing of them with a view of making library and information professionals more proactive, productive and innovative.

v. Systems thinking and understanding, including an understanding of the effects of "double loop" systems

vi. Knowledge of interventions Skills, including demonstrated ability and skill at choosing and using a variety of personal and procedural interventions across the organization to close performance gaps (p. 177)

These skills are reflected in research support skills, search skills and customer service skills.

Librarians' Research Support Skill and Information Service Delivery

Vijesh *et al.* (2020) opined that one of the services provided by libraries in the present dispensation of information technology is research support services. According to Borrego *et al* research support services are embodied in the assistance given to scholars and researchers by library staff to successfully complete their research engagements. These assistance could come at any phase of the research process-the research planning phase, literature search phase and publication phase etc. Research support services are seen as important owing to the increasing complexities associated with retrieving the right information from a pool of information resources and sources. In the view of Esmailzadeh *et al.* (2020), librarians and information providers can serve two functions in the research process which is embodied in the promotion of librarianship knowledge and enhancing the development of human knowledge by guiding researchers through the research process as they are expected to play crucial roles in supporting research across various disciplines by employing a range of specialized skills.

These services include information resource management, research data management, copyright advisory, citation management, scholarly communication, data analysis services, research preservation and curation, and digital literacy training, to name but a few. These intervention/contributions could come at any phase of the research process, including the research planning phase, literature search phase and publication phase etc. It is considered a major service which is possible with resources and skills of the library professionals as librarians contribute significantly to academic success and innovation by connecting researchers with quality resources, assist in data management, and enhance access to specialized information sources (Esmailzadeh *et al.,* 2020).

According to Fazal and Chakravarty (2019), librarians play a crucial role in supporting research activities, and their research support skills are vital to effective information service delivery as they offer essential guidance in navigating information resources, thereby facilitating better decision-making and knowledge generation. This view is supported by Oghenekaro (2019). that libraries provide research collections, services, data literacy training, and research data management which are highly essential for supporting research engagements. In a similar vein, Rabasa and Abrizah. (2022) asserted that one of the primary skills librarians offer is proficiency in research databases and tools as they possess in-depth knowledge of electronic resources, including journals, databases, and open-access repositories. This familiarity enables librarians to guide researchers through vast digital landscapes and help them locate specific, relevant, and credible information. Also, Yadav (2022) offered that research support skill of librarians could be demonstrated in the teaching of database search techniques as well as providing personalized research consultations to ensure that library users and researchers can efficiently access high-quality information.

Another important area through which librarians can offer support for research is data services. According to Fuhr (2022), research data management/service is another significant area where librarians' skills enhance information service delivery as data services involve organizing, storing, and preserving research data for future use. In the view of Tenopir *et al*. (2015) data services are services that address the full data life cycle, including the data management plan, digital curation (selection, preservation, maintenance, and archiving), and metadata creation and conversion and librarians with these skills can provide data services, which may include data mining, metadata knowledge, technical details of repository hardware and software, programming and software expertise, legal and policy knowledge, library instruction, and research consultations, among others.

According to Esmailzadeh *et al.* (2020), the competences of librarians in support of research involves the provision of guidance on data documentation, metadata standards, and data sharing best practices as their expertise in this area ensures that research data is findable, accessible, interoperable, and reusable which ultimately increases the value and longevity of research. Consequently, librarians play an integral role in fostering data stewardship, which is crucial for long-term scientific discovery. Lippincott (2021) reported that in the current dispensation, librarians contribute to systematic review processes, which require comprehensive searches across multiple databases to gather all relevant studies on a topic. Systematic reviews are critical in

evidence-based research, particularly in health sciences and social sciences as librarians' expertise in search strategies, database selection, and study identification makes them valuable collaborators in these labor-intensive processes. Their involvement ensures that systematic reviews are thorough and reliable, enhancing the quality of evidence available for decision-making in various fields. Also, Sejane (2017) stated that librarians' research support skill is in the facilitation of access to specialized information resources that may be otherwise difficult to find or expensive to access. Through resource sharing, interlibrary loans, and consortia, librarians enable access to a broader range of materials than a single library might hold. This access is essential for research that requires comprehensive and diverse sources, and it ensures that users can benefit from resources beyond their immediate institution and this strengthens research outputs and fosters collaboration across institutions.

librarians' research support skills are instrumental in enhancing information service delivery and advancing research quality. From information literacy and bibliographic management to data stewardship and digital scholarship, librarians provide vital support that empowers researchers to achieve their goals. Several studies by Okuonghae and Anaehobi (2022) Austria and Cabonero (2020), Fazal and Chakravarty (2019) and Kennan *et al.* (2014), librarians and libraries are striving at providing research support services and libraries have varying degrees of research support skills. However, training and workshops are needed to help librarians enhance their skills towards information service delivery.

Librarians' Search Skills and Information Service Delivery

In today's academic environment, the role of university libraries transcends the traditional function of merely housing books and other physical resources. Libraries have evolved into dynamic knowledge centers where students, researchers, and faculty seek access to diverse, high-quality information. The effectiveness of information service delivery in these institutions heavily relies on the search skills of librarians. These skills determine how efficiently librarians can retrieve, evaluate, and present relevant information, ensuring that the library meets the academic and research needs of its patrons. According to Oyedokun (2024), the information landscapes become increasingly complex and librarians are expected to navigate various databases, catalogs, and online resources to provide support to researchers and patrons and this cannot be possible with search skills.

According to Afebende (2019), search skills are the strategies used in finding relevant information from a pool of information resources which involve the identification of relevant information source whether bibliographic or full text databases. Also, Chartered Institute of Library and Information Professionals (2018) reported that search skills does not only involve the skills relating to the search for information but also involves the theory, principle and practice of making and using search strategies and tactics. This is because information search skills also has to do with the recognition of when information is needed, where to find such information and use it. In a sinilar vein, Imam *et al.,* (2019) stated that information search skills is related also to information retrieval skills because information retrieval skills has to do with the skills that enable library users to identify, access, search, and retrieve accurate information related to their information needs. The components of information search skills according to Uzuegbu (as cited in Afebende, 2019) are: (i) knowledge of computer and ICT tools, (ii) ability to identify the need for information, (iii) ability to search for information required in reliable sources and media, (iii) formulate search strategies that take into consideration different sources of information, (v) understand the varying ways that information is organized, both in print and digital format and most importantly, (v) the ability analyse and evaluate information according to their relevance to research.

Search skills are premised on the ability to create the right search terms and input right queries so as to get the most relevant information resource. According to Adekanbi (2016), strategic skills is the ability to plan, create appropriate queries and search terms or combination of keywords or concepts which enable the retrieval relevant information. Librarians' acquisition of this skill enhances the capacity to effectively evaluate bibliographic search strategies, select the right search strategies for the search as well as evaluate search results. Apart from the use of appropriate keywords and search terms, strategic skills involve the use of Boolean operators (OR, AND, NOT), truncation and proximity features. According to Ugwu and Opah (2023), a fundamental search skills for librarians is premised in their ability to use advanced search techniques such as Boolean operators, keywords, and filters to refine searches and yield more relevant results as this expertise is crucial when dealing with large datasets and scholarly databases. Boolean logic (OR, AND, NOT) is a mechanism used for search accuracy which allows the inclusion of all synonyms and related terms which is used to either broaden or narrow a search. It allows the user to combine words or phrases representing significant concepts in a key word's search of an online catalogue or bibliographic database. The OR command is used to expand retrieval by including synonymous and related terms in the query. The AND command is used to narrow search results and the NOT command is used to exclude unwanted records from search results.

The use of Truncation is another useful strategic skill which involves the use of dollar sign ($), an asterisk (*) and a plus (+) after a single word or in the middle of a words. Truncation is equally used to take care of variations in spellings for example, he use of S or Z in organization, utilization amongst others (Quadri and Quadri, 2014). Also, Bachchhav (2016) reported on the use of proximity search technique which allows the searcher to define the distance of two terms from each other. Whether, the two search terms, should occur adjacent each other, or, one or more occur in between the search terms; or the search terms should occur in the same paragraph irrespective of the intervening words. Proximity search is as good as 'AND' because it searches

for the occurrence of two or more search terms but is specifies the distance between the search terms . There are also several other kinds of strategic skill like field searching, case sensitive searching, range searching, fuzzy search and weighted search (Bachchhav, 2016). By the acquisition of this search skill, librarians are able to teach, assist and empower library patrons on how to use these techniques so as to conduct more effective independent research.

The application of appropriate key words as well as search terms require the use of appropriate search engines. According to Lavidas *et al.* (2020), librarians' search skill is also premised on the knowledge and use of search engines because the use of appropriate keywords requires the use of appropriate search engines. According to Kore (2014), the use of search engines is gaining prominence as a tool for retrieving information since the advent of the Internet as students rely heavily on the internet in the present dispensation. The Internet search engine is used to find sources of information or to obtain the information itself examples of Internet search engines are AOL Search, Yahoo, Lycos, Excite, Infoseek, Alta vista, Google among others. With the growing availability of online databases, e-books, and other digital materials, librarians must continually adapt their skills to navigate new platforms and technologies.

Librarians' Customer Service Skill on Information Service Delivery

Customer service is about serving people. It is referred to as the genuine, compassionate, personalized, and or, simply put, humanistic approach to meeting the needs of customers so as to win their loyalty (Isibor *et al.* 2016). According to Oghenekaro (2018),Customer service is the act of taking care of the customer's needs by providing and delivering professional, helpful, high quality service and assistance before, during, and after the customer's requirements are met. In a similar vein, Study.com (2016), customer service is defined as the act of taking care of the customer's needs by providing and delivering professional, helpful, high quality service and assistance before, during, and after the customer's requirements are met. Also, Salesforce.com (2016) stated that customer service is the support given to customers before and after the sales of a product or services which helps them to have an easy and enjoyable experience with the organisation. Essentially, customer is more than just providing answers, it represents an extremely significant part of maintaining ongoing customer relationships and a critical ingredient to the success of any organization.

With particular reference to library and information centres, the importance of customer service is aptly captured by American Library Association (cited in Isibor *et al.,* 2016) which stated that the explicit function of the library is to organize, preserve, and make knowledge accessible. In order to achieve this, it is imperative for libraries to identify and meet the needs of the library patrons. The capacity to identify and meets the need of library patrons essentially comes from listening and learning form library patrons and using the insights obtained to improve library services. Isibor *et al.* (2016) affirmed that the concept of customer service have been neglected by librarians because they perceive library customers as a captive audience because libraries enjoyed the monopoly and custody of knowledge but that era is gone. According to Kotoroi (2022), historically, customer care service was viewed as a concept used in business enterprises as a means of leveraging profits; while in the context of libraries, it has been used as a means of enabling libraries to achieve their unique missions and stands as a determinant of effective service delivery.

According to Orayo *et al.* (2019), there are many competitors challenging the library's perceived monopoly on information and knowledge provision and as such librarians need to devise new ways of thinking and alternatives for applying a customer centered approach to service quality and customer satisfaction. This becomes necessary because libraries are predominantly service-oriented organization and good customer service is the key to the library's image, growth and stability. Oghenekaro (2018) asserted that the introduction of various information technology trends has led to reorganization, change in work patterns, and demand for new skills, job retraining and reclassification of positions whereby the emphasis in libraries is premised on access rather than ownership. This emphasis on access demands that librarians do not only equip themselves with ICT skills but also think of how best they can serve the library customers because a customer who perceives the services of a library to be of high quality will be willing to come again.

According to Pundsack (2015), academic library services have been transformed dramatically as wireless services, e-books, mobile access, chat reference among others are now part of the basic academic library service agenda making university libraries a place to make community connections. The author further stated that demographic makeup of library communities has become more diverse, information has become a commodity and the way library patrons are treated must be responsive and reflective of community needs. In view of the above, sffective customer service is important now as library users keep changing their expectations and customer service is premised on improving customer satisfaction, increasing usage and retention, ensuring reliability and consistency, ensuring provision of correct information to customers and more importantly, achieving customer satisfaction (Kotoroi, 2022).

Isibor *et al.* (2016) gave the following as the characteristics of good customer service in the library:

i. Promptness: the quality or habit of arriving or being on time. As members of a professional society, librarians are charged with a weighty responsibility. IFLA (2011) posits that the core mission of library and information professionals is to facilitate access to information for all for personal development, education, cultural enrichment, economic activity and informed participation in and enhancement of democracy. In recognition of this fact, when attending to library customers, promptness should be the watch word. Unnecessary delays should be avoided.
ii. Politeness: is the practical application of good manners or etiquette. Politeness is almost a lost art. Saying

a warm greeting, addressing customers respectfully (sir/madam), 'how may we/I be of service', and 'thank you very much' are a part of good customer service. For any business, using good manners is appropriate whether the customer makes a purchase or not (Salesforce.com, 2016). Librarians are expected to show the highest level of politeness to all library costumers through appropriate courteous responses.

iii. Professionalism: All customers should be treated professionally, which means the use of competent hands and appropriate technology where applicable. Professionalism shows the customer they're cared for. Librarians protect each library costumer's right to privacy and confidentiality with respect to information sought or received and resources consulted, borrowed, acquired or transmitted.

iv. Personalization: is a tailored means of meeting the customer's needs more effectively and efficiently, making interactions faster and easier and, consequently, increasing customer satisfaction and the likelihood of repeat visits. Using the customer's name is very effective in producing loyalty. Customers like the idea that whom they do business with knows them on a personal level

Appearance is regarded as a very important skill for customer service because the success of information service delivery is premised to a great extent dependent on the impression people have of the library and librarians. According to Oghenekaro (2018), appearance deals with every aspect of how an individual is perceived It reflects upon the basic character and work ethics of an individual as opinions can be formed about a person based on his/her appearance, character, speech, and mannerism. In the view of Ariana (cited in Oghenekaro (2018), first impression about an organization is premised on appearance and becomes a decider whether the customer will like to do business with the organization or not. It becomes important for libraries to harness the power of good appearance at the workplace so as attracts customers to patronize and use its resources.

Another important skill for customer service is approachability. According to American Library Association (cited in Oghenekaro, 2018), a successful library transaction is that which the library patron is able to identify that a librarian/information professional is available to provide assistance and feel comfortable to approach the librarian for assistance. It is premised on the disposition of librarians giving out positive verbal and non-verbal responses smiling, making eye contact, open posture, patient, understanding among others which are necessary to set the tone for the entire communication process, and will influence the depth and level of interaction between the staff and the patrons. The essence of this skill is that it would welcome the patrons and place them at ease with the library for a successful transaction.

Positive Attitude has been recognised as a very important skill for customer service. According to Michael and Olayemi (2023), the frequency of users' patronage is premised on the attitude of librarians which are reflected in their capacity to create a welcoming atmosphere in a library. This follows the view of Nze *et al.* (2024) that librarians with positive attitude to work in terms of enthusiasm, dedication and commitment to work are able to create a welcoming environment necessary for effective and efficient service delivery. In a similar vein, Oghenekaro (2018) asserted that positive attitude of librarians play a key role in the relationship between them and the library patrons and this positive attitude can be expressed in respectfulness (have a respectful attitude when interacting with library customers), commitment (being committed to the goal of satisfying users' needs), innovation (willingness to try something new or finding a different way to meet customer's needs) and helpfulness (willingness to assist customers with their needs).

Another key customer service skill is effective communication. According to Moita (2015), communication has a great importance in providing better services to users and librarians must communicate clearly and respectfully with library patrons. The author further stated that in this knowledge environment, any librarian without communication skills cannot deliver effective service and engender customer satisfaction. In the view of Oghenekaro (2018), effective communication is an important component of customer service library and the ability to communicate effectively on an interpersonal level will go a long way in ensuring that they meet the demands of the clientele and also gain their confidence. The author further stated that communication skill for effective customer service in libraries is premised on the ability to listen carefully, ability to see all questions as relevant, smiling and maintaining eye contact, tone of voice (not speaking loudly), choice of words, speaking clearly and politely, not responding sarcastically/making jest of patron, thanking patrons for their questions and feedback, explaining library policies and procedures if need be, instead of saying “I don't know”, refer patron to someone who has the information, Do not use library jargon, asking if you can help with anything else as well as responding to their “thank you” with-you are welcome, it is my pleasure/ that is why we are here (Oghenekaro, 2018).

Research Methodology

Quantitative method and descriptive survey design was adopted for study. The descriptive survey gives a researcher an accurate description of what people in some target group do or think about a phenomenon through the use of surveys to gather data about varying subjects. Descriptive survey design will enable the researcher to described a phenomenon in it natural setting. The research design was used because it enabled the researcher to described how librarian's innovative skill influence information service delivery in federal university libraries in South-South, Nigeria since the study aimed at getting facts about a given population and in a systematic approach, describe the characteristics, features and facts about the population. The population and sample size of the study comprised 60 academic librarians in selected federal university libraries in South-South, Nigeria namely University of Calabar, University of Port Harcourt and University of Uyo using total enumeration technique. 'Librarians' Innovative Skills and Information service delivery

Questionnaire'(LISISDQ) was developed by the researcher and used for data collection. The instrument had three sections, A, B and C. Section A elicited demographic information, section B with 58 items elicited information on librarians' innovative skills while Section C with 20 items elicited information on information service delivery. In Section B and C, the questionnaire was developed a four point rating scale responses of Always (4 points), Often (3 points), Sometimes (2 points) and Never (1 point). Mean and Standard Deviation were used to answer the research questions while independent t-test was used to test the hypotheses. A criterion mean (a midpoint mean) of 2.50 was adopted for agreement and disagreement with the questionnaire items. Any score at 2.50 and above showed agreement while below 2.50 showed disagreement.

Findings and Discussion

Research Question One

What is the influence of librarians' research support skill on information service delivery in federal university libraries in South-South, Nigeria?

Table 1: Mean and standard deviation scores of librarians research support skills in federal university libraries in South-South, Nigeria.

S/N	Research grant	$\bar{X}$	SD	Remarks
1.	I assist users in identifying relevant research topics.	3.42	0.72	Agreed
2.	I guide users in formulating research questions and hypotheses.	2.83	0.94	Agreed
3.	I support users in conducting effective literature searches.	3.41	0.69	Agreed
4.	I train users on the use of academic databases and search engines.	3.17	0.78	Agreed
5	I help users in evaluating the credibility and relevance of research sources.	2.98	0.69	Agreed
6	I provide guidance on citation and referencing styles (e.g., APA, MLA, Chicago).	3.34	0.83	Agreed
7	I assist users in avoiding plagiarism and understanding academic integrity.	3.41	0.69	Agreed
8	I offer support in the use of reference management tools (e.g., Zotero, Mendeley, EndNote).	3.17	0.78	Agreed
9	I help users develop strategies for organizing and managing research data.	3.26	0.91	Agreed
10	I guide researchers in accessing open access journals and institutional repositories.	3.07	0.57	Agreed
11	I provide assistance in conducting systematic reviews or meta-analyses.	2.77	0.68	Agreed
12	I support faculty and students in scholarly publishing and journal selection.	2.77	0.69	Agreed
13	I stay updated with current trends and tools in research support and academic services.	3.17	0.78	Agreed
14	I collaborate with faculty to integrate information literacy into the curriculum.	2.74	0.90	Agreed
15	I offer one-on-one or group consultations for research-related guidance.	3.07	0.86	Agreed
	Cluster Mean	**3.11**	**0.77**	**Agreed**

Source: Field Data (2025).

The result in Table 1 shows the mean score of librarians' research support skills in federal university libraries in South-South, Nigeria. All the items are above the cutoff point of 2.50. This means that librarians assist users in identifying relevant research topics, help users in evaluating the credibility and relevance of research sources as well as offer one-on-one or group consultations for research-related guidance However, the cluster mean of 3.11 for all the items implies that librarians in federal university libraries in South-South, Nigeria are imbued with research support skills to influence information service delivery.

Research Question Two

What is the influence of librarians' search skill on information service delivery in federal university libraries in South-South, Nigeria?

Table 2: Mean and standard deviation scores of librarians' search skills in federal university libraries in South-South, Nigeria.

S/N	Research grant	X	SD	Remarks
1.	I can effectively use basic search techniques (keywords, Boolean operators).	3.41	0.69	Agreed
2.	I am skilled at using advanced search strategies (truncation, phrase searching, field-specific queries).	3.34	0.81	Agreed
3.	I am able to identify the most appropriate databases or sources for specific information needs.	3.69	0.66	Agreed
4.	I can navigate and search within subject-specific databases (e.g., PubMed, ERIC, JSTOR).	3.48	0.81	Agreed
5	I efficiently use library catalogs and discovery tools to locate materials.	3.61	0.54	Agreed
6	I know how to retrieve full-text journal articles and e-resources.	3.61	0.54	Agreed
7	I can refine search results using filters, facets, and sorting options.	2.75	0.83	Agreed
8	I help users design effective search strategies for academic or research purposes.	3.08	0.87	Agreed
9	I stay up to date with new tools and platforms for information retrieval.	3.17	0.78	Agreed
10	I can use citation chaining (backward and forward) to expand a search.	2.87	0.75	Agreed
11	I understand how to evaluate search results for accuracy, relevance, and credibility.	3.23	0.86	Agreed
12	I support users in using search tools embedded in academic writing platforms.	3.34	0.81	Agreed
13	I effectively search for grey literature, such as reports, theses, and conference papers.	2.98	0.67	Agreed
14	I can search for and retrieve information in both print and digital formats.	3.74	0.49	Agreed
15	I assist users in retrieving hard-to-find or obscure materials.	3.25	0.67	Agreed
	Cluster Mean	**3.30**	**0.72**	**Agreed**

Source: Field Data (2025).

The result in Table 1 shows the mean score of librarians' research support skills in federal university libraries in South-South, Nigeria. All the items are above the cutoff point of 2.50. This means that librarians knows how to effectively use basic search techniques, can navigate and search within subject-specific databases, search for and retrieve information in both print and digital formats as well as assist users in retrieving hard-to-find or obscure materials. However, the cluster mean of 3.30 for all the items implies that librarians in federal university libraries in South-South, Nigeria are imbued with search skills that influence information service delivery.

Research Question Three

What is the influence of librarians' customer service skills on information service delivery in federal university libraries in South-South, Nigeria?

Table 3: Mean and standard deviation scores of librarians' customer service skills in federal university libraries in South-South, Nigeria.

S/N	Research grant	X	SD	Remarks
1.	I greet library users in a friendly and welcoming manner.	3.97	0.16	Agreed
2.	I respond to users' inquiries promptly and respectfully.	3.74	0.49	Agreed
3.	I listen actively to understand users' needs before offering assistance.	3.97	0.16	Agreed
4.	I remain calm and courteous when dealing with difficult users or situations.	3.85	0.40	Agreed
5	I provide accurate and helpful information to users.	3.85	0.40	Agreed
6	I follow up with users to ensure their information needs have been met.	3.56	0.69	Agreed
7	I demonstrate patience when assisting users with limited information skills.	3.74	0.49	Agreed
8	I treat all users equally and with respect, regardless of background.	3.74	0.49	Agreed
9	I effectively handle user complaints or feedback to improve services.	3.85	0.40	Agreed
10	I am familiar with library policies and communicate them clearly to users.	3.74	0.49	Agreed
11	I show professionalism in both verbal and written communication.	3.74	0.49	Agreed
12	I go the extra mile to assist users beyond their immediate requests.	3.74	0.49	Agreed
13	I make efforts to create a welcoming and user-friendly library environment.	3.86	0.40	Agreed
14	I assist users in accessing library resources and navigating library systems.	3.74	0.49	Agreed
15	I work well with colleagues to provide consistent service to users.	3.86	0.40	Agreed
	Cluster Mean	**3.80**	**0.43**	**Agreed**

Source: Field Data (2025).

The result in Table 3 shows the mean score of librarians' research support skills in federal university libraries in South-South, Nigeria. All the items are above the cutoff point of 2.50. This means that librarians respond to users' inquiries promptly and respectfully, greet library users in a friendly and welcoming manner, remain calm and courteous when dealing with difficult users or situations as well as effectively handle user complaints or feedback to improve services However, the cluster mean of 3.30 for all the items implies that librarians in federal university libraries in South-South, Nigeria are imbued with customer service skills to influence information service delivery.

Hypotheses Testing

Hypothesis 1

There is no significant influence of librarians' research support skills on information service delivery in federal university libraries in South-South, Nigeria.

Table 4: Independent t-test Analysis of the Influence of Librarians' Research Support Skills on Information Service Delivery in Federal University Libraries in South- South, Nigeria (n= 58)

	Variables	n	$\overline{X}$	SD	t_{cal}	t_{crit}	Decision
Pair 1	Librarians' Research Support Skill	58	3.11	0.77	3.08	1.97	Significant
	Information Service Delivery	58	2.98	0.69			

*significant at P< .05; df= 56 Source: Field Data (2025).

The result in Table 4 reveals that the calculated t-value of 3.08 is greater than the critical t-value of 1.97 at .05 level of significance and at 56 degrees of freedom. With this result, the null hypothesis was rejected. This implies there is significant influence of librarians' research support skills on information service delivery.

Table 5: Independent t-test Analysis of the Influence of Librarians' Search Skills on Information Service Delivery in Federal University Libraries in South-South, Nigeria (n= 58)

c		n	X	SD	t_{cal}	t_{crit}	Decision
Pair 1	Librarians' Search Skill	58	3.30	0.72	3.20	1.97	Significant
	Information Service Delivery	58	2.98	0.69			

*significant at P< .05; df= 56 Source: Field Data (2025).

The result in Table 5 reveals that the calculated t-value of 3.20 is greater than the critical t-value of 1.97 at .05 level of significance and at 56 degrees of freedom. With this result, the null hypothesis was rejected. This implies a significant influence of librarians' search skills on information service delivery.

Table 6: Independent t-test Analysis of the Influence of Librarians' Customer Service Skills on Information Service Delivery in Federal University Libraries in South-South, Nigeria (n= 58)

	Variables	n	X	SD	t_{cal}	t_{crit}	Decision
Pair 1	Librarians' Customer Service Skill	58	3.80	0.43	3.45	1.97	Significant
	Information Service Delivery	58	2.98	0.69			

*significant at P< .05; df= 56 Source: Field Data (2025).

The result in Table 6 reveals that the calculated t-value of 3.80 is greater than the critical t-value of 1.97 at .05 level of significance and at 56 degrees of freedom. With this result, the null hypothesis was rejected. This implies a significant influence of librarians' customer service skills on information service delivery.

Discussion of Findings

The findings of the study are here under discussed in line with the constructs used in the study.

Librarians' Research Support Skills and Information Service Delivery

The research question one shows that librarians' research support skills influence informatiom service delivery and the influence is significant based on the test of hypothesis one. This implies that librarians' research support skills significantly influence information service delivery in federal university libraries in South-South, Nigeria.

The finding from this study is in line with that of Okuonghae and Anaehobi (2022) in their study of correlates of research support services delivery in academic libraries in south-south Nigeria which revealed that research support skills of librarians in terms of knowledge of their information need and their ability to use needed information significantly influenced information service delivery. The finding from this study corroborates that of Austria and Cabonero (2020) in their study on research knowledge and skills of academic librarians in Northern Philippines which revealed that librarians possess research support skills of in five domains of research-conceptualizing research problems, developing and reviewing related literature and studies, proficient, identifying appropriate research methodology, developing writing analysis and interpretation of data as well as developing, formulating conclusions and recommendations that are important for effective and efficient information service delivery. The finding from this study is also in agreement with the study of Kennan *et al.* (2014) on the research support services in academic libraries which revealed that academic libraries are already providing services in the focal areas of bibliometrics and data management and the research support skills of librarians are needed also in journal publishing platforms, and grant writing support.

Librarians' Search Skills and Information Service Delivery

The research question two shows that librarians' search skills influence informatiom service delivery and the influence is significant based on the test of hypothesis two. This implies that librarians' search skills significantly influence information service delivery in federal university libraries in South-South, Nigeria.

The finding from this study is in agreement with that of Nwabueze *et al.* (2022) in their study on information search skills as predictors of use of information resources that revealed that search skills are important the use of information resources and by extension a skill for improved service delivery. The finding from this study is in line with that of Afebende (2019) who investigated the influence of knowledge of information search strategies on the use of library resources by undergraduate students and reported that search skills are a necessity for information resources use and by extension an important skill for librarians in the discharge of information service. The finding from this study is supported by that of Liman *et al.* (2017) in their study of the skills and competencies required by academic librarians in an internet-driven environment which revealed that search skills are prerequisite for improved information service delivery. The finding of the study of Bankole *et al.* (2024) which examined the determinants of effective research information retrieval among Nigerian librarians is in line with the finding from this study as it reiterated that search skills of librarians are necessary requirement for effective and efficient information service delivery

Librarians' Customer Service Skills and Information Service Delivery

The research question three shows that librarians' customer service skills influence informatiom service delivery and the influence is significant based on the test of hypothesis three. This implies that librarians' customer service skills significantly influence information service delivery in federal university libraries in South-South, Nigeria.

This finding is in line with Mugo and Mathu (2021) in their assessment of customer service provision for enhanced user satisfaction in academic libraries with focus on St Paul's University Library, Nairobi, Kenya which revealed that customer service skills are essential skill for providing information service delivery as librarians treated users with respect and courtesy as well as provide room for increased level of communication. The finding of this study agrees with that of Kotoroi (2022) in the study which evaluated the strategies utilized by the Arusha Public Library in Tanzania to improve customer service and showed that libraries are striving towards providing effective service delivery by improving the customer service skill of librarians through training.

The significant influence of librarians' customer service skills n information service delivery is premised n the fact that librarians by the virtue of their training are imbued with the knowledge and skills needed to work in a service organization like the library and without any formal training in customer service are already disposed to customer service activities

Conclusion

Based on the findings from the study, it is concluded that librarians' innovative skills such as research support skills, search skills and customer service skills significantly influence information service delivery in federal university libraries in South-Southm Nigeria**.**

Recommendations

Consequent upon the findings from this study, the following recommendations were proferred:

1. University library management should take proactive steps in developing the research skills of librarians so as to better prepare librarians with the skills needed to position, expand and sustain information service delivery in the present dispensation.
2. University library management should improve the search skill of librarians through periodic training particularly in this era of information explosion occasioned by the impact of information technology
3. University library management should take the issue of customer service skills seriously as librarians need this skill to better understand library users' queries and be better disposed to providing effective and efficient information service delivery

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Librarians' Perception on the Use of Chatbot and Robotic Technology for Service Delivery in Academic Libraries in Rivers State, Nigeria

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Abstract

Modern libraries and information centers contend with increasing numbers of resources and users that are demanding for seamless access to efficient services. Hence, it becomes necessary for librarians to resort to the use of machine-driven measures such as chatbot, robots and others computer-powered assistance to support the effort of her workforce. This work therefore, examined the perception of librarians on the use of chatbot and robots for service delivery in academic libraries in Rivers State. Three research questions guided the study. Descriptive survey design was used in carrying out the study, the population of the study consisted of all the 73 librarians and library officers drawn from 6 university libraries in Rivers State. An online questionnaire titled "Chatbot and Robots for Library Service Delivery" (CARLSD) was used for data collection. Findings of the study revealed that librarians strongly perceived that chatbot and robotic technology enhance library service delivery, improve user engagement and ensure 24/7 availability of services. There is little concern that it may reduce the relevance of libraries or lead to job displacement. Key challenges include lack of technical expertise and high costs of acquisition and maintenance among others. It was recommended that libraries should organize regular training and workshops to enhance librarians' technical skills for implementing and managing chatbot and robotic technologies, while institutions and government bodies should allocate sufficient funds to acquire and maintain these technologies.

Keywords: *Chatbot, Librarians' perception, Robotic*

Introduction

The integration of emerging technologies such as artificial intelligence (AI) and robotics into library services has revolutionized the process of information dissemination and user engagement all over the world. Libraries, as repositories of knowledge, are increasingly adopting innovative tools to enhance service delivery, streamline operations, and meet the evolving needs of digital patrons. Among librarians in Nigeria and Rivers State in particular the adoption of AI-driven chatbots and robotic technologies in academic libraries is gaining attention, prompting an investigation into librarians' perceptions, the benefits of these technologies, and the challenges faced in their implementation.

The advent of digital technologies has transformed libraries from mere physical spaces to dynamic, interactive environments that offer a blend of traditional and digital services. AI-driven chatbots and robotic technologies represent the forefront of this transformation, offering capabilities such as 24/7 uninterrupted user assistance, automated cataloging, and efficient information retrieval. These technologies not only enhance user experience but also optimize library operations by automating routine tasks, thereby allowing librarians to focus on more complex and value-added services.

In Nigerian libraries, the integration of AI technologies such chatbots and robotics are still in its nascent stages. While some institutions have begun exploring these technologies, widespread adoption remains very low due to various factors, including infrastructural challenges, funding constraints, and resistance to change. Understanding librarians' perceptions of these technologies is crucial, as their acceptance and readiness play a significant role in the successful implementation and utilization of AI and robotic systems in library services.

Librarians' attitudes towards AI and robotic technologies are pivotal in determining the extent to which these innovations are embraced within the libraries. Wagwu, et al. (2024) revealed a generally positive perception among librarians towards AI-driven chatbots, highlighting their potential in enhancing user engagement, improving accessibility, and streamlining library queries. The study emphasized that librarians recognized the value of chatbots in handling routine inquiries and providing continuous support, thereby enhancing the provision of library services.

However, despite the acknowledged benefits, there exists a degree of apprehension among librarians regarding the adoption of these technologies. Concerns about job security, the reliability of AI systems, and the potential loss of personal interaction with patrons contribute to a cautious approach towards embracing AI and robotics in library.

The implementation of AI and robotic technologies in academic libraries offers numerous advantages that align with the goals of modern library services. AI-driven chatbots can provide immediate responses to user queries, facilitate access to digital resources, and assist in information literacy by guiding users through research processes. Robotic systems can automate tasks such as shelving, inventory management, and book retrieval, thereby increasing efficiency and reducing the physical strain on library staff.

Moreover, these technologies can operate continuously without fatigue, ensuring uninterrupted service delivery and accommodating the diverse schedules of library users. The ability to handle multiple tasks simultaneously and provide personalized user experiences further enhances the value proposition of AI and robotics in academic libraries. By adopting these technologies, libraries can position themselves as forward-thinking institutions that leverage innovation to meet the evolving demands of the academic community.

Despite the potential benefits, several challenges hinder the widespread adoption of AI and robotic technologies in academic libraries in Rivers State. Infrastructure limitations, such as unreliable power supply and inadequate internet connectivity, pose significant obstacles to the implementation of these technologies. Financial constraints also play a critical role, as the acquisition, maintenance, and upgrading of AI and robotic systems require substantial investment, which may not be readily available in many academic institutions.

Additionally, the lack of technical expertise among library staff presents a barrier to effective utilization of these technologies. Without proper training and support, librarians may struggle to operate and maintain AI and robotic systems, leading to underutilization and potential system failures. Resistance to change, stemming from fears of job displacement and a preference for traditional service delivery methods, further complicates the adoption process.

Research Questions

The following research questions guided the study

1. What are librarians' perceptions on the use of chatbot and robotic technology for service delivery in academic libraries in Rivers State?
2. What are librarians' perceptions on the benefits of chatbot and robotic technology in enhancing library service delivery in academic libraries in Rivers State?
3. What are librarians' perceptions on the challenges of adopting chatbot and robotic technology for service delivery in Rivers State?

Literature Review

The adoption of chatbot and robotic technology in libraries is not just for fun but a systematic strategic designed to improve the services offered to users and transform the roles of library staff for operational efficiency, improve user-personalized engagement and save the time of users. Patrons desired a quick and seamless services which these technologies can play a crucial role in meeting these expectations.

Chatbot is a piece of artificial intelligence (AI) software application uses to simulate discussion or chat with a human through a messaging service on website, social media or other media platforms. Ehrenpreis and DeLooper (2022) say that library's website serves as the first point of call for engaging with its users. It's essential for the website to feature easily accessible content to facilitate access to library resources and showcase services and events. One effective tool for getting acquainted with staff, location, resources and schedule is a chatbot, which is a type of artificial intelligence software.

For library services, voice assistants and chatbots can be used (Mckie & Narayan, 2019). AI technology has an impact on the fundamental components of library operations (Adigun et al., 2023). Chatbots dominate artificial intelligence application can be used, among other things, to alert users to new arrivals and when a book loan is due, inform users of new arrivals, and point users to related information.

Mckie and Narayan (2019) argue that chatbots can provide new library users, generally undergraduate students, with a sense of ease in using the library resources, while minimizing the effects of library anxiety related to research, library databases and librarian services. Nguyen, (2020) holds that chatbot is an artificial intelligence (AI) software or application that can simulate a conversation (or a chat) with a library user in natural language via a messaging app, a blog, a website, a mobile app, or a smart device. Voice assistants and chatbots can be utilized for library services.

Chatbots are used in providing 24/7 user services by answering complex and diverse queries, navigating the library website provides personalized feedbacks and assisting with research by responding to questions from library users and directing them to specific library resources. Chatbots can enable library professionals to increase their efficiency and productivity by responding to difficult questions and save time answering repetitive queries. The difference between chatbots and robots is that chatbots only respond verbally or textually to queries while robots have to show interaction through expressions, movements, verbally and other humanly behaviors.

Robots are machines programmed by a computer capable of carrying out a complex series of actions automatically. A robot can be guided by an external or internal control device. According to Asemi, et al., (2021) automated machines are designed to carry out specific tasks with or without human involvement often for jobs that would be too labor-intensive for humans to do consistently.

These AI tools manage mechanical devices to execute automated tasks using artificial intelligence techniques, either through direct human control or pre-set programs. For example, robots can be used to retrieve books and assist in shelving in libraries. By enhancing collection analysis, visualization, preservation, and reducing service delivery costs, robots significantly improve the operational efficiency of libraries. It's often mimic human actions or work in environments unsuitable for humans. Wiche et al. (2023) describe robots as a category of machines capable of performing various automated tasks that are programmed via computers.

As libraries continue to evolve in the digital age, the collaboration between humans and machines will be essential for delivering exceptional service and ensuring that libraries remain relevant in an ever-changing. This assertion is in agreement with the idea of Wang and Siau (2019) who define a robot as a device designed to execute complex tasks through computer-automated processes. As libraries continue to expand their digital services and resources, which are relatively easy for robots to manage, incorporating robotics into library operations could provide significant benefits and create new opportunities. Robots, in the broadest sense, are automated machines designed to perform tasks autonomously or with minimal human intervention. The application of robot in libraries is an innovative convergence of technology and information management aimed at enhancing service delivery.

Wójcik (2024) sees robots in libraries as programmable devices designed to assist in managing physical and digital library resources, enabling better access to information for users. These robots vary in complexity, ranging from simple automated systems like self-checkout machines to sophisticated humanoid robots capable of interaction. These robots are often equipped with sensors, cameras, and mobility mechanisms, allowing them to navigate physical spaces, locate resources, and even shelve books. For instance, robots like "Tug" are utilized in some libraries to transport books and other materials efficiently. Advanced robots can perform multitasking providing directions, recommending books, and answering frequently asked questions.

Tait and Pierson (2022) pointed out that robots in libraries serve various purposes, enhancing operational efficiency and user experience. They assist in routine tasks such as book sorting, shelving, and inventory management, reducing human workload and minimizing errors. Interactive robots also act as guides, helping patrons locate materials and navigate the library. For example, the National Library of Singapore employs robotic systems to streamline the lending and returning of materials. Furthermore, robots are used in digital resource management, leveraging AI to suggest personalized reading recommendations based on users' preferences. These capabilities improve library services, enabling librarians to focus on more complex tasks such as information literacy programs and research consultations.

Rather than fearing job loss, Wiche, et al., (2023) advice that library professionals should view robotics as an opportunity to redefine their roles and enhance the value they bring to their communities. The advantages of using robots in libraries are multifaceted. First, they significantly increase efficiency by automating repetitive tasks, leading to time and cost savings. For instance, automated book-sorting robots can process thousands of materials daily, a task that would take human staff considerably longer. Second, robots improve accessibility, particularly for users with disabilities, by offering personalized assistance and delivering resources to designated areas. Additionally, robots provide consistent and uninterrupted services, ensuring library operations run smoothly even during off-peak hours or staff shortages. Nguyen (2020) supported the above assertion when he opined that libraries can use robot for improving user satisfaction and operational productivity.

Despite the numerous benefits of robot in the library, Ajani, eta'l. (2022) on examining the perceptions of librarians on the adoption of robots in libraries raises concerns and fears. A significant apprehension is the potential loss of jobs, as robots could replace certain roles traditionally performed by humans. This fear is particularly pronounced in developing countries like Nigeria because of the high unemployment rates. Another concern is the high cost of acquiring and maintaining robotic systems, which may be too expensive for underfunded libraries. Furthermore, ethical considerations arise regarding data privacy, especially when robots collect and store user information. Additionally, the fear of technology failures, such as system malfunctions or cyber-attacks, highlights the importance of ensuring robust security and backup systems. Libraries must address these fears by implementing comprehensive policies and ensuring that robots complement rather than replace human staff. Adeyemi, etal (2024) holds that artificial intelligence such as robots in libraries has the potential to transform service delivery and information management especially if the fears and challenges associated with the use is addressed. Libraries can harness the power of robotics to enhance better user experiences and greater operational efficiency

Methodology

Descriptive survey research design was used in carrying out the study. The population of the study consisted of all the 73 library officers and librarians in the federal and state government owned academic libraries in Rivers State. Three University libraries and three Polytechnic libraries were purposively sampled, these libraries and the number of respondents are University of Port Harcourt library (40), Rivers State University library (11), Ignatius Ajuru University of Education libray (10), Ken SaroWiwa Polytechnic library (3), Captain Elechi Amadi Polytechnic library (6) and College of Health Science and Management Technology library (3). The census sampling technique was adopted for the study since the population is of a manageable size. Online questionnaire was used as instrument for the study, and 70 were returned successfully and used for the study. Mean and standard deviation was used for the analysis of data.

Results and Discussions

Research Question 1: What are l**ibrarians' perceptions on the use of chatbot and robotic technology** in academic libraries in Rivers State?

Table 1: Librarians' perceptions of chatbot and robotic technology

S/N	Librarians perceived that Chatbot and robotic technology	SA	A	D	SD	M	SD	REMARK
1	Provide real time responses to queries, facilitate access to library resources.	60	10	0	0	3.86	0.35	Agree
2	Increase efficiency and reduce the physical strain on library staff.	55	15	0	0	3.79	0.41	Agree
3	Make libraries loss it relevance	5	5	30	30	2.21	0.86	Disagree
4	Cause job loss to librarians	20	20	20	10	2.71	1.03	Disagree
5	Enhance service delivery	60	10	0	0	3.86	0.35	Agree
	Grand mean					3.49		

Table 1 above, items 1, 2, and 5 received high mean scores (3.79 – 3.86) with very low standard deviations (0.35 – 0.41), indicating strong consensus among respondents that chatbot will provide real time responses to queries, facilitate access to library resources and increase efficiency and reduce the physical strain on library staff. **Item 3** on libraries loses relevance scored a moderate mean of 2.21 with a higher standard deviation of **1.86** indicating **divided opinions. Item 4** on job loss had the lowest mean **(2.71)** and the highest standard deviation **(1.03),** showing **mixed perceptions**. Librarians are **uncertain** about whether these technologies will threaten their job security. Some agree, some disagree, indicating **anxiety but not overwhelming fear**. The **grand mean** of **3.49** shows agreement implying a **generally positive perception** of chatbot and robotic technology among librarians. However, there are some **reservations** particularly around **job security and relevance**.

Research Question 2: What are librarians' perceptions on the benefits of chatbot and robotic technology in enhancing library service delivery in academic libraries in Rivers State?

Table 2: Librarians' perceived benefits of chatbot and robotic technology.

S/N	Librarians' perceived benefits of chatbot and robotic technology in library service delivery	A	SA	D	SD	M	SD	REMARK
1	Improve user engagement in library services.	50	20	0	0	3.29	0.45	Agree
2	Ensure 24/7 availability of library services.	70	0	0	0	4.00	0.00	Agree
3	Provide streamline inst ant responses to users' inquiries	65	5	0	0	3.93	0.26	Agree
4	Robot does tedious tasks easily	50	10	10	0	3.00	0.53	Agree
5	Makes libraries still relevant in the digital age.	55	15	**0**	**0**	3.21	0.41	Agree
	Grand mean					**3.49**		

Table 2 on librarians' perceived benefits of chatbot and robotic technology shows a generally positive disposition toward these innovations in academic libraries. The highest-rated benefit was the ability to ensure 24/7 availability of library services, with a perfect mean score of 4.00 and zero deviation, indicating unanimous strong agreement. Similarly, providing streamlined and instant responses to user inquiries received a high mean of 3.93, suggesting strong consensus on its effectiveness. Other areas, such as improving user engagement and reinforcing library relevance in the digital age, also received favorable responses with mean scores above 3.20, reflecting general agreement among respondents.

Research Question 3: What are librarians' perceptions on the challenges of adopting chatbot and robotic technology for service delivery in Rivers State?

Table 3: Challenges face by librarians in adopting chatbot and robotic

S/N	Challenges face by librarians in adopting chatbot and robots	A	SA	D	SD	M	SD	REMARK
1	Lack of technical expertise	40	20	10	0	3.14	0.64	Agree
2	Cost of acquiring and maintenance	25	20	15	10	2.79	1.01	Agree
3	fears of job displacement	30	10	20	10	2.57	0.09	Disagree
4	inadequate funding	10	10	20	30	2.00	1.07	Agree
5	Fear of tech-use	15	10	20	25	2.14	1.06	Disagree
	Grand mean					**2.53**		

Table 3 on the analysis of challenges faced by librarians in adopting chatbot and robotic technologies reveals a moderately concerned but not overwhelmingly negative perception. Key challenges identified include a lack of technical expertise and the high cost of acquisition and maintenance, both of which received agreement from respondents. There was slight concern over job displacement, while inadequate funding and fear of using technology were largely disagreed with, suggesting that emotional resistance is not a major barrier. With a grand mean of 2.53, the overall perception is neutral to slightly agreeable, indicating that while librarians recognize some challenges, they are not insurmountable and could be addressed through training and adequate support.

Discussion of Findings

The findings of this study reveal a clear and growing acceptance among librarians regarding the potential of chatbot and robotic technologies to enhance library services. The high mean scores recorded for items such as improving service delivery, reducing workload, providing instant responses, and ensuring 24/7 availability reflect a strong consensus among librarians on the usefulness of these innovations. These results align with studies such as Kaushal and Yadav (2022) and Oladokun (2023) which found that librarians increasingly view AI tools as enablers of efficiency, responsiveness, and user satisfaction in academic libraries.

However, despite the positive outlook, some concerns and perceived risks were evident. Notably, a segment of librarians expressed worry that automation might reduce the relevance of traditional library roles or lead to job loss. This concern, while not dominant, reflects a broader global discourse on the impact of automation on employment in knowledge-based professions Sanji, et al (2022). Furthermore, the findings show that while librarians recognize the benefits of chatbot and robotic technology, practical challenges such as the lack of technical expertise and high implementation costs could hinder effective adoption. These findings are consistent with Owolabi (2022), who emphasized the need for adequate funding and training to support the integration of emerging technologies in Nigerian libraries.

Interestingly, emotional and psychological barriers like fear of using technology or resistance to change were not significantly perceived as challenges, which indicates a cultural shift among library professionals toward embracing digital tools. The findings align with the view of Fatouh, and Hamam (2024) who suggest that if librarians are empowered through training and institutional support, they are well-positioned to adopt these technologies and transform library services to meet the needs of 21st-century users. Overall, the discussion affirms that while chatbot and robotic technologies hold great promise for academic libraries in Rivers State, their successful adoption will depend on addressing infrastructural, financial, and capacity-related barriers.

Conclusion

The librarians in academic libraries in Rivers State hold a generally positive perception of chatbot and robotic technologies in library service delivery. They strongly agree that these innovations can enhance service delivery, reduce workload, improve user engagement, and ensure 24/7 accessibility. Despite some concerns that such technologies may impact the relevance of libraries or lead to job displacement, the overall sentiment is supportive of their integration into library operations. This indicates a growing openness among librarians to embrace digital transformation in order to meet users' evolving needs in a technologically driven age.

However, the study also uncovered some notable challenges that could hinder the adoption of chatbot and robotic technologies. The major barriers identified include a lack of technical expertise and the high cost of acquisition and maintenance. While fears related to job loss and technology use exist, they were not found to be widely shared or deeply rooted. The findings suggest that with adequate training, funding, and institutional support, librarians are likely to adopt and use these technologies more effectively to improve service delivery and maintain the relevance of libraries in the digital era.

Recommendations

1. Libraries should organize regular training and workshops to enhance librarians' technical skills for implementing and managing chatbot and robotic technologies.
2. Institutions and government bodies should support the funding to acquire and maintain these technologies.
3. Librarians should increase awareness among its members on the long-term benefits of automation to dispel fears and resistance.

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Libraries and Librarians' Preparedness for The Fifth Industrial Revolution: A Study of Librarians in Edo State

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Abstract

This study examined libraries and librarians' preparedness for the Fifth Industrial Revolution (5IR) using librarians in Edo State as a case study. Descriptive research design was used in carrying out this study. The population of the study comprised 202 librarians, who are members of Nigerian Library Association, Edo State chapter who subscribed to the Association's WhatsApp group. The study adopted simple random sampling technique and the entire population was used, hence, there was no sample size. Questionnaire was the only instrument used for data collection. Out of 202 librarians in NLA Edo State Chapter WhatsApp group at the time of distribution of questionnaire, 124 members responded which represents 61.4% of the respond rate and their responses were found useful for the research. Data collected was analyzed using frequency counts and mean score of 2.50. The findings of this study revealed that libraries and librarians in Edo State are aware of the 5th Industrial Revolution technologies in effective library services as the average mean of the findings was 3.3 which is above 2.5 mean benchmark, also they perceived that the adoption of 5IR technologies will be relevant in improving library services as the average mean of 3.4 was recorded which is also above 2.5 mean benchmark. Furthermore, the findings equally showed that inadequate funding may hinder the adoption of 5th Industrial Revolution in libraries in Edo State. The study recommended among others that libraries and librarians should not only be aware of 5IR, they should be prepared to make effective use of them in order to improve library services, librarians should endeavour to acquire technological skills that help them to make use of 5IR technologies and adequate funds should be allocated to the libraries for the adoption and implementation of 5IR and acquisition of its technologies.

Keywords: Libraries, Librarians, 5th Industrial revolution, Information landscape, Information professionals

Introduction

The Fifth Industrial Revolution (5IR) is ushering 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, Ajani & Enakrire (2024) enunciated that the Fifth Industrial Revolution (5IR) 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. One of the emerging technologies for 5IR which is 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.

Several authors like Ajani et al., (2022); Tella, Amuda & Ajani (2022) and Moll (2023) have opinioned that the 5IR is taking the world into an era of remarkable technological advancements and societal transformations. According to Tella, Ajani and Ailaku (2023), questions are need to be asked on what 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. The authors further opined that traditionally, libraries have been regarded as places dedicated to collecting, safeguarding, and disseminating information, however, the very nature of information and how it can be accessed has undergone a profound transformation. The digital world, with its vast databases, search engines, and algorithms, has revolutionized how knowledge is searched, consumed, and shared. In a landscape characterized by information overload and the constant evolution of technology, libraries must not just reinvent themselves but also redefine their purpose.

Carrion (2023) elaborated that terms like cloud computing, robotics, artificial intelligence, virtual/augmented reality, the Internet of Things, blockchain, and the metaverse are gaining popularity among library professionals and users. However, the adoption of such terms to describe new ideas, models, and

techniques in librarianship is not without controversy, with the concept of "Intelligent Libraries" sparking significant debate. While some experts argued that "Intelligent Libraries" is commonly used to refer to "smart libraries," public opinion on this trend varies (Khan et al., 2023). Some library stakeholders find it exciting and believe it can enhance library services and foster innovation while, on the other hand, others view it as empty and questionable. Critics claim that labelling trends in librarianship as "Intelligent Libraries" is merely a marketing strategy to enhance the image of libraries. They suggested that this terminology puts pressure on librarians to transform abstract concepts into practical realities, where innovations can be implemented to sustain the knowledge system in the era of the Fifth Industrial Revolution (5IR) (Mupaaikwa, 2024).

In order to prepare for Fifth Industrial Revolution (5IR), libraries and librarians need to be conversant with new technologies by using technologies like Artificial Intelligent (AI), Machine Learning and Augmented Reality to improve library services. Libraries should also develop a culture of innovation by encouraging librarians on taking risk and experimentation in order to explore new ideas. There should also be collaboration on innovation projects, which should be organized by libraries. It can take the form of workshops and seminars. Libraries can provide continues training for librarians and library users to master previous industrial revolutions skill which herald the 5IR. The Fifth Industrial Revolution (5IR) is a transformative period where information resources and services are becoming more technologically driven. Librarians are to adapt to these changes by incorporating advanced technologies and collaborative methods. The skills that are essential for librarians in the 5IR are cognitive flexibility, emotional intelligent, problem-solving, critical thinking, creativity, and people management.

Statement of the Problem

Libraries and library services of librarians tend to be changing because of the Fifth Industrial Revolution (5IR) technologies, which is making libraries more digital and improving the experience of librarians and library users. Libraries that are prepared to use AI, IoT, and other intelligent technologies for library services will realize the relevance of using 5IR technologies for library services. Librarians as well will find it more beneficial in using the technologies for effective and efficient library services as these technologies can allow libraries to offer better services. There are much to be gained if libraries and librarians can adopt the use of 5IR technologies, with Internet of Things (IoT) devices, library users can easily and safely access resources using their Smart Phones or other IoT devices; they do not need physical library cards or to do things manually, which makes things better for librarians and as well as library users. Opoku et al., (2024) pointed out that some libraries in developed countries also have introduced mobile self-loan services, which lets users borrow resources on their own using their mobile devices; they do not have to wait in line, so it is faster. Libraries also use IoT to monitor their air quality inside, which makes sure the air is good for studying and working.

The question that might be begging for an answer for libraries and librarians in Nigeria is, how prepared are they for the adoption of Fifth Industrial Revolution (5IR) technologies for library services, in spite of the far-reaching benefits of 5IR. There might be challenges in which libraries and librarians may encountered in the course of adopting and implementing 5IR in library services. From observation, such challenges may include and not limited to inadequate IT infrastructure, ensuring seamless integration of 5IR technologies with existing library systems and services, lack of curtailing cyber threat (cybersecurity), inadequate digital literacy, inadequate training of librarians on the use of 5IR technologies, some librarians resistance to change towards technological advancement, cost of 5IR technology acquisition and maintenance, inadequate funding of libraries and librarians' training and retraining of librarians on the use of 5IR technologies. In view of the above challenges, libraries and librarians should adequately be prepared to embrace the adoption of 5IR in order to be abreast with the technological development in library services. Therefore, the study tends to examine libraries and librarians' preparedness for the Fifth Industrial Revolution (5IR), using librarians in Edo state, Nigeria.

Research questions

1. What is the extent of the awareness of the 5th Industrial Revolution Technologies among libraries and librarians in Edo State?
2. What is the perception of the libraries and Librarian on the 5th Industrial Revolution technology in Improving library services?
3. What are the challenges libraries and librarians may face in preparing for 5th Industrial Revolution Technologies in Edo State?

Literature Review

The Fifth Industrial Revolution, which can as well be referred to as "Industry 5.0", is seen as a novel and evolving phase of industrialisation which allows humans to collaborate with advanced technology and A.I.-powered robots to enhance workplace practices. This is coupled with a more human-centric focus as well as increased resilience and an improved focus on technological sustainability. This novel phase of technology is enabled by developments in Information Technology (IT). that include facets such as artificial intelligence, automation, big data analytics, the Internet of Things (IoT), machine learning, robotics, smart systems, and virtualisation. Authors like Shijia (2021); George & George (2022); Pathak, Pal, Shrivastava & Priyanka (2019) explained that several previous studies have elucidated the characteristics of the fifth industrial

revolution, which explains how humans and robots work synchronously and advance in different areas of human well-being. One of them is the energy revolution, a highly transformed workplace culture where robots replace routine tasks, and the introduction of collaborative robots.

In the area of industry-based society, De Vries & Kroukamp (2023) opined that in this rapidly changing world, the term "5IR" represents a significant transformation happening in industries and societies. It helps the society understand the profound changes taking place around them. The 5IR is about the integration of different technologies like the Internet of Things (IoT), cloud computing, robotics, virtual/augmented reality and advanced data analysis, but it goes further to include artificial intelligence (AI), biotechnology, nanotechnology, and the limitless potential of quantum computing (Noble et al., 2022). These technologies come together and complement each other, leading to remarkable advancements and new opportunities. In this revolution, data is incredibly valuable and drives innovation and decision-making; our interconnected world, with countless devices and sensors, generates a massive amount of data, with advanced AI and complex analytics diving into this data, extracting valuable insights that inform decision-making, enabling personalized experiences, and inspiring groundbreaking innovations across industries (Sorensen & Lansing, 2023; Dou et al., 2023).

In the 5IR, Kalu and Ibe (2025) pointed out that Artificial Intelligence (AI) has increasingly become a valuable tool in digital preservation initiatives. Recognizing the potential of AI in digital preservation prompts an exploration of its relevance in historic preservation. The significance of delving into the intersection of Artificial Intelligence (AI) and the digital preservation of historical records lies in its dual importance, which are safeguarding cultural heritage. Artificial Intelligence-driven data analysis enables organizations to uncover hidden historical trends, patterns, and correlations within their data archive, facilitating informed decision-making and strategic planning.

According to Masenya & Chisita (2022), libraries are changing because of the 5IR, which is making libraries more digital and improving the experience for users. Libraries are using AI, IoT, and other intelligent technologies to be more efficient and make users happier; these technologies allow libraries to offer better services, be more sustainable, and keep things secure, with researchers also looking into technology that can make libraries even better. The 5IR has influenced libraries all over the world, including in America, Asia, Australia, and Europe; libraries are using IoT and coming up with new ideas to change the traditional library experience (Tunmibi & Okuonghae, 2023; Jain & Behera, 2023). With IoT devices, library users can easily and safely access resources using their smartphones or other IoT devices; they don't need physical library cards or to do things manually, which makes things better for users. Some libraries in developed countries also have introduced mobile self-loan services, which lets users borrow resources on their own using their mobile devices; they don't have to wait in line, so it's faster. Libraries also use IoT to monitor their air quality inside, which makes sure the air is good for studying and working (Opoku et al., 2024).

Anyira, Kalu & Usiedo (2023) and Gardiner (209) opined that humans live in an era of great possibilities due to automation made feasible by embedded systems and wireless technologies. Automation describes a wide range of technologies that reduce human intervention in processes and the high point of automation is the invention of the Internet of Things (IoT). According to Gardiner (2019) one of the most recent changes in technology is the shift from the "Internet of Communication" to the „Internet of Things" or IoT. This exciting and emerging technology makes it possible to connect everyday objects, that are not themselves computers, by embedding sensors in them.

Valette, Bril El-Haouzi & Demesure (2023) noted that the 5th Industrial Revolution, characterized by the merging of digital, physical, and biological technology, is reshaping society, including education. This revolution is centered on the convergence of these technologies. Implementing the fifth industrial revolution in university libraries allows librarians to enhance their position as facilitators of knowledge creation and dissemination. Librarians can enhance students' engagement with educational materials and improve collaboration among peers by adopting new technologies and creative methods in library services. It is a frequent idea that as awareness grows, usage also increases. An individual who lacks familiarity with a system or resource is unable to utilize it due to their lack of prior understanding. Libraries and librarians in developing nations like Nigeria need to grasp the notion of the Fifth Industrial Revolution (5IR) to provide top-notch and valuable services. Librarians' views on the 5IR focus on how willing individual librarians in a university library are to adopt and communicate the knowledge they have acquired or created about the Fifth Industrial Revolution. A librarian's level of information and communication technology (ICT) skills will have an impact on their ability to provide services during the fifth industrial revolution. (Owolabi, et al. 2021; Ekwueme, Oluwaseun, Ajie, Ofodu & Ambrose, 2024).

According to Bi et al., (2022), libraries use intelligent technologies to send personalized messages to users. They tell users about new things that have arrived, when things are due, and events at the library. IoT and robots with AI help libraries organize books and find things quickly, which helps library staff work better. These technologies also suggest books that users might like based on what they liked before, which makes reading more enjoyable (Hodonu-Wusu, 2024). 5IR libraries understand they need to offer new things to meet the needs of today's world; the old way of lending books is changing, and people visit libraries for different reasons. By analyzing user data and reading habits, libraries will be able to suggest books that align with users' interests, fostering a love for reading and encouraging exploration of new topics (Ziatdinov, Atterava & Nabiyev, 2024). As the future of libraries in the 5IR is characterized by remarkable advancements to meet the evolving needs of users, the following are key aspects that illustrate the future of libraries in the 5IR; digital transformation, intelligent libraries, enhanced user experience, collaborative space, data analytics, community engagement, sustainable practices and global connectivity.

Methodology

Descriptive Research Design was used in carrying out this study. The population of the study comprised 202 librarians, which are members of Nigerian Library Association, Edo State chapter in NLA Edo State chapter WhatsApp group. The study adopted Simple Random Sampling Technique and Questionnaire was used as the only instrument for data collection, which was considered the most suitable instrument to reach out to a sizeable number of respondents. The instrument was designed on four-point likert rating scale. Out of 202 librarians in NLA Edo State Chapter WhatsApp group at the time of distribution of questionnaire, 124 members responded which represents 61.4% of the respond rate. Data collected was analyzed using frequency counts and mean score of 2.5. The mean value of 2.5. was referred as criterion mean. Therefore, any mean score of 2.5 and above was accepted and mean score below 2.5 were rejected.

Results

Table 1: What is the extent of the awareness of the 5th Industrial Revolution Technologies among libraries and librarians in Edo State?

S/N	Extent of awareness of 5IR	VHE	HE	LE	VLE	Mean	Decision
1.	I have heard of 5th Industrial Revolution	60 (240)	52 (156)	12 (24)	0 (0)	3.4	Accepted
2.	I am familiar with emerging technologies used in the 5 th Industrial Revolution.	64 (256)	44 (132)	12 (24)	4 (4)	3.4	Accepted
3.	I am aware of blockchain in library services	32 (128)	56 (168)	32 (64)	4 (4)	2.9	Accepted
4.	I am aware of Artificial Intelligence in library services	84 (336)	28 (84)	12 (24)	0 (0)	3.6	Accepted
5.	My library is aware of 5 th Industrial Revolution technologies	32 (128)	52 (156)	36 (72)	4 (4)	2.9	Accepted
6	I am aware of 3D printing in library services	68 (272)	36 (108)	12 (24)	8 (8)	3.3	Accepted
7	I am aware of Internet of Things (IoT)	68 (272)	40 (120)	16 (32)	0 (0)	3.4	Accepted
8.	I have heard of virtual reality tools in library services	60 (240)	36 (108)	28 (56)	0 (0)	3.3	Accepted
Average mean						**3.3**	

Table 1 shows that in items (1,2,7), the mean scores of 3.4 each of the respondents have heard of 5IR, they are also familiar with emerging technologies used in the 5IR and are aware of Internet of Things (IoT). In items (3 and 5), the mean score of 2.9 each of the respondents are aware of blockchain in library services and their libraries are aware of 5IR technologies. 3.6 mean score of the respondents are aware of Artificial Intelligence in library services, while in items (6 and 8), the mean scores of 3.3 each of the respondents are aware of 3D printing in library services and have also heard of virtual reality tools in library services. The findings also reveals that the overall extent of the awareness of the 5th Industrial Revolution Technologies among libraries and librarians in Edo State are accepted which has 3.3 average mean score, which is above 2.5 mean score benchmark.

Table 2: What is the perception of the libraries and Librarian on the 5th Industrial Revolution technology in Improving library services?

S/N	Challenges in adopting 5IR in libraries	SA	A	D	SD	Mean	Decision
1.	Inadeƙuate funding may hinder the adoption of 5IR	100 (400)	20 (60)	4 (8)	0 (0)	3.8	Accepted
2.	Librarians haɓe limited technical edpertise to use 5IR technologies	56 (224)	48 (144)	20 (40)	0 (0)	3.3	Accepted
3.	There is insufficient infrastructure for 5th Industrial Reɓolution technologies in libraries.	84 (336)	32 (96)	8 (16)	0 (0)	3.6	Accepted
4.	Many librarians seem to be resistant to change	32 (128)	48 (144)	44 (88)	0 (0)	2.9	Accepted
5.	Libraries and librarians may struggle to keep pace with the rapid eɓolution of 5IR technologies.	32 (128)	60 (180)	28 (56)	4 (4)	3.0	Accepted

6.	Difficulty in deƀeloping new eƀaluation methods to assess the effectiƀeness of 5IR technologies	28 (112)	80 (240)	16 (32)	0 (0)	3.1	Accepted
7.	Inadeƙuate possession of technology skills by librarians necessary to implement 5IR.	36 (144)	56 (168)	32 (64)	0 (0)	3.0	Accepted
8.	The high cost of implementing 5IR may hinder its implementation in libraries.	80 (320)	32 (96)	12 (24)	0 (0)	3.5	Accepted
Average mean						**3.3**	

On the challenges in adopting 5IR technologies in libraries in Edo State, table 3 shows that the mean score of 3.8 of the respondents stated that inadequate funding may hinder the adoption of 5IR, the mean score of 3.3 of the respondents stated that librarians have limited technical expertise to use 5IR technologies. 3.6 mean score of the respondents accepted that there is insufficient infrastructures for 5IR technologies in libraries. 2.9 mean score of the respondents accepted that many librarians seems to be resistant to change in technology, 3.0 mean score each of the respondents noted that libraries and librarians may struggle to keep pace with the rapid evolution of 5IR technologies and inadequate possession of technology skills by librarians necessary to implement 5IR can be a challenge. 3.1 mean score of the respondents accepted difficulty in developing new evaluation methods to assess the effectiveness of 5IR technologies may pose a challenge, while 3.5 mean score of the respondents noted that the cost of implementing 5IR may hinder its implementation in libraries. The findings revealed that the overall challenges to adopting 5th Industrial Revolution technologies in libraries in Edo State are accepted with 3.3 average mean score which is above 2.5 mean score benchmark and funding is noted as the main challenge.

Discussion of Findings

The findings of this study shows that libraries and librarians in Edo State are aware of the 5th Industrial Revolution technologies as a result of them being aware of Artificial Intelligence in library services. This is mostly indicated by librarians in Edo State. This finding collaborated with the study carried out by Ekwueme, Ofodu, Oluwaseun, Ajie & Ambrose (2024), in which they found out that there is a high awareness of 5IR technologies among librarians, with robotics. The findings also indicate that libraries and librarians in Edo State thought that the adoption of 5IR technologies will be relevant to them as being seen in the responses of majority of the respondents. This simply means that if 5IR if adopted in libraries in Edo State will be of immense benefit to libraries and librarians as well and also improves library services. Similar finding was noted by Ekwueme, Ofodu, Oluwaseun, Ajie & Ambrose (2024), as they asserted that Librarians generally view 5IR technologies positively, believing they can enhance diversity and inclusiveness in library services, particularly by providing individualized learning materials.

The findings further show that inadequate funding may hinder the adoption of 5th Industrial Revolution in libraries in Edo State. This, therefore implies that libraries in Edo State need funds in order to fully implement and adopt of 5IR technologies for effective library services. This was collaborated by Berman et al., (2021) assertion that there is a significant financial hurdle to surmount. The implementation and maintenance of intelligent library systems entail substantial costs, from the acquisition of cutting-edge technology to the ongoing training and support of staff members. Given that libraries frequently operate within tight budget constraints, prudent financial planning and the judicious allocation of resources are imperative to navigate these fiscal challenges.

Conclusion

The study examined libraries and librarians' preparedness for the fifth (5th) industrial revolution (5IR), using librarians in Edo State as a case study. It revealed that libraries and librarians in Edo State are aware of the 5th Industrial Revolution technologies as a result of them being aware of Artificial Intelligence in library services. Libraries and librarians in Edo State also perceived that the adoption of 5IR technologies will be relevant to them as being seen in the responses of majority of the respondents. The 5IR will be of immense benefit to libraries and librarians as well if adopted and will also improves library services. Inadequate funding may hinder the adoption of 5th Industrial Revolution in libraries in Edo State, which implies that libraries in Edo State need funds in order to fully implement and adopt of 5IR technologies for effective library services.

Recommendations

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

1. Libraries and librarians should not only be aware of 5IR, they should be prepared to make effective use of them in order to improve library services.
2. Librarians should endeavour to acquire technological skills that help them to make use of 5IR technologies.
3. Adequate funds should be allocated to the libraries for the adoption and implementation of 5IR and acquisition of its technologies.

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Library Spaces and the Fifth Industrial Revolution: Redefining Physical and Digital Environments for Future-Ready Services

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Abstract

This research investigates Library Spaces and the Fifth Industrial Revolution: Redefining Physical and Digital Environments for Future-Ready Services. Employing a survey research design, the study targeted librarians working in various library types across Nigeria. A sample of 120 librarians (10 from each of the 4 library type – e-library, national, academic, and public) was selected, stratified across three states: Delta, Enugu, and Imo, to ensure representation from diverse regions and library settings. A structured questionnaire served as the primary data collection instrument. The instrument underwent face and content validity assessment by experts in library and information science. A Cronbach's alpha reliability test yielded a coefficient of 0.85, indicating strong internal consistency. Data were analyzed using mean scores. The findings revealed that the 5th Industrial Revolution is significantly altering library spaces. Physical libraries are transitioning from solely book repositories to dynamic learning hubs, incorporating collaborative spaces, maker labs, digital studios, and technology-rich environments. Digital platforms are becoming integral to library services, offering access to e-resources, virtual collections, online learning platforms, and virtual reference services. Essential design considerations identified include flexible and adaptable spaces, seamless integration of technology, user-centered design principles, and accessibility for all. The study concluded that the 5th Industrial Revolution necessitates a holistic rethinking of library spaces, requiring librarians and architects to collaborate in creating integrated physical and digital environments that cater to the evolving information needs of users. The study recommends that libraries in Nigeria invest in infrastructure upgrades, technology integration, and staff training to create future-ready library spaces. Furthermore, it emphasizes the importance of incorporating user feedback in the design and development of library spaces.

Keywords: *5th Industrial Revolution, library spaces, physical library, digital library, user experience, librarians.*

I. Introduction

The concept of library spaces is undergoing a profound transformation, driven by the advancements of the 5th Industrial Revolution (5IR). This revolution, characterized by the convergence of human intelligence and cutting-edge technologies like artificial intelligence (AI), the Internet of Things (IoT), and augmented reality (AR), is not only reshaping industries but also redefining how people interact with information and physical environments. According to Adewojo, Dunmade and Akanbiemu (2023), libraries, traditionally seen as repositories of books, are now evolving into dynamic hubs that integrate physical and digital resources, services, and experiences. This evolution necessitates a rethinking of library spaces to accommodate new technologies and meet the changing needs of users

The 5IR is significantly influencing the design and functionality of both physical and digital library spaces. Physical libraries are increasingly incorporating technologies like smart sensors, interactive displays, and flexible furniture to create adaptable and engaging environments. These spaces are designed to foster collaboration, creativity, and community engagement, offering users a variety of settings for individual and group activities (Azizi, Nair, Rabiee & Olofsson, 2020). Simultaneously, digital platforms are becoming integral to library services, providing users with seamless access to a vast array of online resources, virtual reference assistance, and personalized learning experiences. The integration of these physical and digital realms is crucial for creating a holistic library experience that caters to the diverse needs of modern library users.

This transformation presents both opportunities and challenges for libraries. The integration of 5IR technologies has the potential to enhance library services, improve user engagement, and expand access to information (Agim, Abah & Ezejiofor, 2025). However, it also requires libraries to address issues such as digital equity, technological infrastructure, and the need for staff training and development. There is a growing recognition that libraries must adapt to these changes to remain relevant and continue to serve their communities effectively.

II. Statement of the Problem

Despite the transformative potential of the 5IR, many libraries are struggling to adapt their spaces to fully embrace the opportunities it presents. A significant gap exists in the understanding of how to effectively integrate the key technological trends of the 5IR into the design and functionality of library spaces. While some libraries have begun to incorporate new technologies, there is often a lack of a cohesive strategy for creating integrated physical and digital environments. This deficiency is compounded by limited research that holistically examines the evolving role of digital platforms and technologies in enhancing library services within this new paradigm. Previous studies have explored various aspects of library transformation, but there is a need for more focused research that specifically addresses the challenges and opportunities presented by the 5IR.

In particular, there is a need to examine the key technological trends of the 5th Industrial Revolution impacting library spaces, how these trends are influencing the design and functionality of physical library spaces, the evolving role of digital platforms and technologies in enhancing library services, and the essential design considerations for creating integrated physical and digital library environments

Research Questions

- What are the key technological trends of the 5th Industrial Revolution impacting library spaces?
- How are these trends influencing the design and functionality of physical library spaces?
- What is the evolving role of digital platforms and technologies in enhancing library services?
- What are the essential design considerations for creating integrated physical and digital library environments?

III. Literature Review

Conceptualizing the 5th Industrial Revolution (5IR) and Its Relevance to Libraries

The 5th Industrial Revolution (5IR) represents a significant evolution in societal and technological development, moving beyond the automation and efficiency focus of the 4th Industrial Revolution to emphasize the collaboration between humans and machines, along with a focus on sustainability and personalization (Bagavathi, 2023). This new era is characterized by several converging technologies, including artificial intelligence (AI), the Internet of Things (IoT), big data, robotics, augmented and virtual reality (AR/VR), and 5G, which are transforming industries, economies, and social structures.

At the heart of the 5IR is the enhanced interaction and interdependence between humans and advanced technological systems. This collaboration aims to leverage the strengths of both, with machines handling repetitive or data-intensive tasks, and humans providing creativity, critical thinking, and ethical judgment. According to Bi, Wang, Zhang, Huang, Wu, Gong, and Ni (2022), the 5IR also places a strong emphasis on creating sustainable and human-centric systems, where technology is used to improve quality of life, promote environmental responsibility, and foster social equity. This involves a shift towards more personalized products, services, and experiences, tailored to individual needs and preferences.

The relevance of the 5IR to libraries is profound, as these institutions have historically served as crucial hubs for information access, knowledge dissemination, and community engagement. In the 5IR, libraries are presented with both opportunities and challenges. Cao, Liang, and Li. (2018) stated that the technologies of the 5IR can be harnessed to enhance library services, improve user experiences, and expand access to information resources. For example, AI can power personalized information retrieval systems, automate routine tasks, and provide virtual assistance to users; IoT can create smart library spaces that adapt to user needs; and AR/VR can offer immersive learning experiences and new ways to engage with information. However, libraries must also address the challenges of the 5IR, such as the digital divide, the need for digital literacy, and the ethical implications of using advanced technologies (Enakrire & Oladokun, 2023; Uzoegbu, Friday & Hephyang, 2025). By adapting to the changing landscape of the 5IR, libraries can continue to play a vital role in promoting knowledge, fostering innovation, and supporting community development in the 21st century.

Evolution of Library Spaces: From Traditional to Smart and Digital Environments.

The evolution of library spaces has been a dynamic process, reflecting societal shifts, technological advancements, and changing user needs. Traditionally, libraries were designed primarily as repositories for books and other print materials, characterized by quiet study areas and stacks of shelves (Gaitanou, Andreou, Sicilia & Garoufallou, 2024). However, the advent of digital technologies has revolutionized library functions and designs. The integration of online public access catalogs (OPACs), electronic resources, and the internet transformed libraries into hybrid spaces, blending traditional print collections with digital resources. This transformation marked a significant shift towards greater accessibility and convenience, enabling users to access information remotely and expanding the scope of library services beyond physical boundaries.

The concept of smart libraries has emerged, leveraging technologies like artificial intelligence (AI), the Internet of Things (IoT), and data analytics to create more interactive, personalized, and efficient library environments. Smart libraries are characterized by features such as automated systems, enhanced digital infrastructure, and user-centric designs that facilitate seamless access to information and services. These spaces are equipped with advanced technologies to support diverse user activities, including collaborative projects, digital literacy training, and access to multimedia resources (Greene & Groenendyk, 2021). The

evolution towards smart libraries reflects a broader trend of creating intelligent spaces that adapt to user needs and enhance the overall library experience.

In line with the foregoing review done, Abbasi et al. (2024) conducted a mixed-methods study titled Transforming Academic Library Spaces: An Evaluation Study of Deakin University Library at the Melbourne Burwood Campus Using TEALS. The research aimed to evaluate refurbished library spaces to align with student needs. Using the TEALS (Tool for the Evaluation of Academic Library Spaces) framework, the study combined observational analysis, focus groups with students and staff, and an online survey. Data analysis revealed strengths in user-centered design and weaknesses in underutilized zones. The study concluded that iterative spatial evaluations are critical for creating adaptive learning environments and recommended prioritizing flexible, technology-integrated spaces in future redevelopments. Also, in another study, Gaitanou, et al (2024) explored interdisciplinary approaches in Integrating Social Sciences, Management, and Engineering to Develop Smart Libraries for Enhanced Learning Experiences. Using mixed methods (user surveys, case studies, and data analytics), the study analyzed how smart libraries integrate AI, IoT, and big data. Findings emphasized the role of user-centered design and interdisciplinary collaboration in transforming libraries into tech-driven hubs. The study recommended holistic frameworks for sustainable smart library development

Technological Trends of the 5th Industrial Revolution Impacting Libraries

The 5th Industrial Revolution (5IR) is characterized by a convergence of several cutting-edge technologies that are rapidly transforming various sectors, and libraries are no exception. Artificial intelligence (AI) is at the forefront, enabling libraries to automate tasks, personalize services, and enhance information retrieval (Gupta & Gupta, 2023). Machine learning, a subset of AI, allows library systems to learn from user interactions, improving the accuracy of recommendations and search results. The Internet of Things (IoT) is also playing a significant role, connecting physical library resources and spaces to the digital world (Bagavathi, 2023). This interconnectivity enables features like smart shelves that track inventory in real-time and personalized environmental controls that enhance user comfort.

These 5IR technologies are not only streamlining library operations but also enhancing user access and experience. Virtual and augmented reality (VR/AR) are creating immersive learning environments, allowing users to explore digital collections and historical artifacts in new and engaging ways (Bi, et al, 2022). Blockchain technology is being explored for its potential to secure digital content and manage intellectual property rights, addressing key challenges in the digital library landscape. The integration of these technologies is leading to the development of "smart libraries" that are more responsive, adaptive, and user-centered. As libraries embrace these 5IR innovations, they are evolving from traditional repositories of information to dynamic hubs for knowledge creation, collaboration, and community engagement (Adewojo, 2023).

Backing up the forgoing is with an empirical study by Adeleke et al. (2024) who investigated Awareness, Perception, and Skills of Librarians for the 5IR Integration in University Libraries. The study surveyed 60 librarians at Nigeria's National Open University (NOUN), with 44 respondents. Using SPSS for regression analysis, it found high awareness of robotics (82%) but low competency in AI and IoT. Professional rank and qualifications significantly influenced technological readiness ($p<0.05p < 0.05p<0.05$). The study concluded that targeted training programs are essential for librarians to leverage 5IR technologies effectively. Also, Abbasi et al. (2024) identified IoT, AI chatbots, and AR/VR as key trends in their evaluation of Deakin University's smart library. These technologies enhanced resource accessibility and personalized user experiences, aligning with 5IR's human-machine collaboration ethos

Impact of Emerging Technologies on Physical Library Spaces

Emerging technologies are profoundly reshaping physical library spaces, moving them beyond their traditional role as book repositories. The integration of these technologies is fostering the creation of dynamic and interactive environments that cater to the evolving needs of library users (Hodonu-Wusu, 2024). For instance, the Internet of Things (IoT) is enabling the development of smart library spaces with features like automated lighting and climate control, enhancing user comfort and energy efficiency. Virtual and Augmented Reality (VR/AR) technologies are also being incorporated into library spaces, offering immersive experiences that allow users to explore digital collections and engage with information in new and innovative ways (Enakrire & Oladokun, 2023).

These technological advancements are not only transforming the physical appearance of libraries but also their functionality. Libraries are increasingly becoming collaborative hubs, equipped with flexible furniture and technology-enabled spaces that support group projects and knowledge creation (Anaehobi & Agim, 2019). The integration of technologies like 3D printing and makerspaces is empowering users to create and innovate within the library environment. Furthermore, AI-powered systems are being utilized to personalize user experiences, providing tailored recommendations and intuitive navigation within the library space (Jinendran Jain & Kumar Behera, 2023). As a result, emerging technologies are helping to create library spaces that are more adaptive, user-centered, and conducive to learning, research, and community engagement.

In support of the foregoing, Abbasi et al. (2024) demonstrated that IoT sensors and AI-driven analytics optimized space utilization at Deakin University Library, reducing overcrowding and improving accessibility. However, challenges like noise control and privacy concerns persisted. The study has also highlighted how

RFID systems and cloud-based platforms in smart libraries reduced physical storage needs, enabling repurposing of spaces for collaborative work and VR labs

Implications of emerging technologies for future ready services and 5IR

Emerging technologies are profoundly reshaping library spaces, making them more adaptive, user-centered, and conducive to the multifaceted demands of learning, research, and community engagement in the Fifth Industrial Revolution (5IR). Technologies such as artificial intelligence (AI), the Internet of Things (IoT), robotics, and 5G networks enable libraries to transcend their traditional roles as static repositories of knowledge and evolve into dynamic, intelligent environments. These technologies facilitate seamless access to resources through IoT-enabled devices, mobile self-loan services, and AI-driven personalized recommendations, enhancing user convenience and engagement (Tella & Ajani, 2023; Enakrire et al., 2024). Moreover, the integration of sensors and networked technologies transforms physical library spaces into "living-learning labs" that dynamically respond to user behaviors, fostering interactive and collaborative learning experiences while maintaining privacy and security (Lippincott et al., 2021). Such innovations not only improve operational efficiency but also promote sustainability and inclusivity, positioning libraries as vital hubs in the 5IR knowledge ecosystem.

The implications of these emerging technologies for future-ready library services are extensive and transformative. When embedding AI, big data analytics, virtual and augmented reality, and blockchain into their services, libraries can offer personalized, efficient, and secure information access that aligns with the human-centric ethos of the 5IR (Jain & Behera, 2023). This technological convergence supports lifelong learning, academic integrity, and community engagement, enabling libraries to serve diverse user needs in increasingly digital and hybrid environments. Furthermore, these innovations require libraries to rethink staff roles, infrastructure, and policies, emphasizing upskilling, ethical governance, and privacy-aware implementation to sustain trust and relevance (Tella & Ajani, 2023). Ultimately, the strategic adoption of 5IR technologies empowers libraries to redefine their physical and digital environments, ensuring they remain indispensable, future-ready institutions that foster knowledge creation, dissemination, and community resilience in an era of rapid technological change.

In line with the above review done, a study by Adeleke et al. (2024) revealed that 5IR technologies like AI chatbots and blockchain could streamline library services but require librarians to upskill in data ethics and digital literacy. The study recommended policy reforms to support continuous professional development. Also, another study by Abbasi et al. (2024) emphasized that smart libraries must balance automation with human-centric services, advocating for ethical AI use and inclusive design to maintain relevance in the 5IR.

IV. Methodology

The study used the survey research design. The target population are librarians working in various library types across Nigeria. The population was over 10,000 librarians in Nigeria (NLA Bulletin, 2024). Using a purposive sampling techniques, a sample of 120 librarians were selected (10 from each of the 4 library type – e-library, national, academic, and public) across three states: Delta, Enugu, and Imo, to ensure representation from diverse regions and library settings. A structured questionnaire served as the primary data collection instrument. The instrument underwent face and content validity assessment by experts in library and information science. A Cronbach's alpha reliability test yielded a coefficient of 0.81, indicating strong internal consistency. Data were analyzed using mean scores

V. Results and Discussion

Research Question 1: What are the key technological trends of the 5th Industrial Revolution impacting library spaces?

Table 1: Mean and Standard Deviation of Responses on the Key Technological Trends of the 5th Industrial Revolution Impacting Library Spaces

S/N	Item	Mean	SD	Decision
1	Integration of Artificial Intelligence (AI) tools into library services	3.25	0.68	Strongly Agree
2	Adoption of Virtual Reality (VR) and Augmented Reality (AR) for immersive learning experiences	3.18	0.71	Strongly Agree
3	Use of blockchain technology for securing digital records and transactions	2.78	0.73	Agree
4	Expansion of Internet of Things (IoT) applications for smart library environments	3.09	0.65	Strongly Agree
5	Increased use of Big Data analytics to personalize library services	2.84	0.70	Agree

6	Deployment of robotics for customer service and operational tasks	2.92	0.74	Agree
7	Integration of cloud computing services to enhance digital resource management	3.31	0.66	Strongly Agree
	Grand Mean	**3.05**		**Strongly Agree**

From the analysis presented in Table 1, it is evident that librarians in academic libraries agreed on several key technological trends impacting library spaces. The items that were agreed upon included the use of blockchain technology for securing digital records and transactions (Mean = 2.78), the increased use of Big Data analytics to personalize library services (Mean = 2.84), and the deployment of robotics for customer service and operational tasks (Mean = 2.92). Following these were the strongly agreed items: integration of Artificial Intelligence (AI) tools into library services (Mean = 3.25), adoption of Virtual Reality (VR) and Augmented Reality (AR) for immersive learning experiences (Mean = 3.18), expansion of Internet of Things (IoT) applications for smart library environments (Mean = 3.09), and integration of cloud computing services to enhance digital resource management (Mean = 3.31). This shows that while librarians moderately agreed with the importance of robotics, Big Data, and blockchain, they expressed stronger agreement with AI, VR/AR, IoT, and cloud computing as the dominant technological drivers of change in library spaces. Overall, the grand mean score of 3.05 reflects a positive and moderately high perception of the impact of 5th Industrial Revolution technologies on reshaping library spaces. The result suggests that librarians in academic libraries are not only aware of but are also increasingly embracing emerging technologies, with a stronger inclination toward technologies that enhance service delivery, user engagement, and operational efficiency. Supporting these findings, Hodonu-Wusu (2024) emphasized that academic libraries are increasingly investing in Artificial Intelligence and Big Data analytics to provide smarter, user-centered services, confirming the strong agreement found in this study. The use of Virtual Reality (VR) and Internet of Things (IoT) is rapidly transforming library spaces into dynamic, interactive environments, aligning with librarians' perceptions of VR/AR and IoT importance. Furthermore, Gupta and Gupta (2023) reported that cloud computing integration has become a key strategic focus for libraries seeking scalable and flexible resource management, corroborating the high mean score associated with cloud technologies in this study. Collectively, these studies demonstrate the active and growing influence of 5th Industrial Revolution technologies on the structure and services of modern academic libraries.

Research Question 2: How are these trends influencing the design and functionality of physical library spaces?

Table 2: Mean and Standard Deviation of Responses on How Trends Are Influencing the Design and Functionality of Physical Library Spaces

S/N	Item	Mean	SD	Decision
1	Redesign of library spaces to accommodate smart technologies (IoT sensors, automation systems)	2.86	0.72	Agree
2	Creation of flexible and collaborative workspaces for digital scholarship	2.93	0.69	Agree
3	Integration of immersive learning zones (VR/AR facilities) in physical library layouts	2.74	0.75	Agree
4	Development of technology-rich makerspaces and innovation hubs	2.88	0.70	Agree
5	Increase in environmentally sustainable library designs powered by smart energy systems	2.79	0.73	Agree
6	Enhanced security and surveillance systems powered by AI and IoT	3.15	0.68	Strongly Agree
7	Adoption of modular and reconfigurable furniture to support digital learning activities	3.07	0.67	Strongly Agree
	Grand Mean	**2.92**		**Agree**

From Table 2, it can be observed that librarians in academic libraries mostly agreed that emerging technological trends are influencing the design and functionality of physical library spaces. The items agreed upon included the redesign of library spaces to accommodate smart technologies (Mean = 2.86), the creation of flexible and collaborative workspaces for digital scholarship (Mean = 2.93), the integration of immersive learning zones using VR/AR (Mean = 2.74), the development of technology-rich makerspaces and innovation hubs (Mean = 2.88), and the rise of environmentally sustainable library designs powered by smart energy systems (Mean = 2.79). In addition to these, two items were strongly agreed upon by the librarians: enhanced

security and surveillance systems powered by AI and IoT (Mean = 3.15) and the adoption of modular and reconfigurable furniture to support digital learning activities (Mean = 3.07). Overall, the grand mean of 2.92 suggests a moderately high and positive perception of how emerging technological trends of the 5th Industrial Revolution are reshaping the physical structure and functionality of academic library spaces. The result indicates that academic librarians are acknowledging significant shifts toward smarter, more flexible, environmentally conscious, and digitally supportive environments. Supporting the results of this table, Jha (2023) emphasized that the evolution of makerspaces and innovation hubs within academic libraries is becoming a dominant design shift, as libraries adapt to user needs for collaboration and creativity. Similarly, sustainable and smart designs are increasingly becoming a priority in library architecture, with trends like energy-efficient smart systems and modular furniture being crucial for 21st-century libraries. Furthermore, Agim, et al (2025) demonstrated that integrating AI-driven chatbots, security systems and creating flexible learning environments has become a core strategy for libraries seeking to remain functional and safe in a technology-driven age. Together, these studies reinforce the view that technological trends are fundamentally altering the layout, operation, and ethos of modern library spaces.

Research Question 3: What is the evolving role of digital platforms and technologies in enhancing library services?

Table 3: Mean and Standard Deviation of Responses on the Evolving Role of Digital Platforms and Technologies in Enhancing Library Services

S/N	Item	Mean	SD	Decision
1	Digital platforms have enhanced remote access to library collections and databases	3.21	0.61	Strongly Agree
2	AI-powered discovery tools improve precision in information retrieval	3.10	0.66	Strongly Agree
3	Cloud-based library systems streamline cataloguing and circulation services	3.32	0.59	Strongly Agree
4	Social media is increasingly used to promote library programs and services	2.93	0.74	Agree
5	Digital repositories and institutional archives support open access and scholarly visibility	3.07	0.62	Strongly Agree
6	Library mobile apps have improved user engagement and service personalization	3.19	0.60	Strongly Agree
7	Virtual reference services (chatbots, email, live chat) are improving user assistance	3.15	0.65	Strongly Agree
	Grand Mean	**3.14**		**Strongly Agree**

From Table 3, it is evident that librarians in academic libraries overwhelmingly recognize the evolving role of digital platforms and technologies in enhancing library services. Only one item received an "Agree" rating: the use of social media for promoting library services (Mean = 2.93), which suggests moderate agreement about its growing importance. On the other hand, the remaining six items were rated as "Strongly Agree." These include improved remote access to library collections (Mean = 3.21), enhanced discovery via AI tools (Mean = 3.10), cloud-based cataloguing systems (Mean = 3.32), institutional repositories for open access (Mean = 3.07), mobile applications improving personalization (Mean = 3.19), and virtual reference services (Mean = 3.15). The grand mean score of 3.14 reflects a high level of agreement among librarians that digital platforms and emerging technologies are playing a pivotal role in the evolution and enhancement of library services. These findings indicate a strong consensus among librarians on the transformative impact of digital tools across different aspects of library operations and user engagement. This result above is in line with previous studies. According to Bagavathi (2023), digital repositories and cloud technologies have significantly increased the discoverability and preservation of scholarly output, particularly in academic libraries transitioning toward open access. Also, mobile apps and virtual reference services positively influence user satisfaction by providing round-the-clock, flexible service delivery models. Additionally, Agim, et al (2025) emphasized that AI-driven discovery systems and chatbots are revolutionizing user interactions by offering real-time support and improved precision in search results. Collectively, these studies validate the perception that digital platforms and technologies are becoming integral components of modern library ecosystems.

Research Question 4: What are the essential design considerations for creating integrated physical and digital library environments?

Table 4: Mean and Standard Deviation of Responses on the Essential Design Considerations for Creating Integrated Physical and Digital Library Environments

S/N	Item	Mean	SD	Decision
1	Flexible spaces that support both individual and collaborative work	2.91	0.68	Agree
2	Integration of high-speed Wi-Fi and technology hubs throughout the library	2.87	0.72	Agree
3	Creating seamless digital access points (e.g., interactive kiosks, smart shelves)	2.95	0.65	Agree
4	Sustainability features in both physical and digital infrastructure	2.83	0.70	Agree
5	Designing multipurpose learning commons to bridge physical and virtual engagement	3.12	0.63	Strongly Agree
6	Incorporation of augmented reality (AR) and virtual reality (VR) experiences	3.05	0.60	Strongly Agree
7	Prioritizing user-centered and adaptive design principles	3.18	0.58	Strongly Agree
	Grand Mean	**2.99**		**Agree**

From Table 4, it is observed that librarians in academic libraries agreed on several essential design considerations for creating integrated physical and digital environments. Items such as providing flexible spaces for individual and group work (Mean = 2.91), integrating high-speed Wi-Fi and tech hubs (Mean = 2.87), creating seamless digital access points (Mean = 2.95), and emphasizing sustainability in both physical and digital infrastructures (Mean = 2.83) received an "Agree" decision. Meanwhile, stronger consensus was noted on designing multipurpose learning commons (Mean = 3.12), incorporating AR and VR experiences (Mean = 3.05), and prioritizing user-centered adaptive design principles (Mean = 3.18), all categorized as "Strongly Agree." The grand mean of 2.99 suggests a generally strong acknowledgment among librarians that integrating flexible, technologically rich, sustainable, and user-centered elements is crucial when designing future-ready library environments. There is a balanced emphasis on both infrastructural flexibility and digital innovation to ensure that libraries meet the evolving expectations of users in a hybrid service landscape. Several empirical studies support these findings. For instance, Jinendran and Kumar (2023) highlighted that user-centered design and flexible learning spaces are fundamental to encouraging engagement in academic libraries, stressing that flexible and technology-driven environments drive usage and satisfaction. The importance of incorporating emerging technologies like AR and VR into library designs is to bridge digital and physical user experiences and create immersive learning opportunities. In line with this, Skøtt (2023) found that the redesign of library spaces to include sustainable technologies, seamless Wi-Fi access, and multipurpose digital learning commons significantly improved user experience and service delivery. These studies collectively affirm that the integration of adaptability, technology, and sustainability are critical in modern library design.

VI. Conclusion

The findings of this study affirm that the 5th Industrial Revolution is significantly influencing the direction and transformation of academic library environments. Librarians are not only receptive to these changes but are also progressively adopting and integrating emerging technologies that redefine how library spaces function and how services are delivered. The perception across academic libraries indicates a growing appreciation for smart infrastructure, environmental sustainability, and user-driven service models, which are increasingly becoming core to future library planning and design. As academic libraries transition into hybrid service landscapes, a paradigm shift is essential—one that aligns digital innovation with physical restructuring. It is evident that the future of libraries rests on their ability to embrace adaptive designs, invest in intelligent technologies, and co-create spaces that resonate with evolving user expectations. By addressing these insights through strategic investments, training, design innovation, and stakeholder collaboration, libraries can position themselves as dynamic hubs of knowledge, innovation, and lifelong learning in the era of the 5th Industrial Revolution

VII. Recommendations

The study recommended the following:

1. **Organize regular training and capacity-building workshops** for librarians on 5IR technologies such as artificial intelligence, robotics, and Internet of Things (IoT) to improve implementation and professional confidence in using these tools.
2. **Develop institutional technology roadmaps** that strategically integrate emerging technologies into library workflows, emphasizing user-centric applications that boost engagement, efficiency, and service delivery.
3. **Redesign library physical layouts** to accommodate modular and smart infrastructure such as sensor-driven lighting, IoT-enabled shelves, and flexible learning zones that support hybrid activities.

4. **Incorporate sustainability standards** into library renovation or construction projects by using green materials, energy-efficient systems, and multipurpose furniture to align with future-ready, environmentally conscious designs.
5. **Invest in cloud-based digital library platforms** and user-friendly mobile applications that support access to e-resources, personalized services, and real-time virtual assistance.
6. **Encourage the integration of AI-powered tools** such as virtual reference bots, smart cataloging systems, and analytics dashboards to automate services and gain insights into user behavior and needs.
7. **Establish collaborative planning committees** involving librarians, architects, IT specialists, and users to co-design flexible library spaces that prioritize inclusivity, adaptability, and technology fusion.
8. **Adopt universal design principles** in both digital and physical environments to cater for diverse user needs, ensuring accessibility, interactivity, and comfort across various user demographics.

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Marketing Digital Literacy Services in Nigeria Academic Libraries: Strategies, Challenges and Opportunities for the 5th Industrial Revolution

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Abstract

This paper is titled "Marketing Digital Literacy Services in the Academic Library System of Nigeria: Possible Strategies, Challenges faced, and Opportunities in the 5th Industrial Revolution". The 5th Industrial Revolution (5IR) is transforming the global landscape, driven by emerging technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT). As Nigeria strives to participate in this revolution, digital literacy has become an essential skill for its citizens. Academic libraries in Nigeria play a vital role in promoting digital literacy, but marketing these services effectively in the 5-IR era poses significant challenges. This study explores the strategies, challenges, and opportunities faced by Academic libraries in Nigeria in marketing digital literacy services in the context of the 5-IR. The study highlights the impact of 5IR technologies on marketing digital literacy services, including the use of AI-powered chatbots, virtual and augmented reality, and data analytics. Despite the challenges, the study identifies opportunities for Academic libraries in Nigeria to leverage 5-IR technologies to improve the marketing of digital literacy services, enhance community engagement, and promote digital inclusion. The recommendations have implications for library practice, policy, and research, emphasizing the need for Academic libraries to develop innovative marketing strategies, leverage 5-IR technologies, and foster partnerships to promote digital literacy services and support Nigeria's participation in the 5-IR.

Keywords: digital literacy, academic libraries, marketing, 5th Industrial Revolution, digital inclusion.

INTRODUCTION

Digital Literacy can best be seen as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills. Microsoft,(2020) defined digital literacy as the ability to navigate our digital world using reading, writing, technical skills, and critical thinking. it uses technologies – like smart phones, PCs, e-readers, and more – to find, evaluate, and communicate information.

Digital literacy skills also encompass digital responsibility, which involves ethical consumption and communication of information online. As technology dependence increases, students face various challenges, such as plagiarism, cyber bullying, verifying sources of information, and behaving responsibly while interacting with others. Digital literacy equips students with the necessary skills to navigate through these challenges effectively, enabling them to become responsible digital citizens.

Today, social interactions are happening online, and it is growing day by day. Earlier, friendships and familial connections relied on slow and traditional ways of communication like letters, but technological evolution has eliminated these traditional means providing a vast socializing world. On the positive side, social media facilitates the ability to connect with individuals beyond one's immediate geographical boundaries. However, it exposes people, particularly youngsters, to precarious social situations. With digital literacy, students can learn to be safe online and engage with others safely, safeguarding their personal information and keeping themselves and others safe from online threats, crime, and scams.

According to Andrew (2024), digital literacy is crucial for enhancing employability in today's job market. Many industries require digital skills ranging from basic computer proficiency to advanced data analysis and programming. Job seekers with digital literacy can leverage online job platforms, create professional profiles, and demonstrate their skills through digital portfolios and certifications. In sectors such as information technology, digital marketing, and e-commerce, individuals with strong digital literacy can pursue diverse career opportunities. They can work remotely, collaborate on global projects, and adapt to technological advancements, contributing to economic growth and innovations.

Overview of the 5th industrial revolution

THE DAWN OF THE FIFTH INDUSTRIAL REVOLUTION



Fifth Industrial Revolution has emerged, referred to as Industry 5.0, which represents a paradigm shift towards the integration of advanced technologies and the latest innovations in manufacturing processes and systems with a new hallmark in mind characterized by three main features: human-centricity, sustainability, and resilience. In the current scientific literature, there is still a lack of efforts to systematically review the state-of-the-art of Digital Transformation towards Industry 5.0. This systematic literature review aims to address this research gap by investigating the academic progress at the crossroads of Digital Transformation and Industry 5.0. The systematic review covered the analysis of journal articles and conference papers within the Industry 5.0 domain that were published during the last five years until March 2023. An overview of Digital Transformation and Industry 5.0 research fields is firstly captured by enumerating a list of prominent journals and international conferences for publishing on Industry 5.0-related content, and secondly, by illustrating the significance of Digital Transformation and Industry 5.0 based on keywords classification.

According to many, we are at the brink of the fourth industrial revolution. The theme of Industry 4.0 is "Smart Manufacturing for the Future". Now, some futurists even discuss what the fifth industrial revolution's theme will be. There are a few visions for Industry 5.0. One emerging theme is human-robot co-working. In recent years, we have seen significant advancements in robotics and artificial intelligence (AI) research. Today, there are robots for various purposes at affordable prices in the market. It is not long before we closely interact with robots in our lives and workplaces. Testing autonomous cars in traffic is a promising example of this upcoming trend. There are companies having an employee record for robots or AI applications. While there are many studies on human-robot collaboration for low-level tasks with a focus on robot development, we lack studies focusing on organizational issues emerging from human-robot co-working. In this study, we discuss the possible issues related to human-robot co-working from the organizational and human employee's perspective. We believe the issues identified in this study will be the focus of many upcoming organizational robotics research studies.

The emergence of Fifth Industrial Revolution (5IR) alleviates the Fourth Industrial Revolution's (4IR) techno centric driven behavior by promoting collaboration. The 5IR is based on the observation that 4IR focused less on the original principles of social fairness and sustainability and more on digitalisation and artificial intelligence-driven technologies to increase production efficiency and flexibility.

Industrial revolutions are times of rapid change achieved through innovation. The First Industrial Revolution began in the mid-1700s, with the arrival of steam engines and their radical influence on manufacturing by enabling machine production and factories The Second Industrial Revolution harnessed the power of electricity in the late 1800s, leading to mass production and rapid transport of people, products, and ideas. In the mid-1900s, the Third Industrial Revolution (3IR) initiated the digital era; mainframe and personal computers and the Internet connected consumers globally and supported immense storage and dissemination of information.

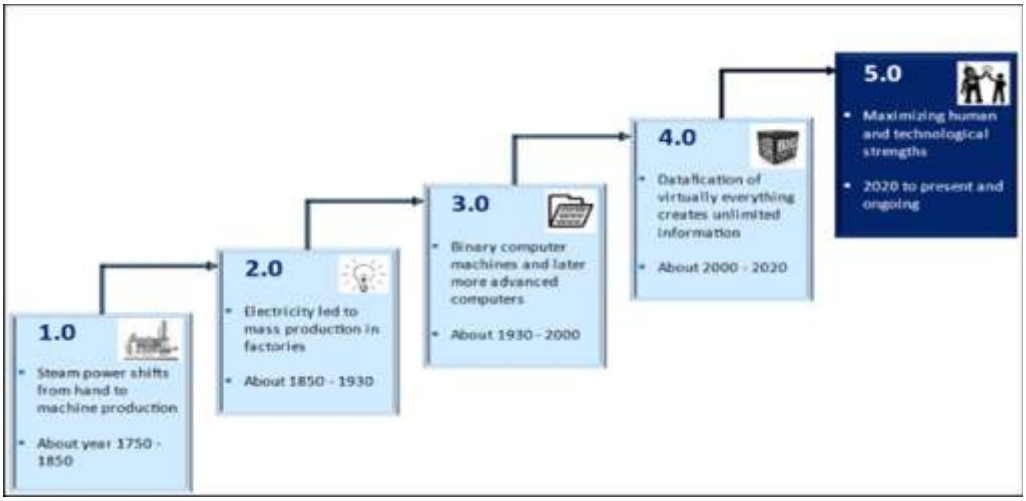


Fig.2. Progression of Industrial Revolutions.

The 4IR, starting with the twenty-first century, features ubiquitous connectivity of machines, devices, and people, yielding essentially unlimited information that moves very quickly and effectively (Schwab2015, 2016). The speed and scope of these information-based innovations warranted the distinction between the 3IR and 4IR. For example, it took several decades for computers to become mainstream in households in most Westernized societies in the 3IR but only about a month for millions of consumers to be captivated by the Pokémon Go Gaming App in 2016, during the 4IR (Schulze2019). In the 4IR, technological innovations-including smart factories, the Internet of Things (IoT), AI, 3D printing, bitcoin, and gene editing—continue to spread across industries and economies The prioritization of progression, speed, and connectivity, achieved through technology, has received considerable attention from retailers and service providers, which adopt a host of technologies to facilitate various activities, both in stores and online. Grewal, R. (2020) outline how technologies infused with social presence and convenience characteristics, such as smart shelves, augmented and virtual reality, (dis)embodied robots, avatars, and smart windows, are radically altering in-store retailing

and customer experiences. Efforts to ensure the continual advancement of technology in the 4IR largely have sought to harness technology's power to enhance customer experiences while maximizing firm profit, potentially by replacing employees with advanced technology.
It is unclear exactly where or when the 5IR term emerged, but popular press articles and websites (e.g., AryuNetworks 2020; Gauriand Van Eerden 2019) have noted its emergence. Manufacturing research also acknowledges the 5IR (Xu etal. 2021), as exemplified by special issues of *Journal of Manufacturing Systems, International Journal of Production Research,* and *IEEE Transactions on Industrial Informatics* to encourage research along these lines. These special issues largely reflect a manufacturing perspective; with this article, we seek to encourage retail and service scholars to engage more with this vital research realm too. Limited academic attention has addressed implications of the 5IR, so we also offer a novel interpretation of the 5IR, as it applies to retail and service settings
Several previous studies have elucidated the characteristics of the fifth industrial revolution, which explains how humans and robots work synchronously and advance in different areas of human well-being. One of them is the energy revolution a highly transformed workplace culture where robots replace routine tasks and the introduction of collaborative robots. In addition, the fifth industrial revolution will see robots given tasks and decision-making capabilities, primarily aiming to improve quality and production processes. This development represents an outstanding opportunity for synergistic collaboration between humans and, in due course, advanced human–machine systems, fostering a dynamic evolution characterised by unprecedented progress.

The Significance of the Fifth Industrial Revolution
While the Fourth Industrial Revolution was characterized by hyper-connectivity through smart devices linking us to most parts of the planet, the upcoming Fifth Industrial Revolution will amplify and streamline this connection, replacing traditional smart devices with brain-computer interfaces and heralding a transformative evolution in our engagement with technology While the 4IR witnessed a competitive interplay between humans and machines, the 5IR aims to foster a collaborative and harmonious relationship between them. Specifically, in 5IR, humanity has expected further technological advancement to address 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.
The 4th IR is surreal because it has embraced the possibilities of artificial intelligence, commonly known as AI. At its best, it is the most significant feature and contribution of the industrial revolution. The contributions of the legacy of artificial intelligence in entrepreneurship, industry, education, and everyday life remain, to some extent, shrouded inside. The applications of AI have their positive and negative aspects. The prevailing concern is that artificial intelligence, while still unfolding its full potential, may outstrip its job-creating capacity, leading to a net loss of employment opportunities. Its true potential and capabilities are still being explored with further discourse.
If AI is the fourth industrial revolution, the fifth industrial revolution has “cobots” as its primary technological offering. Collaborative robots, or “cobots” are designed to work alongside and, more importantly, assist their human counterparts. These technologically advanced machines are designed to be user-friendly and provide physical assistance in performing dangerous tasks. With the introduction of cobots, there should be no fear of losing the production line to automation, which has been a primary concern of Industry 4.0. All of this increases a company's agility

An overview of academic library and its Services
Academic Libraries according to Oduagwu (2006), Opara (2007), Nworie & Anunobi (2022) are libraries of the universities, university colleges and other institutions forming part of or associated with institutions of higher learning. In other words, they are libraries established, maintained and administered by a university or any other tertiary institution of higher learning to meet the educational objectives of the parent institution. (Akide & Odugwu, 2021), Nworie (2022), Onuoha and Chukwueke (2021) opine that academic libraries are established with the sole aim of supporting and enhancing teaching, learning research and community development. They exist to support, and promote the accomplishment of the vision and mission of the parent institution. According to them, academic libraries are an integral part of the tertiary institution. They are considered the most important structure for the realization and attainment of the goals of the institution – university, polytechnics, colleges of education or any other institution of higher learning.
In further assertion, academic libraries serve two complementary roles or purposes which are to support the institution's curriculum and to support research of the institution's faculty members and students. They play vital roles in assisting the parent institutions to fulfill their basic functions by collecting, organizing, preserving and making available for use, books, manuscripts, journals and related materials to students and faculty members (Oduagwu 2002:3). As such, academic libraries are the pivot around which all academic activities of the tertiary institutions revolve.
As identified by Oduagwu (2002:3) the functions of academic libraries include but are not limited to.
I. Selection of materials based on the requests from the faculty and other members of the academic community.
ii. Preparation of the materials for use by the students, faculty members and others who require them, for example – stamping, cataloguing, classifying, pasting and lettering etc.
iii. Making materials easily accessible physically on the shelve, bibliographically through catalogues and indexes etc.

iv. Circulation of materials from the general and reserved collections.
v. Offering referral services and a lot more.

In almost all academic libraries, these activities are departmentalized to include :– Acquisition/Collection Development, Bibliographic Services, Readers' Services.
According to Opara (2007); Schonfeld (2018) and Alegoke (2021), academic libraries offer an array of services based on the curriculum and basic mission of the parent body. Over time, the traditional services provided by academic libraries have included:- Library instruction; Loan services; Inter-library loan; Library Orientation; Current Awareness Services; Selective Dissemination of Information; Reprographic Services; Readers' Advisory Services; Compilation of Bibliographies/Indexes etc. These services vary across institution types and may also vary in nomenclature.
However, the advent of Information Communication Technology (ICT) has resulted in a paradigm shift from traditional method of services delivery in most academic libraries. According to Adegoke (2021), "For over three decades, academic libraries' roles have started changing from being repositories of books to active users learning centers which are fully equipped with both physical and electronic materials."
In response to the increasing need of divergent information of the millennium users in digital formats, Adegoke (2021) and Mbagwu and Iroeze (2021) have in their different opinions' itemized the contemporary or modern library services in academic libraries to include the following: Digital Library Services; Virtual Reference Services; Ask – a – librarian Services; Adaptive Learning Services (ALS) Web-based Services,; Social Media Services; Web Forms; Virtual Library Tours; Linkedin; Real Time Services; Current Awareness; Referral Services; Inter-library Loans Services; Knowledge Creation and Digital Humanity Services; Selective Dissemination of Information Services; Data Services; Publishing Support Services; Makerspace Services; Web-based User Education; Twitter; WhatsApp; Blogs etc. These services have greatly satisfied the sophisticated Information Communication Technology based demands of the 21 st Century library users. It is expected that as more and more innovations emerge, it would result in more divergent and advanced academic libraries service delivery in the near future.

Application of digital literacy among academic libraries
Digital literacy plays a transformative role in academic libraries and the education system, serving as a cornerstone for effective learning and information management in the digital age. In academic libraries, digital literacy encompasses the ability to locate, evaluate, and use digital resources effectively. Libraries are no longer mere repositories of books; they have evolved into dynamic hubs that provide access to digital databases, e-books, and online journals. This shift has necessitated the development of digital literacy skills among both library staff and users. For instance, librarians are now tasked with guiding students and researchers in navigating complex digital platforms, ensuring they can access credible and relevant information (UNESCO, 2011). Furthermore, digital literacy in libraries fosters critical thinking by enabling users to assess the credibility of online sources, a skill that is increasingly vital in combating misinformation.
In the education system, digital literacy is integral to preparing students for the demands of the 21st-century workforce. It involves not only the technical skills required to use digital tools but also the cognitive abilities to analyze and create digital content. NITDA, (2024), educational institutions are incorporating digital literacy into their curricula to enhance students' learning experiences and equip them with the skills needed for lifelong learning. For example, digital literacy enables students to engage with interactive learning platforms, participate in virtual classrooms, and collaborate on projects using digital tools (Karpati, 2011). These capabilities are particularly crucial in a globalized world where digital communication and collaboration are the norms.
The integration of digital literacy into academic libraries and education systems also addresses issues of accessibility and inclusivity. Libraries and schools are leveraging digital technologies to bridge the digital divide, providing access to resources for underserved communities. However, the implementation of digital literacy programs is not without challenges. Academic libraries and educational institutions often face resource constraints, including limited funding and inadequate infrastructure. Additionally, there is a need for continuous professional development to ensure that educators and librarians are equipped to teach and support digital literacy. Addressing these challenges requires a collaborative approach involving policymakers, educators, and technology providers to create sustainable solutions.
In conclusion, digital literacy is a critical component of academic libraries and the education system, enhancing information access, fostering critical thinking, and preparing individuals for the digital economy. By investing in digital literacy initiatives, academic institutions can ensure that students and researchers are well-equipped to navigate the complexities of the digital world, thereby contributing to a more informed and equitable society.

Role of Academic Libraries in Promoting Digital Literacy
Academic libraries play a major role to promote both digital literacy faculty, and the broader community. According to Rudrani (2024), below are the roles libraries play:
Access to Digital and Media Resources: Academic libraries provide access to a wide range of digital resources, including e-books, academic journals, databases, and multimedia materials such as audiovisual content and digital archives. By offering access to diverse media formats, libraries facilitate exposure to different types of digital content, which is essential for developing media literacy skills.

Instruction and Training**:** Librarians conduct workshops, training sessions, and individual consultations to educate users about digital and media literacy concepts and skills. These sessions cover topics such as evaluating online sources, critically analyzing media content, understanding copyright and clear use, and using digital tools for academic research and media production.
Media Literacy Initiatives**:** Academic libraries often develop initiatives specifically focused on media literacy, which may include workshops, online tutorials, and interactive learning modules. These initiatives aim to improve users' ability to critically evaluate media messages, identify biases and propaganda, and understand the role of media in shaping societal understanding and attitudes.
Technology Infrastructure**:** Libraries provide access to computers, software applications, and multimedia equipment that users can utilize to enhance their digital and media literacy skills. This infrastructure enables users to engage in activities such as digital storytelling, media production, and data visualization, nurturing hands-on learning experiences. Support for Digital Scholarship: Academic libraries support digital scholarship initiatives by providing guidance on digital research methods, data management, and scholarly communication in the digital age. Librarians help users in understanding digital repositories, archives, and data sets, simplifying the discovery and utilization of digital resources for academic purposes.
Critical Thinking and Information Literacy**:** Libraries promote critical thinking skills by encouraging users to critically evaluate digital and media content, understand credible sources from misinformation, and analyze the socio-cultural contexts in which media messages are produced and disseminated. Through information literacy instruction, libraries empower users to navigate the complexities of the digital and media landscapes effectively.
Collaboration and Partnerships**:** Libraries collaborate with other campus units, academic departments, and external organizations to develop interdisciplinary initiatives aimed at promoting digital and media literacy. By this kind of partnerships, libraries enhance their literacy programs and initiatives, developing a culture of digital and media literacy across the academic community.
Digital Archives and Special Collections**:** Many academic libraries maintain digital archives and special collections that contain valuable primary source materials in digital format. These resources provide students and faculty with access to historical documents, manuscripts, photographs, audio recordings, and other digital artifacts, which is helping to do research and inquiry across a wide range of disciplines.

Strategies for Marketing Digital Literacy effectively



Source: Digital Marketing Strategy. www.kisspng.com

Rajeshkumar et. al.(2021) in their work elaborated the various strategies involve in marketing digital litereacy. They stated as follows;

1) Search Engine Optimization
Search engine optimization is also known as SEO which consists of techniques to optimize the result of the search. It can be derived from the search engine's algorithm. It can access the relevancy of the terms on the website by using search optimization match term can redirect the links to the users. The main benefits of the approach are a) A high level of segmentation b) Flexibility and Monitoring c) Effectivenessd) IE library competitive advantage e) Target to users.
2) Content Marketing:
Content marketing is similar to SEO which refers to the publicity link with appropriate text on the website page with specific content. Search engine marketing (SEM) is a similar technique. Content marketing direct use of website hosting advertisement related to their content. In content level marketing there are two methods by topic and using keywords.
3) Search Engine Marketing :
It is also known as search engine marketing (SEM). Pay-per-click (PPC) is commonly related to first-tier search engines. It is an internet-based advertising model for in force traffic to websites. Cost per click can be calculated and paid by the advertiser.

4) Email Marketing: Any email communication is considered email marketing it helps build user relations, trust in resources, products, and services, or brand reorganization. E-mail marketing is an efficient way to stay connected with our users or patron to promote library product resources and services.

5) Content Marketing: Content is this gets popular generally while user viewing or user sharing it after publishing over the electronic form. Content marketing is known as electronic word of mouth marketing defined as a strategy which rapidly explored by the users as self-disseminating publicity. E.g. email services of yahoo.com and gmail.com etc.

6) Social Media: Social media is the most powerful tool to reach the users' community which allows interaction and communication with them. It is more attractive in this digital platform to come and join socially on a single platform.

7) Mobile Media: It is a digital marketing strategy to reach out to target users on their smartphones, mobile, tablets by sending those SMS, email, MMS, and social media apps. Libraries made available SMS or text message services enable users to get the alert about the new arrival, transactional message, or digest message directly.

8) Web Design: web 2.0 has the ability for the user to collaborate and share information online via web base communication, social media, and blogging. Static and dynamic pages over the web can able to users more social, collaborative, interactive, and responsive.

9) Corporate blogs: Libraries should start a blog to achieve the objectives of libraries and organization aims.

Opportunities available in marketing digital literacy in 5th industrial revolution era

Many academic libraries are making available a number of essential student services such as a writing center, counseling and advising services, tutoring, disability services, enhanced technology lab spaces, multi - functional device (e. g., tablets, smart phone, etc.) and laptop lending services, practice presentation areas, group and individual work spaces, greater access to digital production facilities in video, audio, music, photography, distance learning course support and functional use of satellite and cable technologies. " Libraries are among the first places prospective students and their parents visit in the academic institution Shashira and Danappa (2023). The library has the potential to create a positive and memorable first impression to promote institutional mission, academic culture and cater to the needs of today‟s learner. Shashira and Danappa (2023) went further to state some opportunities attached to the promotion of digital literacy among users community;

1) Crafting the user experience: Both seasoned researchers and newcomers need intuitive interfaces for navigating libraries' huge stores of data.

2) Delivering mobile content: Libraries adjust to the expectations of user‟s accustomed consuming mobile - friendly websites, apps, and e - books.

3) Recording scholarly research: This becomes more complex as research encompasses datasets, visualizations, and other new media.

4) Managing N - List data: Thanks to electronic publishing, users are hungry to explore how content connects and interacts over time.

5) Providing open access e - resources: Major initiatives by the National Science Foundation and others show that open access is going main stream.

6) Rethinking design: Library environments are better reflecting how libraries are actually used by students and including areas for study and hands on work.

7) Online learning: A well - established pillar of higher education, libraries is increasingly playing a role in guiding faculty and developing their own online resources.

8) The Semantic web: A new computer science field that seeks to intelligently relate pieces of information online, the technology could allow for more accurate searches of library catalogs and databases.

The challenges faced by libraries in promoting digital information literacy

The following challenges are considered to be major setback to the promotion of digital literacy among academic libraries;

- **Inadequate of resources: this is the major concern in the implementation and promotion of digital literacy among academic libraries in Nigeria.**
- Library staff competence and Preservation: One of the most pressing challenges is addressing the digital divide.
- Budget limitation /Funding : Implementing new technologies and programs requires financial resources.
- Rapid Technological Change and Changing User Expectations: The pace of technological advancements can be overwhelming.
- Security of information (Copyright and Privacy): Libraries deal with sensitive patron information, and the Fifty Industrial Revolution raises concerns about data privacy and cyber security.
- Digital Literacy Gaps, Balancing Tradition and Innovation: While libraries offer digital literacy programs, addressing the varying levels of digital literacy among patrons can be challenging.

Librarians' Training and Development: Adapting to new technologies requires staff to continuously update their skills. It is an ongoing process that adapts to changing business requirements and individual employee growth.

Conclusion

In a rapidly changing world, libraries remain essential pillars of knowledge dissemination and innovation, making a lasting impact on education, culture, and the empowerment of individuals and communities across the continent. Their ability to adapt, innovate, and serve as beacons of inclusivity underscores their indispensable role in navigating the complexities of the digital age. In conclusion, the article suggested the future role of libraries as technology continues to evolve, envisioning a dynamic and adaptive ecosystem that remains a cornerstone of knowledge dissemination. The importance of libraries in the 5IR is summarized, emphasizing their crucial role in fostering digital literacy, inclusivity, and lifelong learning. Through an in-depth exploration of these facets, this article contributes to the understanding of how libraries can effectively navigate the challenges and harness the opportunities presented by the Fifty Industrial Revolution

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Marketing of Information Products and Services by Librarians in University Libraries in Edo State in the 5th Industrial Revolution

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Abstract
*This study investigated the marketing of information products and services by librarians in university libraries in Edo State within the context of the 5th Industrial Revolution. Employing a descriptive survey design, the study involved 89 professional and paraprofessional librarians across Ambrose Alli University and the University of Benin. Data were collected using structured questionnaires and analyzed using descriptive statistics, with a decision mean benchmark of 2.50. Findings revealed that university libraries in Edo State provide a wide range of information products and services to a high extent, with a grand mean of **2.9**. Among the most provided services were reservation services ($\bar{}$=3.3), reference services ($\bar{}$=3.1), and current awareness services ($\bar{}$=3.1). In terms of marketing strategies, libraries employed various techniques such as digital marketing, personalized email campaigns, social media engagement, and library advocacy programs, with a grand mean of **2.9**. Marketing was reported to significantly benefit the libraries, particularly by increasing visibility and awareness ($\bar{}$=3.1), improving user engagement ($\bar{}$=3.0), enhancing resource utilization ($\bar{}$=3.0), and strengthening collaborations ($\bar{}$=2.9), culminating in a grand mean of **3.0**. However, librarians face several challenges, including limited budgetary resources, inadequate personnel, insufficient training, and rapid technological changes, with a grand mean of **2.87**. The study concludes that despite notable challenges, marketing plays a pivotal role in improving library services and fostering user engagement in the digital age.*
Keywords: *Information Product, Marketing, Services, University Libraries, 5th Industrial Revolution.*

INTRODUCTION
University libraries major objective is to provide adequate information products and services to support academic excellence. These resources enable students, faculty, and researchers to discover, access, and utilize relevant information for learning, teaching and research. The 5th industrial revolution is characterised by Artificial Intelligence (AI), robotics and Internet of Things (IoT), which is transforming information products and services. The library therefore needs to adapt to these changes to remain relevant (Vebe & Tyonum, 2023)

Mbagwu (2022) highlighted some information products and service which include: digital resources and online databes, reference services, current awareness services, digital repositories, bibliographic databases, information literacy programs, document delivery services, and reservation services amongst others. According to Adebambo et.al.(2023), some of the information products and services in this era include AI-powered databases, virtual and augmented reality resources, and personalized information services, chatbots and virtual assistants, data analytics and visualization, collaborative platforms. These products and services enhance research productivity, improve learning outcomes and increase visibility. Exploring the 5th industrial revolution, university libraries can reinvent information products which are essential for improving academic excellence, research productivity and student success (Bala, 2022).

In the 5th industrial revolution era of technological advancement, Olubiyo and Olubiyo (2022) stated that there has been a growing trend in library practice whereby university libraries create awareness about their information resources and services with a view to increasing users' patronage of those products and services, attracting prospective patrons, keeping existing clients and improving the public image of the university libraries. This is referred to as marketing of library and information products and services.

It is hoped that the result of this study will provide information on marketing of information product and services by librarians in the area under study. It will also enable librarians to be service-oriented and dedicated to the University Libraries' mission with diversity. This study will increase the awareness of librarians of operational efficiencies in the ability to use marketing in library and information services.

OBJECTIVES OF THE STUDY
The main objective of the study is to investigate marketing of information product and services by librarians in university libraries in Edo State in the 5th industrial revolution. Specifically, the study seeks to:

1. Find out the extent of provision of information products and services in University libraries in Edo State.
2. Ascertain the strategies used in marketing of information product and services by librarians in University libraries in Edo State.
3. Identify the benefits of marketing of information product and services by librarians in University libraries in Edo State.
4. Identify the challenges facing marketing of information product and services by librarians in University libraries in Edo State.

LITERATURE REVIEW

Information Products and services in University Libraries

With the impact of technologies and other environmental changes, the role and concept of libraries product and services is changing very fast with in the 5th industrial revolution. The range of services that takes place outside the physical library is expanding due to the new technology, and it is likely to expand further. The scope of some services has become nearly unlimited. Some forms of service can be offered almost as easily around the globe as around the town. Libraries serve and will serve far beyond their walls (Irewole & Glerose, 2021). Libraries in Nigeria play a pivotal role in supporting academic endeavors by providing a range of information products and services such as **digital Resources and Online Databases; institutional repositories and open access initiatives; research support services; reference and information assistance; interlibrary loan services; multimedia and audio-visual materials; special collections and archives; library workshops and training programs; user education and outreach programs; information and communication technology (ICT) infrastructure; accessibility services for differently-abled users; current awareness services; document delivery services; collaborative partnerships and consortia;** and **integration of artificial intelligence (AI) in library services** (Onwuekwe,2022).

However, many library and information services struggle hard to satisfy users within the limits, imposed by a small budget. In some libraries, decrease in fund has lowered the quality of service. Millie, (2020) suggested a veritable means out of this poor state of libraries. They proffered that libraries need to create a niche in the society to survive and recommended the need to concentrate towards marketing of knowledge products and services through a well-planned marketing strategy. The library is obviously not a profit making organization, hence it is worth it and survival cannot be determined by profit. Continued financial support for the operation of the library may depend on the demonstrated use of services it provides.

Strategies for Marketing of Information Products and Services

The library has many products and services that it can market. Each library needs to identify what it wishes to market and how. Millie (2020) opined that Marketing is not just about developing and promoting new services and products but also about bringing awareness to clients of existing services and products and determining their appropriateness. Marketing plan needs to be developed and implemented with ongoing enhancement of the services and products should follow.

Marketing strategies employed by librarians in university libraries play a crucial role in promoting information products and services by ensuring that the academic community is aware of and effectively utilizing available resources. Librarians are increasingly leveraging digital marketing channels for promotion. Trang et.al. (2023) emphasizes the effectiveness of social media campaigns in reaching a wide audience. Librarians utilize platforms like Twitter, Facebook, and Instagram to share updates, highlight resources, and engage with the academic community. Also, personalized communication remains a powerful tool in library marketing. According to Mbagwu (2022), librarians craft targeted email campaigns to specific user groups. These campaigns may include information about new acquisitions, upcoming events, and tailored recommendations based on user preferences. A study by Callaghan (2023) explores how librarians collaborate with faculty to integrate information literacy components into course curricular, ensuring that students are aware of and proficient in using library services. Librarians can organize workshops and training sessions to educate users about available resources. To enhance engagement, librarians should incorporate gamification elements into their marketing strategies. As highlighted by Serafeim and Christos (2022), game-like approaches, such as library scavenger hunts, quizzes, and challenges, create a playful environment that encourages exploration of information products and services.

The design and navigation of the library website play a pivotal role in user engagement. Oseji, (2020) discuss the importance of user-centric website design. Librarians ensure that information products and services are prominently featured, with intuitive navigation, making it easier for users to discover and access resources. Librarians should ensure that mobile apps are widely promoted and easily accessible. Millie (2020) highlights the importance of mobile-friendly interfaces and apps that provide on-the-go access to library resources. Librarians actively promote the convenience and features of mobile applications to enhance user engagement. Other strategies include: **Utilization of Library Ambassadors;Multimedia Content for Outreach; Targeted Promotional Events and Exhibitions; Collaborative Marketing with Academic Departments;Data-Driven Decision-Making;Library Advocacy Programs; Integration of Augmented Reality (AR) and Virtual Reality (VR);**and**Alumni Engagement Programs:Community Engagement Initiatives** (Adebambo et.al.,2023)**.**

The marketing of information products and services by librarians in university libraries in the 5th industrial revolution is a strategic practice that yields numerous benefits for both librarians and users. One of the primary benefits of marketing library services is the increased visibility and awareness of available resources. As highlighted by Olubiyo and Olubiyo, (2022), strategic marketing campaigns on various platforms, including social media and library websites, contribute to a broader understanding of the wealth of information products and services offered by university libraries. Marketing initiatives enhance user engagement by actively involving the academic community. Trang, et.al. (2023) emphasizes that targeted marketing strategies, such as interactive workshops, social media challenges, and personalized communications, create a dynamic and participatory environment, encouraging users to explore and utilize library resources more actively.

Benefit of marketing Information Products and services

Effective marketing leads to a more comprehensive utilization of library resources. When users are well-informed about the array of resources available, they are more likely to explore and engage with databases, digital collections, and specialized services, resulting in a maximized return on the library's investments. Marketing initiatives often involve the promotion of new technologies and digital tools available

in the library. Mclntosh et.al. (2021) suggest that such promotions not only improve user awareness but also encourage the development of technological competencies among students and faculty, preparing them for the digital age.

Library marketing fosters a sense of community among users. Panjaitan and Purba (2020), note that by creating a vibrant and connected community through events, newsletters, and collaborative projects, librarians contribute to a positive and supportive academic atmosphere, where users feel connected to each other and to the library. Other benefits include: **Advocacy for Information Literacy; Support for Research and Academic Excellence; Strengthening Collaborations; Improved User Satisfaction; Promotion of Lifelong Learning; Effective Communication of Library Values; Adaptation to Evolving User Needs; Increased Library Funding and Support;Promotion of Inclusivity and Diversity; and Continuous Improvement through Data Analytics.**

Challenges Facing Marketing of Information Products and Services

While marketing information products and services in university libraries offers numerous benefits, librarians also face various challenges especialy in this era of the 5th industrial revolution. One of the foremost challenges faced by librarians is the constraint of limited budgetary resources for marketing initiatives. As discussed by Irewole and Glenrose (2021), insufficient funds may restrict the implementation of comprehensive marketing campaigns, limiting the scope and effectiveness of promotional activities.

Also, Librarians often contend with the challenge of changing perceptions about libraries in the digital age. Oseji, (2020) suggests that the stereotyping of libraries as outdated or irrelevant may impede marketing efforts, requiring librarians to actively communicate the evolving and dynamic nature of modern library services.In the digital era, information overload and intense competition for user attention pose significant challenges. The abundance of online information and the proliferation of diverse sources make it challenging for librarians to stand out and effectively communicate the unique value proposition of their services.

Librarians often face time constraints and limited personnel for marketing activities. Callaghan (2023) highlights how the dual responsibilities of librarians, balancing collection management and user assistance, can lead to challenges in dedicating sufficient time and human resources to strategic marketing initiatives.Incorporating technology into marketing strategies can be challenging due to technological barriers. Adebambo et.al., (2023) discuss issues such as outdated systems, inadequate training, and limited technological infrastructure, which may hinder librarians from fully leveraging digital tools and platforms for effective marketing. Other challenges include: **Resistance to Change;Lack of Targeted User Understanding;Measurement of Impact and ROI;Legal and Ethical Concerns;Lack of Collaboration and Communication;Rapid Technological Changes:Misalignment of Marketing Strategies; External Economic Factors;Lack of Training and Professional Development;Difficulty in Demonstrating Tangible Benefits** (Oseji, 2020). Addressing these challenges requires a holistic approach, involving organizational support, professional development, and a nuanced understanding of user needs. Despite the hurdles, librarians play a vital role in navigating these challenges to ensure that library services remain relevant, accessible, and valued in the 5th Industrial revolution.

RESEARCH METHODOLOGY

The descriptive survey research design was employed for this study.The population for this study is eighty nine (89) comprising professional and paraprofessional librarians in two (2) university libraries in Edo State which are: Ambrose Alli University Library, Ekpoma and John Harris Library, University of Benin. Total enumeration technique was used for the study because the population is manageable and accessible to the researcher. A structured questionnaire was used as instrument for data collection. Out of the eighty nine questionnaires distributed, seventy eight was returned which representing 87.6% of the entire population under study. The data collected were analyzed using descriptive statistical tools. Weighted mean was used to answer the research questions raised. Any mean ranking from 2.50 and above was accepted while mean score below 2.50 were rejected.

DATA ANALYSIS AND DISCUSION

Table 1: Information products and services in university libraries

S/N	Extent of Information products and Service provision	VHE	HE	LE	VLE	Mean	STD
1	Reading and lending services	9(11.54%)	59(75.64%)	4(5.13%)	6(7.69%)	2.9	0.72
2	Reservation services	12(15.38%)	48(61.54%)	10(12.82%)	8(10.26)	3.3	0.83
3	Reference services	13(16.67%)	62(79.49%)	1(1.28%)	2(2.56%)	3.1	0.77
4	Current Awareness Services	14(17.95%)	60(76.92%)	2(2.56%)	2(2.56%)	3.1	0.77
5	Exhibition and displays	10(12.82)	61(78.21%)	2(2.56%)	5(6.41%)	2.9	0.74
6	Provision of seating and study facilities	8(10.26%)	62(79.49%)	5(6.41%)	3(3.85%)	2.9	0.74
7	Provision of library publications	15(19.23%)	50(64.10%)	3(3.85%)	10(12.82)	2.8	0.72
8	Bindery services	20(25.64%)	40(51.28%)	10(12.82%)	8(10.26%)	2.9	0.73
9	Research Support Services	10(12.82%)	5570.51%)	10(12.82%)	3(3.82%)	2.9	0.73
10	Audio-visual facilities	15(18.29%)	40(48.78%)	15(18.28%)	8(9.76%)	2.6	0.60
11	Journals and Periodicals	17(16.83%)	50(49.50%)	9(8.91%)	2(1.98%)	3.0	0.76
12	Digital Resources and Online Databases	14(15.735)	60(67.42%)	3(3.37%)	1(1.12%)	2.9	0.72
13	Reference Materials	17(21.79%)	55(70.51%)	2(2.567%)	4(5.12%)	3.1	0.79
		Grand mean				**2.9**	**0.74**

Table 1 shows the extent of provision information products and services by librarians in university libraries in Edo state. From the table it can be seen that reservation services (x=3.3), references services (x=3.1), and reference materials were the informations products and services mostly provided and utilized in the university libraries. The grand mean of x=2.9 suggest that the extent of provision of information products and services is to a high extent.

Table 2: Strategies for marketing of information product and services by librarians in university libraries

S/N	Strategies	SA	A	D	SD	Mean	STD
1	Creating a web page	8(10.25%)	57(73.07%)	3(3.84%)	10(12.82%)	2.8	0.70
2	Digital Marketing	13(16.67%)	52(66.67%)	9(11.53%)	4(5.12%)	3.0	0.75
3	Social Media Campaigns	13(16.67%)	54(69.23%)	3(3.84%)	8(10.25%)	2.9	0.72
4	Personalized Email Campaigns	15(19.23%)	56(71.79%)	5(6.41%)	2(2.56%)	3.0	0.76
5	Collaborative Workshops and Training Sessions	10(12.82%)	62(79.48%)	4(5.12%)	2(2.56%)	3.0	0.76
6	Utilization of Library Ambassadors	14(17.94%)	63(80.76%)	1(1.28%)	0(0%)	3.1	0.79
7	Multimedia Content for Outreach	16(20%)	55(70.51%)	2(2.56%)	5(6.41%)	3.0	0.76
8	Collaborative Marketing with Academic Departments	13(16.67%)	53(67.94%)	9(11.53%)	3(3.84%)	2.9	0.74
9	Library Advocacy Programs	16(20.51%)	60(76.92%)	2(2.56%)	0(0%)	3.1	0.79
10	Community Engagement Initiatives	15(19.23%)	58(74.35%)	3(3.84%)	2(2.56%)	3.1	0.79
		Grand Mean				**2.9**	**0.75**

Table 2 shows the strategies for marketing information product and services in university libraries in Edo State. It revelaed that commuinity engagement initiatives (x=3.1), library advocacy programme (x=3.1), digital marketing (3.0) and collaborative workshops and training sessions (3.0) were the major strategies for marketing information products and services in University libraries in Edo State which indicate high agreement compared to the grand mean of X=2.9.

Table 3: Benefits of marketing of information product and services by librarians in university libraries

S/N	Benefits	SA	A	D	SD	Mean	STD
1	Increased Visibility and Awareness	15(19.23%)	59(75.64%)	4(5.12%)	0(0%)	3.1	0.77
2	Improved User Engagement	14(17.94%)	60(76.9%)	2(2.56%)	2(2.56%)	3.0	0.70
3	Enhanced Utilization of Resources	18(23.07%)	55(70.51%)	3(3.84%)	2(2.56%)	3.0	0.70
4	Enhance Advocacy for Information Literacy	19(24.35%)	48(61.53%)	7(8.97%)	4(5.12%)	3.0	0.70
5	Identify Changing Users Preferences	17(21.79%)	45(57.69%)	10(12.82%)	6(7.69%)	3.0	0.72
6	Strengthen Collaborations	12(15.38%)	55(70.51%)	8(10.25%)	3(3.84%)	2.9	0.70
7	Improved User Satisfaction	13(16.67%)	54(69.23%)	9(11.53%)	2(2.56%)	3.0	0.75
8	Promote Effective Communication of Library Values	10(12.82%)	55(70.51%)	9(11.53%)	4(5.12%)	3.0	0.70
		Grand Mean				**3.0**	**0.71**

Table 3 shows responses on the benefits of marketing of information product and services by librarians in university libraries in Edo State. It revealed that marketing helps in increased visibility and awareness (x=3.1), that marketing contributes to improved user engagement (x=3.0), enhancing the utilization of resources (x=3.0), that marketing helps in strengthening collaborations (x=2.9), Overall, the findings indicate a general agreement among respondents regarding the various benefits of marketing information products and services by librarians in university libraries in Edo State, with particularly strong agreement on aspects related to user engagement, collaborations, and user satisfaction.

Table 4: Challenges facing marketing of information product and services by librarians in university libraries

S/N	Challenges	SA	A	D	SD	Mean	STD
1	Limited Budgetary Resources	17(21.79%)	53(67.94%)	5(6.41%)	3(3.84%)	3.0	0.75
2	Perception of Libraries towards marketing	11(14.10%)	55(70.51%)	9(11.53%)	3(3.84%)	2.9	0.73
3	Inadequate Training and Professional Development	13(16.67%)	57(73.07%)	3(3.84%)	5(6.41%)	3.0	0.75
4	Information Overload and Competition	10(12.82%)	56(71.79%)	9(11.53%)	3(3.84%)	2.9	0.72
5	Limited library Personnel	9(11.53%)	48(14.10%)	3(3.84%)	8(10.25 %)	2.5	0.60
6	Limited technological infrastructure	16(20.51%)	48(61.53%)	9(11.53%)	5(6.41%)	2.9	0.72
7	Resistance to change within the organizational culture of libraries	12(15.38%)	52(66.67%)	8(10.25%)	6(7.69%)	2.8	0.07
8	Lack of deep understanding of user needs and preferences	12(15.38%)	53(67.94%)	5(6.41%)	8(10.25 %)	2.8	0.70
9	Lack of Collaboration and Communication	19(24.35%)	45(57.69%)	9(11.53%)	5(6.41%)	3.0	0.75
10	Rapid Technological Changes	14(17.94%)	53(67.94%)	5(6.41%)	6(7.69%)	2.9	0.72
		Grand mean				**2.87**	**0.65**

Table 4 showed the challenges facing marketing of information products and services by librarians in university libraries in Edo State. Limited budgetary resources pose a challenge, with a mean rating of (x=3.0), lack of collaboration and communication (3.0), perception of Libraries towards marketing (x=2.9), inadequate training and professional development (x=3.0), information Overload and Competition (x=2.9), limited Library Personnel (x=2.5), limited Technological Infrastructure (x=2.9). The result therefore showed that there were several challenges facing marketing of information products and services by librarians in university libraries in Edo State.

Discussion of findings

The study revealed that information products and services were provided to users to a high extent. Among the most provided services and products were reservation services, reference services, and current awareness services. This finding agreed with the study of Vebe & Tyonum, (2023) who reported that these services were common among most libraries. Similarly, this finding agreed with the study of Mbagwu (2023), who highlighted how Nigerian university libraries provide access to various information products and services.

Findings from the study also revealed that university libraries in Edo state adopted several strategies in the marketing of information product and services. These include digital marketing, social media campaigns, collaborative workshops and training sessions, and the utilization of library ambassadors. These findings align with Millie (2020), who found that librarians adopt several innovative strategies for marketing information products and services, including "leveraging digital platforms and social media, developing targeted outreach campaigns, fostering community partnerships, implementing user-centric services". Similarly, Callaghan (2023) revealed that marketing of information products and services by librarians usually focuses on promotion and publicity, hence the use of these strategies that foster visibility and collaboration between the users and the librarians.

Furthermore, the study revealed several benefits of librarians' marketing information products and services in university libraries in Edo State. Specifically, the findings showed that marketing helps in increased visibility and awareness, marketing contributes to improved user engagement, enhances the utilization of resources, enhances advocacy for information literacy, helps in strengthening collaborations, and improves user satisfaction. This finding agreed with the study of Panjaitan and Purba (2020), who found that marketing boosts visibility and engagement with clienteles. Strategic marketing campaigns on various platforms, including social media and library websites, contribute to a broader understanding of the wealth of information products and services offered by university libraries. Mclntosh et.al. (2021) emphasizes that targeted marketing strategies, such as interactive workshops, social media campaigns, and personalized communications, create a dynamic and participatory environment, encouraging users to explore and utilize library resources more actively. Also, Onwuekwe (2022) noted that when users are well-informed about the array of resources available, they are more likely to explore and engage with them, resulting in a maximized return on the library's investments.

Findings also revealed several challenges facing the marketing of information products and services by librarians in university libraries in Edo State. The majority of respondents agreed that limited budgetary resources, perception of libraries towards marketing, inadequate training and professional development, information overload, and competition are challenges; limited technological infrastructure and resistance to change within the organizational culture of libraries are the most common challenges. This finding agreed with the study of Vebe and Tyonum (2023), who reported that insufficient funds may restrict the implementation of comprehensive marketing campaigns, limiting the scope and effectiveness of promotional activities. Additionally, the findings align with those of Oseji (2020), who found that the stereotype of libraries as outdated or irrelevant may impede marketing efforts, requiring librarians to actively communicate the evolving and dynamic nature of modern library services.

CONCLUSION

This study underscores the diverse array of information products and services available in university libraries in Edo State, with a general consensus among respondents regarding their availability and utilization. The study equally highlights the various strategies employed by librarians for marketing these services, along with the associated benefits. However, the study also identified significant challenges hindering the full implementation of marketing initiatives, including limited funding, inadequate technological infrastructure, and insufficient training of library personnel. These barriers highlight the need for institutional support, capacity building, and strategic investment in library marketing. As the information needs of users become increasingly dynamic and technology-driven, university libraries must continuously evolve their marketing approaches to remain relevant and impactful. Overall, the study provides insights that can inform policy-making, resource allocation, and strategic planning aimed at enhancing library services and user satisfaction in the 5th industrial revolution era.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. There is need to address the challenge of limited budgetary resources which is crucial for enhancing marketing efforts. Allocating sufficient funds can facilitate the implementation of effective marketing strategies and the improvement of library infrastructure.
2. There is also need to invest in training and professional development programs for library staff with the aim of enhancing their marketing skills and competencies, enabling them to adapt to evolving user needs and preferences.
3. There is need to encourage collaboration between libraries, academic departments, and other stakeholders can facilitate knowledge sharing, resource pooling, and the development of innovative marketing initiatives.
4. Libraries should embrace technological advancements to enhance their marketing capabilities and improve user engagement. This includes leveraging digital platforms, multimedia content, and data analytics to tailor services to user preferences and increase visibility.

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Marketing the National Library of Nigeria through Leveraging Digital Innovation for Enhanced Visibility and User Engagement in the 5th Industrial Revolution

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Abstract

As the global information landscape shifts towards the Fifth Industrial Revolution (5IR)—a phase defined by the integration of human-centric technologies such as artificial intelligence, intelligent automation, and smart systems—the National Library of Nigeria (NLN) must reposition itself as a dynamic and digitally relevant institution. This paper explored how strategic marketing, driven by digital innovation, can enhance the visibility, relevance, and user engagement of the NLN in this new era. Drawing on theoretical insights and practical examples, the study outlined the transformation of library marketing from passive publicity to interactive digital outreach in the NLN. It highlighted the NLN's 8-point agenda, which includes digitization, virtual service enhancement, automation, and community engagement, as a framework for repositioning the library. The paper further recommended actionable strategies such as building a national digital marketing plan, leveraging social media, hosting virtual programs, forming key partnerships, and deploying AI-powered tools to personalize user experience. Despite challenges such as infrastructure deficits and digital literacy gaps, the paper concluded that the NLN can become a central pillar in Nigeria's educational and cultural ecosystem by embracing 5IR.

Keywords: *National Library of Nigeria, Fifth Industrial Revolution, digital marketing, user engagement, library innovation, visibility, digital transformation.*

1.0 Introduction

In an increasingly digitized world, libraries must transcend their traditional roles as passive custodians of heritage to become dynamic, digitally-driven institutions that engage, educate, and empower society. One way of achieving this is through marketing of its services and products.

A simple definition of marketing is that it is a management process of identifying and bridging gaps, anticipating and satisfying wants/needs of consumers (users). Philip Kotler in answering key questions in marketing sees it as "Marketing is the science and art of exploring, creating, and delivering value to satisfy the needs of a target market at a profit. Marketing identifies unfulfilled needs and desires. It defines, measures and quantifies the size of the identified market and the profit potential. It pinpoints which segments the company is capable of serving best and it designs and promotes the appropriate products and services.

The concept of marketing for non-profit organizations was first introduced by Kotler and Levy in 1969 (Kotler and Levy, 1969). Later in the book, marketing for non-profit organizations, Kotler (1982) elaborated the marketing strategies for non-profit organizations like libraries. According to him, non-profit organizations like libraries are basically engaged in the production of services rather than goods. Services are distinct in nature primarily due to the characteristics of being intangible, inseparable, variable and perishable.

Marketing libraries become necessary as library services have long been perceived as free as libraries are service organizations. But in the modern economy, nothing comes free. Raina (1988) says, "the age-old concept of certain social services like health, education, justice, etc. being made available free is becoming irrelevant as the time goes by. This is true with library and information services also as marketing effectively shows that the resources are used well lest being questioned by the authorities about the justification for spending and or its relevance. Besides, there is increasing competition to libraries. Internet, Mobile phones, TV programs, Cinemas, Social events, Libraries have to take on the challenge of winning the users back and this can be done by increased marketing efforts.

Acharya (2023) posits that library marketing encompasses a range of activities and approaches aimed at connecting libraries with their target audiences, raising awareness about available resources and services, and fostering a positive perception of the library's role within the community. It involves understanding user needs, designing effective communication strategies, and employing innovative techniques to engage and attract library patrons.

The National Library of Nigeria (NLN)—as the apex library and intellectual nerve center of the nation—finds itself at a crucial inflection point. The global shift toward the Fifth Industrial Revolution (5IR), an era characterized by advanced digital technologies, a shift in user behaviors and information demand, ingenious marketing strategies presents both an opportunity and a mandate for the NLN to evolve and remain relevant.

Unlike the Fourth Industrial Revolution which emphasized automation, the 5IR prioritizes strong collaboration between humans and intelligent machines, offering new frontiers for service delivery, user engagement/satisfaction and information dissemination. In this context, the ability of national libraries to market themselves effectively and to remain visible, relevant, and user-centered has become a critical success factor. However, in Nigeria, there is a significant awareness and engagement gap, especially among young, tech-savvy demographics who are often unaware of the library's digital offerings or its relevance in their academic, cultural, and personal development (Olalere & Adeyemo, 2022).

This paper suggests that the NLN must proactively leverage digital innovation tools and marketing strategies through engaging in educative content making marketing by utilizing blogs, Search Engine Optimization (SEO) to increase the organization visibility, social media engagement on popular platforms like Instagram, TikTok, Facebook, X (Twitter) using influencer collaborations, user-generated content, paid advertisements, Email Marketing to other professional organizations to establish and maintain positive cordial relationships through newsletters, drip campaigns, personalized offers, Influencer Marketing by leveraging on partnerships with influencers or content creators. This by identifying popular individuals that align with the organization's vision to redefine its public image, increase its visibility, and engage users in meaningful and measurable ways. By aligning with national digital transformation goals and embracing technologies such as artificial intelligence, smart content delivery, virtual engagement platforms, and social media analytics, the NLN can rebrand itself as a 21st-century institution interactive, inclusive, and impactful. This paper thus calls for a deliberate, strategic shift in how the National Library of Nigeria perceives and promotes its role in the digital age, presenting practical insights for marketing its services and collections in the 5IR era.

2. Marketing libraries in the past decades

Historically, libraries functioned with minimal need for public-faced marketing; their mandates and prestige were self-evident. However, in today's attention-driven, hyper-connected society, visibility and relevance cannot be constantly assumed. In Nigeria, studies have shown that many young people remain unaware of the roles and resources of the NLN (Olalere & Adeyemo, 2022). Competing with platforms like Google Scholar, YouTube, and open educational repositories, innovative technologies like AI, VR, Grok, Perplexity and others. Libraries must now actively market their relevance and resources, especially to the digital-native generation.

Digital marketing, including social media engagement, search engine optimization (SEO), multimedia content, and personalized recommendations, is rapidly becoming essential to library operations globally (Ifijeh & Yusuf, 2020). In the Nigerian context, Ugboma (2023) emphasizes that national libraries must build strong online personas to reposition themselves as digital knowledge brands.

3.0 Marketing the National Library of Nigeria in the 5IR era

The National Library of Nigeria (NLN), as the apex institution for the collection and preservation of Nigeria's intellectual heritage, stands at a defining crossroads. As the world transitions into the Fifth Industrial Revolution (5IR)—characterized by the synergy between humans and advanced technologies such as artificial intelligence (AI), robotics, and intelligent automation—libraries must move beyond traditional service delivery. Instead, they must rebrand as agile, digitally vibrant platforms. For the NLN, this calls for a strategic pivot: leveraging digital innovation to enhance visibility and engage users across diverse demographics (Anunobi & Ezeani, 2021).

In this manner, the NLN under its present leadership outlined an 8 points agenda (listed on the organization Nigerbiblios website) which seeks to rebrand the organization and leverage on the digital innovations to enhance user access and visibility of the organization. These 8 point agenda are;

1. Digitization and development of the national library of Nigeria repository (a central location that houses information resources) which allows for collections to have digital copy to be made easily accessible to the public. This is an ongoing continuous process
2. Enhancing virtual library services by subscribing to global database and making such available for users
3. Automation of library operations and services by phasing out card catalogs and having a unified online public access catalog to link materials in all branches
4. Enhancing the branch libraries environment
5. Providing library services to the hard to the reach
6. Enhance literacy sensitization and encourage documentation of family heritage in indigenous language
7. Expansion and strengthening of the national library archives

8. Collaborating with schools to ensure establishment and management of library to promote lifelong reading

The points listed above can be grouped as marketing strategies deployed by the national library under;

1. Constant, meaningful digital presence to engage users through the organizations' website, social media platforms to reach broader audience
2. Partnerships; by collaborating with locals to form book clubs, friends of the library at state branches, this helps to promote love and positive will for learning through the library. Thus, the NLN appeal and visibility to users and non-users alike increases
3. Virtual services; hosting of virtual events, online workshops, webinars to audiences who find difficulty in accessing physical locations
4. Community outreach; this is done through a readership campaign that takes place annually and marking of internationally recognized days by the United Nation (Read aloud day, Indigenous language day). This programs/campaigns serve to promote, market the NLN positively while engaging communities and ensuring equal access and opportunities to all

The Fifth Industrial Revolution blends human creativity with advanced technology to produce user-centered solutions. This goes beyond digitization to include smart systems that learn from user behavior. Libraries around the world are already leveraging 5IR technologies. For instance, the British Library employs AI to curate personalized content, while the Library of Congress uses predictive analytics to recommend resources based on user patterns (FAIFE, 2022).

In Nigeria, however, such applications remain underutilized. Yet, the opportunity is immense. 5IR offers tools for immersive virtual exhibitions, machine learning-powered indexing, and intelligent outreach campaigns. As Igun (2021) notes, Nigerian libraries can use emerging technologies to bridge access gaps and reach underserved populations more efficiently.

It is important to emphasize that the national library of Nigeria through its effort in developing the nations repository, user-friendly website, a sustained nationwide readership campaign exercise as well as collaborations with schools, professional organizations and communities is leveraging on this opportunity to positively market itself

4.0 Reimagining the National Library of Nigeria through Marketing

The NLN must evolve into a **digitally branded national information hub**. A robust, interactive website equipped with smart search, AI-assisted FAQs, and mobile optimization is a starting point. Strategic and active use of platforms like X (formerly Twitter), Facebook, Instagram, and YouTube can amplify outreach. Digital storytelling about Nigeria's literary history, new book launches, and community literacy initiatives can foster stronger connections with the public (Afolabi & Oyelude, 2020).

Email newsletters, WhatsApp groups for scholars, and partnerships with influencers in the education and culture sectors can further drive engagement. Importantly, analytics tools can track which services users interact with most—empowering the NLN to personalize user experiences and maximize impact (Chigbundu & Nwachukwu, 2023).

5.0 Challenges and Realities

Library marketing is essential in dispelling misconceptions about libraries being outdated and irrelevant, and should emphasize the library's role as a hub for learning, creativity, and innovation.

Admittedly, the path to library marketing is fraught with limitations and constraints such as infrastructure limitations, bibliographic control, digital divide/access, increased partnerships and collaborations and digital literacy gaps, budget constraints, limited staff and expertise in marketing, targeting diverse audiences, and measuring the effectiveness of marketing efforts.. Yet, these should not be viewed as deterrents but as opportunities for renewed vigor and innovation.

Government support, public-private partnerships, and integration with national digital economy policies (NITDA, 2020) can mitigate many of these barriers. The NLN's **National Repository of Nigeria (NRN)** project is already a step in the right direction, providing access to Nigeria's intellectual content in digital format. Its digital footprint can be amplified through social media campaigns and API integration with educational platforms (National Library of Nigeria, 2023).

Despite these limitations, library marketing is crucial for ensuring relevance and sustainability in the rapidly changing information landscape.

6.0 The Way Forward: Strategic Actions for the NLN

To reposition the NLN as a leading public-facing knowledge institution in the 5IR era, a multi-faceted approach that requires the use of digital innovations, strategic partnerships and community outreach is required, to this, the following actions are necessary:

1. Formulate a National Library Digital Marketing Strategy aligned with Nigeria's Digital Economy Policy and Strategy (2020–2030).
2. Build Staff Competencies through training in digital communication, social media analytics, and content creation.
3. Digitize More Resources and make them accessible via mobile-friendly platforms and user-friendly interfaces.
4. Host more virtual events, webinars to reach wider audience
5. Partner with Key Stakeholders—such as National Information Technology Development Agency, Nigerian Communications Commission, educational influencers, media houses, and local tech startups.
6. Host events workshops with prominent authors for book signing that cater to diverse interests
7. Launch podcasts featuring children authors, book reviews and talks on trending national topics
8. Monitor and Evaluate—using KPIs for reach, engagement, and user satisfaction to inform continuous improvement.

7.0 Conclusion

Libraries face unique challenges in today's digital landscape and must adapt and innovate to remain relevant. Library marketing is crucial for effectively serving communities by raising awareness, fostering engagement, and shaping public perception of the library's role. It encompasses a range of activities, including digital marketing, social media engagement, community outreach, and partnerships. The goal of library marketing is to increase user awareness, foster engagement, and challenge misconceptions.

Therefore, the National Library of Nigeria can no longer afford to function quietly on the periphery of national development. With 5IR technologies, it has the tools to become an intellectual lighthouse—not only storing knowledge but illuminating it for millions across platforms they already inhabit.

In this new era, marketing is not about commercializing knowledge, it is about connecting and satisfying people's needs with the resources that empowers them. By embracing digital innovation, the NLN can redefine its relevance and reaffirm its role as a central pillar in Nigeria's educational and cultural ecosystem.

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Open Educational Resources and Information Dissemination to Distance Learners in University of Calabar Library in the 5th Industrial Revolution

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Abstract
This study investigates the influence of open educational resources and information dissemination to distance learning in the 5th industrial revolution era. Using a descriptive design, the research focused on librarians at the University of Calabar library, Cross River State, Nigeria, with data collected through a structured questionnaire. Simple Linear Regression statistics and one-way analysis of variance (ANOVA was used to answer the research questions and to test the null hypotheses at .05 level of significance. The findings from the analysis and the test of hypotheses revealed that there is significant influence of khan academy, open textbook and open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. It further emphasizes the importance of funding, reliable power supply, and collaboration for effective 5th IR adoption. It was recommended among others that University management should incorporate Khan Academy, open textbooks, and open access journals into official distance learning curricula and learning management systems to enhance content accessibility and alignment with modern learning modalities. It was also recommended that Distance learners should engage actively with Khan Academy content, open textbooks, and open access journals to supplement university-provided materials and develop self-directed learning skills. Yet using (OER) in disseminating information can reduce costs and increase flexibility in terms of time and space.
Keywords: *Open Educational Resources, Information Dissemination, Distance Learners, Academic Libraries, 5th Industrial Revolution*

Introduction

The Fifth Industrial Revolution (5IR), is considered as an era of integration of digital technologies, artificial intelligence, and the Internet of Things, while libraries are undergoing a significant paradigm shift, technological change and innovation, the preparedness of librarians in skills and knowledge become crucial to ensure libraries continue to fulfil their vital role as information managers and knowledge disseminators. Dumbiri., Ibia,, and Oladokun, (2024) noted that librarians are now at the forefront of creating, processing large digital repositories, navigating complex information landscapes, and facilitating access to a variety of resources. To effectively overcome the challenges and seize the opportunities brought by the 5IR, librarians need to possess a diverse set of skills and knowledge, encompassing both traditional library practices and emerging technological competencies to generate, process and disseminate in information over a distance (Sabah Hayder and Taher 2022).

University of Calabar is among the institutions that offers distance learning programme in Nigeria. The programme offers a flexible and accessible learning experience that breaks down barriers to education. The university through its online programmes, empower learners to pursue academic and professional goals as well as providing high-quality education anytime and anywhere. The term distance according to Hong-Cheng and Jih-Rong (2014) implies that learning is not performed face-to-face, but makes use of media, whether printed media or non-printed (audio/video, computer/Internet, radio and television broadcasts). Open means there is no limitation as to age, year of graduation, period of study, registration time, and frequency of examinations. The only limitation applied is that not every staff and students have the available means to study as well as having the web-technological skills to navigate the platform. The essence of distance learning is the separation between students and teachers which mean students have to be able to study independently (Parker, Jeanette A. 2021). In other o enhance effective service delivery, University of Calabar provides a variety of learning materials, basically in the form of printed and non-printed materials. During the learning process in one semester, students have to read the printed materials and utilize learning support based on multimedia and internet. Learning support materials provided for students including computer assisted instruction (CAI), digital reference materials, video, audio files, animations, TV and radio broadcast. University of Calabar also provides learning support services based on internet, namely online tutorial, personalised learning, e-learning and online-based enrichment materials. Online tutorial is a kind of e-learning implemented in university of Calabar to teach students about a certain subject. Online tutorial as one of learning support service for students as virtual class that is designed in 8 weeks. Students also have to do 3 tasks during the semester. By participating online learning, students can have opportunity to interact with the tutor, ask about the topic, and also know and discuss each other, if they can't attend a face to face class. Open Educational Resources (OER) is

widely used these days, including in education. OER have gained increased attention for their potential and promise to obviate demographic, economic, and geographic educational boundaries and to promote life-long learning and personalized learning. The rapid growth of OER provides new opportunities for teaching and learning, at the same time, they challenge established views about teaching and learning practices in higher education (Harsasi, 2015). University of Calabar also utilizes OER in learning process, including online learning. E-learning is designed in 8 weeks. Every week, tutor provides learning material and discussion forum. In week 3, 5, and 7, students have to do task given by the tutor. To enrich the material, tutor can adopt material that is freely taken from internet, via OER.

Thomas, (2017) Open Educational Resources (OERs) are learning and teaching materials that are freely available online for anyone to use. OERs can consist of full courses, course materials, modules, textbooks, videos, tests, software and any other tools, materials or techniques used to support access to knowledge. Normally, small units of OER (eg animations, videos, podcasts, etc) are most attractive to educators from both the re-use and production angles, as they are easier to embed into existing classroom or online learning activities. Many teachers embed OER material into teaching sessions (eg classroom sessions, practical classes, workshops, seminars) and/or provide links to OERs via the VLE to enhance self-directed learning opportunities**.** The utilization of OER is expected to be useful for students since it can increase student's insight beyond what they can get from printed materials. This study was conducted to determine the extent to which open educational resources influence information dissemination among distance learners in university of Calabar in the 5th Industrial Revolution using constructs such as khan academy, open text books, open access journals in other to ensure remote access. The results of the study would create remote access to the resources among distance learners.

Information Dissemination according to Oinam and Thoidingjam (2019), refers to the process of sharing research findings with stakeholders and wider audiences. Dissemination is essential for the uptake and use of research findings is crucial for the success and sustainability of practice-based research networks (PBRNs) in the long term. Information dissemination involves forwarding the information from one source to several destinations without too much communication overhead and delay. Academic libraries needed to change the pattern of services to its users in terms of disseminating open educational resources. Presently, their users most especially distance learners are more inclined towards technology driven resources than printed materials. Many of the university libraries have the problems in terms of visitors to lend the print resources due to limited numbers.

This has made a dynamic shift in the mode of services provided in the library. The librarian and information professional needed a change to adjust this environment, they rightly so implemented automation in library keeping traditional and new generation digital library go together. This served the various sections of communities who use resource either in print and electronic format. This shift made the librarian as resource provider to librarian teacher who also collaborates with teaching faculties to make effective use of resources both in teaching sessions and out of class hours. The open educational resources also made students to understand the subject much better way using audio video materials, photographs, e research articles and interactive learning materials. To handle the digital library, the library professional needed various competencies such as knowledge of handling, skills to disseminate the information.

Open Educational Resources (OER) and their dissemination face several challenges, including limited access to resources, unsatisfactory institutional support, and a preference for traditional materials. Additionally, challenges arise in managing content, ensuring quality, and addressing copyright issues. Furthermore, factors like digital literacy gaps and the need for training to effectively utilize OER can hinder their adoption. This new information society, students need to be trained on the available skills of searching and use of technology in the teaching methods. The present generation students spend a lot of time using technological devices in their learning process. They are also not willing to spend their time in library reading printed resources. Instead, they use more of electronic resource readers and technology skills in accessing them, through mobiles devices, tab, laptop etc. This generation shift should be addressed both by librarian and teaching faculties to have proper knowledge gain by students. Open educational resources have potential to foster and spread knowledge among students and researchers through the sharing and reuse of educational material, either in digital or another form, which can be beneficial in better shaping the academic communities. In University of Calabar, like other institutions in Nigeria, there exist a gap due to factors like low awareness, limited capacity building, inadequate funding, quality assurance concerns, insufficient policy frameworks, and challenges related to digital access and skills has hinders effective dissemination of resources among distance learners which has become germane for the researcher to carry out the study.

Purpose of the Study

The main purpose of the study was to determine the influence of open educational resources on information dissemination to distance learners in university of Calabar and its implication for the 5th Industrial Revolution. Specifically, the study aimed at determining the influence of:

i. khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.
ii. open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. .
iii. open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Research Questions

i. How does khan academy influence information dissemination to distance learners in university of Calabar in the 5th industrial revolution?
ii. How does open textbooks influence information dissemination to distance learners in university of Calabar in the 5th industrial revolution?
iii. How does open access journals influence information dissemination to distance learners in university of Calabar in the 5th industrial revolution?

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance.

i. **Ho_1:** There is no significant influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.
ii. **Ho_2:** There is no significant influence open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.
iii. **Ho_3:** There is no significant influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution

Literature Review

Pérez Armijo (2021) makes a valuable contribution to the development of new technique for distance learning, a perspective that aligns with one of the central objectives of our research. The author concludes that, in the context of the distance learners and with the support of the Khan Academy (KA) platform, it is essential to innovate method, such as the flipped classroom. This proposal is especially relevant for students of the 21th centutry, who are immersed in digital environments (Pérez Armijo, 2021). These strategies not only encourage meaningful learning and improve skills, but also enhance social skills by allowing interaction and socialization of learning that can be applicable to distance learners.

` According to Mitchell, & Chu, (2014) Khan Academy is a platform that offers classes with educational videos hosted on YouTube. The website is meant to be used as a supplement to the videos, because it includes other features such as progress tracking, practice exercises and teaching tools. The material can also be accessed through mobile applications. The videos enable students to acquire knowledge at their own learning speed according to the concept of mastery learning. They are therefore used by teachers to teach according to the principle of Flipped Classroom. However, university of Calabar can apply this platform in teaching and instructional training of their distance learning students. This will encourage self-learning and practice.

Khan Academy is an educational platform that provides a wide variety of resources, including videos, articles, and exercises in mathematics, allowing users from all over the world to learn at their own pace. Although it encompasses areas such as economics, computer science, physics, biology and chemistry, our main focus is the Mathematics. This tool is especially relevant for students of the Mathematics-Physics study program at the Universidad Nacional Daniel Alcides Carrión (UNDAC). Given the university's transition from face-to-face to virtual education,

Khan Academy becomes an essential resource in achieving the program's goals. The platform is free, available in Spanish, and only requires an internet connection to access. For ease of use, Khan Academy offers a detailed manual (Khan Academy, 2023). Khan Academy could be a valuable resource for disseminating information to distance learners at the University of Calabar, particularly for those studying mathematics. Its free, online platform offers a wide range of videos, quizzes, and exercises that can supplement traditional learning methods. However, distance learning in Nigeria, and at Unical, presents unique challenges related to technology access and internet connectivity.

This paper examines the implication of the use of open educational resources among distance learners in university of Calabar, Cross River State. The study will review different related articles to bring out the usefulness of Open textbook in teaching and learning of distance learners. An open textbook is a free textbook that can be used freely by everyone. It is offered online by the author and has no copyright or Digital Rights Management (DRM) restrictions. Open textbook is accessible to all intended users. Both teachers and students, everybody is free to use it in different ways. The traditional print formats that have been in use for ages are facing the danger of extinction and the transition to digital textbook format is rapid. The advantages and challenges of adoption of open textbook were highlighted in this paper. Omolema, (2017) revealed that the use of open textbook in the education system improves teaching and learning significantly, have dependable quality and easy to use with reduced cost, as well as having the potential to increase the teacher's opportunity to make input in the curriculum development. But the use is not without challenges. In open textbooks, lack of quality and effectiveness is not ruled out. This notwithstanding, the adoption and use of open textbook is highly recommended by the researchers as an effective tool for distance learners in Nigerian universities in anticipation that with time some of these challenges will be mitigated.

Zaid and Alabi (2020) are of the view that Open Educational Resources (OER), including open textbooks, are increasingly recognized as valuable tools for improving access to education and promoting quality learning in Nigeria. The National Universities Commission (NUC) has a policy on OER in higher education, and studies indicate that OER are gaining popularity among Nigerian students. These resources can be retained, reused, revised, remixed, and redistributed, making them a sustainable tool for educational development.

Educateachild.org, (2021). Opined that Open textbooks offer a valuable and cost-effective alternative for distance learning, providing free and adaptable digital resources. They can be easily downloaded, edited,

and distributed, making them ideal for online courses where flexible and customized learning materials are needed. Furthermore, open textbooks can reduce the burden of high textbook costs for both students and institutions. Open Textbook Library has open textbooks that have been reviewed by faculty from a variety of colleges and universities to assess their quality. All textbooks are either used at multiple higher education institutions; or affiliated with an institution, scholarly society, or professional organization.

Open access journals make scholarly, peer-reviewed articles freely available via the Internet. Open access gives ILL practitioners the ability to provide articles that our patrons have requested quickly and free-of-charge by sending the URL or a copy of the article to them. European Commission (2022 assert that open access can also provide a location for previously hard-to-track-down items such as grey literature. However, until these open access sites are searchable through utilities such as OCLC, they are now an additional place to look in searching for items. While we are continually building more search tools such as ILLiad add-ons, as resources proliferate we need to be able to quickly and easily search them. It is in the interest of interlibrary loan to make sure the open access stays open by encouraging scholars at our institutions to consider publishing their research in open access journals or request copyright for those articles. (Farrow. Pitt, & Weller, 2020).

The 'gold' route to OA is via OA journals. There are an increasing number of OA journals available – the Directory of Open Access Journals7 lists more than 4,500 worldwide. A recent survey of publishers (Cox and Cox, 2008) found that almost one quarter offered at least one fully OA title. Despite the fact that it is just one of the numerous ways OA can be achieved, many commentators mistakenly equate OA journals with OA itself (Fazackerley, 2021). Open access journals are closest to the traditional route, in that papers are submitted, peer reviewed and published. The added-value role of the publisher remains, and so do the associated costs. There is no single funding mechanism, however – the commonly used phrase 'author pays' to describe such journals does not apply to all, and they may be run by volunteers, receive grants, or rely on subsidies. Commercial publishers, however, will usually require payment by or on behalf of authors when manuscripts are accepted for OA journals. In some cases, the entire journal is freely available from the date of publication; in others – the 'hybrid' model – authors may choose whether or not to have their article made freely available. Thirty per cent of journal publishers offer hybrid titles, where payment can be made for an article in a subscription journal to be made available on OA, with more than half offering this option for all their titles (UK Research and Innovation (UKRI) 2021). Open Access publishing (also sometimes called Gold OA) is a form of open access in which a publisher makes all articles and related content associated with a certain journal available for free immediately on the journal's website. In this model, authors are often asked to bear the cost of publication, typically through an article processing charge

RESEARCH METHODOLOGY

Descriptive survey design was used for this study. The descriptive survey gives a researcher an accurate description of what people in some target group do or think about a phenomenon through the use of surveys to gather data about varying subjects. This design is considered appropriate for this work because the research aimed at getting facts about the given population and in a systematic approach, describe the characteristics, features and facts about the population. The population of the study was 12 librarians in federal university Calabar, Nigeria. The entire 12 librarians constituted the sample size for the study, hence there was no sampling due to the small and manageable size. The researcher developed instrument captioned: “Open Educational Resources and Information Dissemination Questionnaire' (OERIDQ). The researcher administered the instruments with the help of six research assistants. Simple Linear Regression statistics and one-way analysis of variance (ANOVA was used to answer the research questions and to test the null hypotheses at .05 level of significance.

RESULTS AND DISCUSSION

This section deals with the result of the statistical analysis of data gathered for this study as well as their interpretation and discussion of findings. The presentation of the data was done following the trends of the three hypotheses directing the study.

Hypothesis one:

There is no significant influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution

Table 1: **Simple regression analysis of the influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.762[a]	.581	.579	4.743

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	749.72	1	749.72	60.00	.00[b]
	Residual	124.95	10	12.50		

	Total	874.67	11			

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.82	6.99		1.26	.24
	Khan_academy	2.62	.49	.762	5.37	.00

The first research objective, question and the hypothesis focused on the influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The results of the analysis regarding the research question and hypothesis are presented in Table 1 above. The Table indicates a positive R-value which signifies a positive relationship between khan academy and information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The Table also shows R-square value as .581. This value indicates that khan academy accounts for 58.1% of the variance in information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Furthermore, the Table also indicates the ANOVA section which is a test of the hypothesis postulated. The table shows an F-ratio of 60.00 and a p-value of .00. In view of the p-value which is less than the alpha level of 0.05, the null hypothesis which states that there is no significant influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution was rejected. This implies that there is a significant influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

This significant influence is affirmed in the t-value section of the table which has a p-value of .00. Moreover, the t-value section of the table, in addition to providing the p-value, has the standardized coefficient value of .762. This section of the results implies that for every unit of variation in khan academy, there is 76.2% of variation in information dissemination to distance learners in university of Calabar in the 5th industrial revolution .refore, the summary of the analysis in respect to the testing of the hypothesis is that there is a significant influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Hypothesis two:
There is no significant influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution

Table 2: **Simple regression analysis of the influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.844[a]	.712	.710	3.093

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	778.98	1	778.98	81.41	.00[b]
	Residual	95.68	10	9.57		
	Total	874.67	11			

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.04	4.05		2.48	.03
	Open_textbook	2.46	.27	.844	9.02	.00

The second research objective, question and the hypothesis focused on the influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The results of the analysis regarding the research question and hypothesis are presented in Table 2 above. The Table indicates a positive R-value which signifies a positive relationship between open textbook and information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The Table also shows R-square value as .712. This value indicates that open textbook accounts for 71.2% of the variance in information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Furthermore, the Table also indicates the ANOVA section which is a test of the hypothesis postulated. The table shows an F-ratio of 81.41 and a p-value of .00. In view of the p-value which is less than the alpha level of 0.05, the null hypothesis which states that there is no significant influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution was rejected. This implies that there is a significant influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

This significant influence is affirmed in the t-value section of the table which has a p-value of .00. Moreover, the t-value section of the table, in addition to providing the p-value, has the standardized coefficient value of .844. This section of the results implies that for every unit of variation in open textbook, there is 84.4% of variation in information dissemination to distance learners in university of Calabar in the 5th industrial revolution . Therefore, the summary of the analysis in respect to the testing of the hypothesis is that there is a significant influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Hypothesis three:
There is no significant influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution

Table 3: **Simple regression analysis of the influence of** open access journal **on information dissemination to distance learners in university of Calabar in the 5th industrial revolution**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.809[a]	.655	.653	4.102

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	766.40	1	766.40	70.79	.00[b]
	Residual	108.27	10	10.83		
	Total	874.67	11			

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.17	6.51		.64	.54
	Open_access_journal	2.65	.41	.809	6.48	.00

The third research objective, question and the hypothesis focused on the influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The results of the analysis regarding the research question and hypothesis are presented in Table 3 above. The Table indicates a positive R-value which signifies a positive relationship between open access journal and information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The Table also shows R-square value as .655. This value indicates that open access journal accounts for 65.5% of the variance in information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Furthermore, the Table also indicates the ANOVA section which is a test of the hypothesis postulated. The Table shows an F-ratio of 70.79 and a p-value of .00. In view of the p-value which is less than the alpha level of 0.05, the null hypothesis which states that there is no significant influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution was rejected. This implies that there is a significant influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

This significant influence is affirmed in the t-value section of the table which has a p-value of .00. Moreover, the t-value section of the table, in addition to providing the p-value, has the standardized coefficient value of .809. This section of the results implies that for every unit of variation in open access journal, there is 80.9% of variation in information dissemination to distance learners in university of Calabar in the 5th industrial revolution. Therefore, the summary of the analysis in respect to the testing of the hypothesis is that there is a significant influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution.

Discussion of Findings

The finding of the influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution revealed that there is significant influence of khan academy on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The finding can be attributed to the fact that Khan Academy offers personalized learning experiences through adaptive learning pathways, interactive exercises, and real-time feedback. This personalization is especially valuable for distance learners who often lack immediate access to in-person academic support. The ability of Khan Academy to tailor content to individual learning paces ensures that students at the University of Calabar can engage with material more effectively, regardless of their background or prior knowledge. The finding lend credence to the observation of Pérez Armijo (2021) who observed that khan academy does not only encourage meaningful learning and improve skills, but also enhance social skills by allowing interaction and socialization of learning that can be applicable to distance learners.

The finding of the influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution revealed that there is significant influence of open textbook on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The finding can be attributed to the fact that the digital nature of open textbooks aligns with the technological integration characteristic of the 5th Industrial Revolution. As education increasingly incorporates artificial intelligence, cloud computing, and smart learning systems, open textbooks provide a flexible medium that can be accessed through various devices including smartphones, tablets, and laptops. For distance learners, this means continuous, on-demand access to learning materials, regardless of time or location which is an essential factor for independent and self-paced learning. The finding is in line with the observation of Omolema, (2017) who revealed that the use of open textbook in the education system improves teaching and learning significantly, have dependable quality and easy to use with reduced cost, as well as having the potential to increase the teacher's opportunity to make input in the curriculum development process most especially in the 5th industrial revolution.

The finding of the influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution revealed that there is significant influence of open access journal on information dissemination to distance learners in university of Calabar in the 5th industrial revolution. The finding can be attributed to the fact that The 5th Industrial Revolution emphasizes the integration of digital tools with human-centered learning. Open access journals are inherently digital, making them easily accessible through mobile phones, tablets, and computers. For distance learners who depend heavily on digital platforms for their education, this seamless accessibility supports continuous and flexible learning. Moreover, many open access journals are indexed in global repositories and are compatible with smart learning environments and artificial intelligence tools that promote personalized learning and academic discovery. The finding lend credence to the observation of Taylor and Francis, (2021) who alleged that open access journals have a significant positive impact on scholarly communication, increasing research visibility, accessibility, and citation rates. By removing paywalls, they allow a broader audience, including researchers, students, and the public, to access research, fostering knowledge sharing and collaboration.

CONCLUSION

The study concluded that, the fifth Industrial Revolution (IR) will significantly impact library services, particularly in open and distance learning. Librarians should recognize the significance of acquiring the web technological skills adaptable to curriculum and proficient in data management to enhance effective services delivery. Despite raging concern about training cost, job security, and economic efficiency, there is a moderate level of concern and uncertainty regarding the implementation of the 5th Industrial Revolution. Librarians should embrace advance technologies and collaborative approaches through training and re-raining, acquire the necessary skills in navigating this changes so as to provide innovative and inclusive service to students in open distance learning setting.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. University management should incorporate Khan Academy, open textbooks, and open access journals into official distance learning curricula and learning management systems to enhance content accessibility and alignment with modern learning modalities.
2. Distance learners should engage actively with Khan Academy content, open textbooks, and open access journals to supplement university-provided materials and develop self-directed learning skills.
3. Educational policy makers should develop and enforce policies that encourage the use of OERs in higher education, especially for distance learning institutions.

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Open Science: Opening the Science in Library Services in the 5th Industrial Revolution

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Abstract

The advent of the 5th Industrial Revolution opened the science of service delivery in libraries. Working at the intersection of the 5th Industrial Revolution and open science, this descriptive study employed a questionnaire to collect data from all the 100 librarians in university libraries in Delta State, Nigeria on how the integration of open science has opened the science in service delivery in the era of the 5th Industrial Revolution. A total enumeration sampling technique was used for the study. Descriptive statistical tools (mean, frequency counts, and percentage) were used for data analysis. The study found that libraries as mainstays of knowledge dissemination and community engagement engage in open science in service delivery to make scientific research, data, and dissemination accessible in society. The challenges encountered in opening the science in library service delivery include funding constraints, technological barriers, and resistance to change. The strategies for opening the science in service delivery include facilitation of open access publishing, curation and preservation of open data, and promotion of citizen science initiatives. It was recommended that libraries should be well-funded to acquire the 5th Industrial Revolution technologies that can aid service delivery.

Keywords: *Open science, Library services, 5th Industrial Revolution, Librarians, Libraries*

Introduction

Libraries across the globe are shaken to their philosophical foundation in the 5th Industrial Revolution through a synergistic application of advanced technologies and human-centric values in providing library services (Adjei, 2023). The 5th Industrial Revolution brought significant transformations in the application of technologies in different sectors and disciplines, of which librarianship is no exception (Ekweme et al., 2024). Libraries cannot resist the transformative wave of the 5th Industrial Revolution, which is opening the science in the performance of library services. Different from the 4th Industrial Revolution, which concentrated principally on automation and connectivity through technologies such as artificial intelligence and the Internet of Things, the 5th Industrial Revolution accentuates collaboration between humans and machines as a way of fostering services that meet the information needs of library users (Adei, 2024). This requires libraries to embrace and promote open science principles, ensuring greater accessibility, transparency, and collaboration across the global knowledge landscape. In this setting, libraries are not mere repositories of information, but active centres for modernization, knowledge sharing, and the democratization of knowledge. Through the adaption to these shifts, libraries can serve as significant players in advancing societal progress while maintaining their foundational role in empowering individuals through information and learning.

The 5th Industrial Revolution is opening the science in library services through the adoption of open science principles (Petcu et al., 2020). Open science is a movement whose aim is to make scientific research, data, and dissemination accessible to all and sundry in society. Open science comprises practices which include open access publishing, open data sharing, and research and scientific collaboration. The National Academies of Sciences, Engineering, and Medicine (2018) defined open science as a tool employed to ensure that scientific knowledge is openly available, accessible, and reusable for the good of society. van der Graaf (2023) noted that opening the science in library services in the 5th Industrial Revolution requires integrating open science in the delivery of library services.

As the 5th Industrial Revolution tools such as artificial intelligence powered robots and smart machines are leveraged in opening the science in library services, the importance, strategies and challenges thereof are yet blurred. This study therefore investigates the significance of integrating open science in opening the science in library services in the era of the 5th Industrial Revolution. The study also identifies the strategies employed in using open science in library services, as well as the challenges thereof. The focus is on librarians in the public universities in Delta State, Nigeria.

Research Questions (RQs)

The following research questions guide the study.

RQ1: What is the significance of integrating open science in library services in the 5th Industrial Revolution?

RQ2: What are the strategies for opening the science in service delivery in the 5th Industrial Revolution?

RQ3: What are the challenges encountered in opening the science in library service delivery in the 5th Industrial Revolution

Literature Review

The 5th Industrial Revolution

The 5th Industrial Revolution is noted for infusing advanced technologies and human intelligence into performing library operations. The technologies include artificial intelligence (AI), robotics, the Internet of Things (IoT) cloud computing, big data, and 3D printing (Chiware, 2020; Kaur, 2019). It indicates the present and impending phase of industrial and technological evolution, which builds on the strength of the 4th Industrial Revolution. The 5th Industrial Revolution era heralds a monumental transformation dominated by the merging of innovative technologies which include artificial intelligence, the Internet of Things, blockchain, and advanced robotics (Alojaiman, 2023). This convergence brings a transformative era in societal development, basically redesigning the way people live. According to Nwobu et al. (2024), the 5th Industrial Revolution brought a reflective societal and technological evolution, presenting an essential change strengthened by automation, interconnectedness, and data-driven decision-making that pervade all facets of human life. The 5th industrial revolution invariably is based upon personalization and the utilization of collaborative robots and workers for effective service delivery.

Open Science and Library Services in the 5th Industrial Revolution

Open science is the movement that encourages a transparent and available alliance in scientific research such as free publications, free data, free methods and free software to eliminate the barricades to knowledge sharing. Open science refers to "the efforts by scholars, governments, research funding bodies, and the scientific community to make the publications and the research data publicly accessible in digital format with no or minimal restriction as a means for accelerating research" (Paic, 2021). The three key areas of open science include open access, open research data, and open collaboration. Other areas are post-publication peer review, open research notebooks, open access to research materials, and open-source software (OECD, 2015). The democratization of knowledge with the instrumentality of open science supports the objectives of the 5th Industrial Revolution which aims at bridging technological innovations with human values which include equity and inclusivity (Rafols et al., 2024). Contemporary libraries are engaging in open science to drive service provision by providing access to a series of information resources and research data. This is because libraries are recognised as research hubs which provide scholars access to information resources and research data using modern-day technologies (Adekoya et al., 2024).

Abankwa and Yuan (2019) averred that libraries are at the vanguard of the open science movement by championing impartial access to information and research data. Libraries play an essential role in the era of the 5th Industrial Revolution by facilitating open access publishing. In the words of Ekweme et al. (2024), among the mandates before libraries in the 5th Industrial Revolution was to support learners, academics and researchers through the provision of platforms, and tools that would enable them to publish in open access journals. Libraries are expected in this regard to host preprints, theses/dissertations, and other academic works in institutional repositories.

In the 5th Industrial Revolution, open science enhances the quality of library services by enabling libraries through remote and free access to information resources (Rice, 2022). This is so as library services have evolved from traditional book lending and reading spaces to dynamic hubs of information exchange, learning, and community development (Dempsey & Malpas, 2018). This transformation is driven by the application of the 5th Industrial Revolution tools and principles that improve the functionality, accessibility, and germaneness of libraries. The science in library service comprises fields which include information science, data management, behavioural science, and technology integration (Sulyman et al., 2021). Libraries have to play an active role in open science as modern-day libraries are technology-driven, curating and preserving open data (Mumelaš & Martek, 2024). These services enhance research and innovation in diverse areas of knowledge (Adekoya et al., 2024). According to Abankwa and Yuan (2019), the duties of libraries as custodians of knowledge encompass establishing frameworks for the management, preservation, and curation of datasets as a way of ensuring that such data can be accessed and reused by prospective researchers.

The benefits of open science are the prospect for innovative scientific discoveries, reproducibility of scientific results, an expedition of cross-disciplinary collaboration, economic growth via enhanced prospects for invention, improved resource efficiency, getting open support for research funding, and enhancing public trust in research (OECD, 2020). Open science initiative expedites open access to publications. Hoorn (2014) averred that open science plays a crucial role in expediting the required scientific research and innovation process. Open science disrupts how science is performed, catalyses the creative process and removes the obstructions to the diffusion of knowledge. It enhances openness through quick, appropriate and high-quality scientific communication between scholars and society at large, promoting improved reaction to societal challenges (European Commission (2017).

Challenges in Opening the Science in Library Services

Opening the science in library services requires embracing open science initiatives which needs maximum input of staff and library leadership. Funds have to be sufficiently available to acquire the necessary infrastructure and facilities. (Catalini & Gans, 2016). More so the acquisition of library infrastructure and facilities requires budgetary outlay, and some of the libraries are unable to meet the financial requirements.

Adekoya (2020) averred that some libraries are operating under inadequate budget. This has the possibility of hindering their investment in the infrastructure needed for open science initiatives.

Technological deficiencies experienced by libraries can impede the successful opening of the science in library services. According to Zhang et al. (2020), using advanced technologies which include AI and Blockchain for data management and security requires technical expertise and resources. Chowdhury (2024) averred that some libraries do not have staff who are technology-savvy. Most of the librarians are not well-versed in using AI and blockchain for managing data and securing information in the library. Scalability is among the main concerns for Blockchain systems, as the devolved nature of the tool may cause limitations in transaction speed and network capacity (Narayanan et al., 2016). Catalini and Gans (2016) noted that as Blockchain networks enlarge, sustaining the level of performance while allowing enhanced the size of transaction is a great challenge.

Some library staff are resistant to change. Meanwhile, the disruptive innovations in libraries requires that library staff are ready to embrace changes as a way of enhancing service provision in libraries (Adekoya & Adedimeji, 2023). More importantly, the transition to open science may encounter resistance from stakeholders who are accustomed to traditional publishing and research paradigms (Banovic, 2020). Also, the challenge of ethical and legal concerns is monumental in the adoption of open science. This is inherent due to the necessity for libraries to navigate complex matters related to data privacy, intellectual property rights, and the ethical use of AI (Baez et al., 2021). Ibinaiye and Jiyane (2021) observed the transformations and challenges open science has brought to academic libraries and found that academic libraries encounter challenges concerning the provision of support for open big data, the expansion of library services, and the adoption of new roles and responsibilities. Most of the libraries have not developed supporting models for research data management. Some find it difficult to provide data management plan assistance, provide data science literacy, and integrate library services into the research and educational process.

Strategies for opening the Science in Library Services

As advancement in technology continues to enhance and transform service delivery in libraries, libraries have to leverage technological advancement in opening the science in service delivery using some strategies. Overgaard and Kaarsted (2018) claimed that the science in library service delivery can be opened by promoting citizen science initiatives. Citizen science initiatives deal with involving the public in scientific research by considering the data, observations, or analysis offered by non-professionals in advancing knowledge in different disciplines. Libraries permit the public to partake in citizen science tasks and foster inclusivity and community-driven research by organising workshops, offering information resources, and forming collaborative spaces.

Opening the science in the delivery of library services in the 5th Industrial Revolution requires the library to encourage digital literacy among the staff. Staff adhere to technological principles and make use of technological innovations more if they have digital literacy (Adekoya & Adedimeji, 2023). Subaveerapandiyan (2023) posited that to leverage the potential of open science in opening the science in-service delivery, libraries have to improve the digital literacy of their staff by providing training programmes in data analysis, AI tools, and ethical considerations in the use of technologies. Also, encouraging collaborative networks is among the pragmatic ways of opening the science in library services through the instrumentality of open science in the era of the 5th Industrial Revolution. Libraries have the potential to serve as centres for interdisciplinary collaboration by facilitating connection among researchers, policymakers, and the public to tackle societal challenges.

Methodology

The study employs the descriptive survey design. The population of the study consist of 100 librarians from 7 public universities in Delta State, Nigeria including: Admiralty University Ibusa, Library (6), Delta State University, Abraka. Library (45), Southern Delta State University, Osoro Library (5), Dennis Osadebe University, Asaba Library (16), Federal University of Petroleum Resources, Effurun, Library (13), Nigerian Maritime University, Okerenkoko, Library (9) and University of Delta, Agbor Library (6). Total enumerative sampling technique was used due to the manageable size of the population. A questionnaire was used as the instrument of data collection. In order to ensure that relevant items were included in the questionnaire, extensive and relevant literature was consulted before the instrument for data collection was constructed; to ensure face and content validity. The questionnaire had three sections. Section A elicited information on the significance of integrating open science in library services in the 5th Industrial Revolution. Section B elicited information on challenges encountered in opening the science in library service delivery in the 5th Industrial Revolution. Section C elicited information on the strategies for opening the science in service delivery in the 5th Industrial Revolution. Descriptive statistical tools of frequency count and percentage were used for data analysis. Responses were scaled on Agree and Disagree. This was facilitated with the use of SPSS version 21. Answers were presented in tables. Out of the 100 copies of the questionnaire administered, 73(73%) were returned and used for the study.

Results

RQ1: What is the significance of integrating open science in library services in the 5th Industrial Revolution?

Table 1: Significance of integrating open science in library services in the 5th Industrial Revolution

S/N	Significance	Agree		Disagree	
		No.	%	No.	%
i	Provision of access to a series of information resources and research data	73	100	0	0
ii	Encouragement of digital literacy among the staff	73	100	0	0
iii	Encouragement of collaborative networks	66	90.4	7	9.6
iv	Establishment of frameworks for the management, preservation, and curation of datasets	62	84.9	11	15.1
v	Promotion of citizen science initiatives	55	75.3	18	24.7

Table 1 shows that the significance of integrating open science in library services in the 5th Industrial Revolution included the provision of access to a series of information resources and research data 73(100%), encouragement of digital literacy among the staff 73(100%), and encouragement of collaborative networks 66(90.4%). This shows that open science was highly significant in library services in the 5th Industrial Revolution.

RQ2: What are the challenges encountered in opening the science in library service delivery in the 5th Industrial Revolution'

Table 2: Challenges encountered in opening the science in library service delivery in the 5th Industrial Revolution

S/N	Challenges	Agree		Disagree	
		No.	%	No.	%
i	High budgetary outlay	71	97.3	2	2.7
ii	Technological deficiencies among staff	66	90.4	7	9.6
iii	The ethical use of AI	60	82.2	13	17.8
iv	Intellectual property rights	46	63.0	27	37
v	Navigation of complex issues about data privacy	44	60.3	29	39.7
vi	Resistance to change among staff	24	32.9	49	67.1

As revealed in Table 2, the challenges encountered in opening the science in library service delivery in the 5th Industrial Revolution are high budgetary outlay 71(97.3%), technological deficiencies among staff 66(90.4%), the ethical use of AI 60(82.2%), intellectual property rights 46 (63.0) and navigation of complex issues about data privacy 44(60.3%). This implies that several challenges are encountered in opening the science in library service delivery in the 5th Industrial Revolution.

RQ3: What are the strategies for opening the science in service delivery in the 5th Industrial Revolution?
Table 3: Strategies for opening the science in service delivery in the 5th Industrial Revolution

S/N	Strategies	Agree		Disagree	
		No.	%	No.	%
i	Development of robust policies on open science	67	91.8	6	8.2
ii	Invest in AI infrastructure	63	86.3	10	13.7
iii	Enhancing the skills of library staff and users in open science tools, data management, and emerging technologies through training	61	83.6	12	16.4
v	Fostering collaboration with other libraries, governments, and international organizations to share resources and expertise	56	76.7	17	23.3
v	Engaging communities in library programmes to promote inclusivity	56	76.7	17	23.3
vi	Advocating for policy reforms on open science practices by working with policymakers to create regulations that support open access to publicly funded research	51	69.9	22	30.1
vii	Promotion of citizen science initiatives	51	69.9	22	30.1
viii	Encouragement of digital literacy among staff	49	67.1	24	32.9
ix	Encouraging collaborative networks	49	67.1	24	32.9

Table 3 reveals that the strategies for opening the science in service delivery in the 5th Industrial Revolution include the development of robust policies on open science 67(91.8%), investing in AI infrastructure 63(86.3%), and enhancing the skills of library staff and users in open science tools, data management, and emerging technologies through training 61(83.6%). With these strategies, service delivery can be enhanced through open science.

Discussion

The era of the 5th Industrial Revolution requires libraries to open the science in service delivery by embracing open science. This study found that the significance of integrating open science in library services in the 5th Industrial Revolution are provision of access to a series of information resources and research data, encouragement of collaborative networks, establishment of frameworks for the management, preservation, and curation of datasets, and promotion of citizen science initiatives. This is in agreement with the position of Abankwa and Yuan (2019) that libraries enhance their online service provision using the open science technology. Also, the study found that integrating open science in service provision encourages digital literacy among the staff. This is in agreement with the finding of Ekweme et al. (2024) that digital literacy and collaborative networks are enhanced with the use of open science in libraries.

It was found in this study that challenges such as high budgetary outlay, technological deficiencies among staff, resistance to change among staff, and navigation of complex issues about data privacy, intellectual property rights, and the ethical use of AI are encountered in opening the science in library service delivery in the 5th Industrial Revolution. This makes it difficult for library staff to fully adopt and use open science technology. This is in line with the finding of Zhang et al. (2020) that librarians experience technological deficiencies which can impede successful opening of the science in library services. Also, Chowdhury (2024) observed that most of the libraries do not have technology-savvy staff that can facilitate the use of open science technology in libraries. More so, the issue of resistance to change among library staff has been heavily criticized in the literature. Adekoya and Adedimeji (2023) asserted that adopting new technological innovation in libraries requires that library staff are ready to embrace changes as a way of enhancing service provision in libraries.

The strategies for opening the science in service delivery in the 5th Industrial Revolution, as found in this study, include the development of robust policies on open science, investing in AI infrastructure, and enhancing the skills of library staff and users in open science tools, data management, and emerging technologies through training. This is in agreement with the finding of Zhang et al. (2020) that there is a need to develop policies guiding open science. Chowdhury (2024) advocated for policy reforms on open science practices by working with policymakers to create regulations that support open access to publicly funded research. Abankwa and Yuan (2019) claimed that libraries are opening the science in service delivery by promoting citizen science initiatives which entails involving the public in scientific research by considering the data, observations, or analysis offered by non-professionals in advancing knowledge in different disciplines.

Conclusion

The 5th Industrial Revolution provides a special prospect to re-envision library services using open science initiatives. In the current era of the 5th Industrial Revolution, libraries have to open the science in service delivery through the adoption of open science. Integrating open science in library services is very significant in the era of the 5th Industrial Revolution as open access aids the provision of access to a series of information resources and research data. Opening the science in the delivery of library services by embracing technological developments and human-centric values enables libraries to serve as promoters for inclusive, transparent, and collaborative research ecosystems. Nevertheless, some challenges are encountered in opening the science in library service delivery in the 5th Industrial Revolution. By employing strategies such as the development of robust policies on open science, investing in AI infrastructure and enhancing the skills of library staff and users in open science tools such changes can be subdued.

Recommendations

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

1. Libraries should embrace open science as a technology for providing effective services to users in the era of the 5th Industrial Revolution.
2. Library staff should enhance their skills in the use of open science technology and be ready to embrace technological changes at all times.
3. The library should adopt strategies such as the development of robust policies on open science, investing in AI infrastructure, and enhancing the skills of library staff and users in open science tools as a way of opening the science in service delivery in the 5th Industrial Revolution.

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Perception and Readiness of Librarians in Deploying Artificial Intelligence and Technology for Innovative Service Delivery in University Libraries in Katsina State

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Abstract

This study examined the perception and readiness of librarians in deploying Artificial Intelligence (AI) for innovative service delivery in university libraries in Katsina State. A descriptive survey research design was employed in carrying out the study. It targeted librarians from three selected university libraries in the State namely, Federal University, Dutsinma (FUDMA), Umaru Musa Yar'adua University, Katsina (UMYU) and Aqalam University Katsina (AUK). The total population of the study is 274 subjects. A sample of 132 respondents were drawn from the total population using proportionate random sampling technique. Therefore, the data was collected from the 152 librarians of 3 university libraries in the State. Statistical Package for Social Sciences (SPSS version 20.0) application software was used to analyze the data collected. Simple percentages were chosen for easier analysis and interpretation of the data collected. The major findings revealed that librarians are moderately aware of Artificial Intelligence (AI) technologies. Their potential to enhance service delivery, information access, and user satisfaction was also moderate. However, their perception and readiness to deploy AI technologies were influenced by factors such as technological infrastructure, digital skills, institutional support, and policy frameworks. The major challenges identified as affecting the deployment of AI in university libraries include inadequate funding and staff training, resistance to change on the part of the library staff, as well as rapid pace of technological advancements. The study recommended the need for capacity-building initiatives, partnership with technology providers. Development of a comprehensive AI integration policy was also recommended. Additionally, the study suggested the incorporation of AI-related courses and training programs in our library schools among others.

Keywords: Artificial Intelligence, Service Delivery, Librarians, University Libraries

Introduction

The advent of artificial intelligence (AI) and technology has transformed various sectors, including libraries. University libraries, in particular, are leveraging AI and technology to enhance service delivery and meet the evolving needs of their patrons. Librarians' perceptions of artificial intelligence (AI) and technology play a crucial role in its adoption and implementation in university libraries. The readiness of librarians in deploying artificial intelligence (AI) and technology has been a growing concern in the library and information science field. Studies showed that librarians' readiness to adopt AI and technology is influenced, including their technical skills, knowledge, and attitudes. The potential benefits of AI and technology in university libraries are numerous. Improved service delivery: AI-powered services can enhance user experience, increase efficiency, and provide support. Automation of routine tasks: AI can automate routine tasks, freeing up librarians to focus on more complex and value-added services. Enhanced knowledge management: AI can help libraries manage and provide access to vast amounts of information, improving knowledge discovery and innovation.

Statement of the Problem

The adoption of artificial intelligence (AI) and technology in university libraries has the potential of enhancing service delivery and improve user experience. However, despite the growing importance of AI in libraries, there is dearth of empirical investigation on the perception and readiness of librarians in deploying AI and technology for innovative service delivery in university libraries in Katsina State.

Previous Studies showed that librarians' perception and readiness play a crucial role in the successful adoption and implementation of AI and technology in libraries (2018Cox). However, it is observed that many librarians lack the necessary skills and knowledge to effectively utilize AI technologies [2]. A study by Oniovoghai et al. (2023) found that librarians in Nigeria are eager to leverage AI for improved service delivery, but require training and development to build their capacity.

Despite the growing body of research on AI in libraries, the perception and readiness of librarians in deploying AI for service delivery in university libraries in Katsina State has not been reported by the previous research. Therefore, this study aimed to bridge this gap by assessing the perception and readiness of librarians in deploying AI and technology for innovative service delivery in university libraries in Katsina State.

Research Objectives

1. To assess the perception of librarians towards the deployment of artificial intelligence and technology in university libraries in Katsina State.
2. To examine the readiness of librarians in deploying artificial intelligence and technology for innovative service delivery in university libraries under study
3. To explore the potential benefits of artificial intelligence and technology in enhancing service delivery in university libraries under study

Literature Review

Perception of Librarians towards AI and Technology

Research has shown that librarians generally have a positive perception of AI, recognizing its potential to enhance service delivery and improve library operations [1]. However, some librarians may harbor concerns about job displacement and the need for new skills to work effectively with AI technologies.

The perception of librarians towards artificial intelligence (AI) and technology has been a topic of interest in recent years. Studies have shown that librarians have varying perceptions towards AI and technology, ranging from enthusiasm to skepticism.

According to a study by Cox and Pinfield (2019), librarians are increasingly recognizing the potential benefits of AI and technology in improving library services, such as enhancing user experience and increasing efficiency (Cox2019). However, they also note that librarians may have concerns about the impact of AI on their roles and the need for new skills.

Another study by Fernández (2020) found that librarians are generally positive about the potential of AI to improve library services, but they also express concerns about the lack of transparency and accountability in AI decision-making processes (Fernández 2020)

A study by Kaushik (2020) explored the perceptions of librarians towards AI-powered chatbots in libraries, finding that librarians believe chatbots can improve user experience and provide 24/7 support, but also raise concerns about the limitations of chatbots in providing personalized support (Kaushik, A. (2020).)

Readiness of Librarians in Deploying AI and Technology

Studies have highlighted the importance of librarians' readiness to adopt and utilize AI and technology in university libraries. This includes having the necessary skills, knowledge, and infrastructure to support AI-powered services [2]. Research has shown that librarians in Nigeria, for instance, are eager to leverage AI for improved service delivery, but may require training and development to build their capacity.

According to a study by Arkorful and Abaidoo (2019), librarians need to develop new skills and competencies to effectively utilize AI and technology in libraries, such as data analysis and programming [1]. The study emphasizes the importance of training and professional development programs to enhance librarians' readiness.

Another study by Chiu and Ho (2020) found that librarians' attitudes towards AI and technology are influenced by their perceived usefulness and ease of use (Chiu 2020). The study suggests that librarians are more likely to adopt AI and technology if they believe it will improve their work efficiency and effectiveness. A study by Kimand Lee (2019) explored the readiness of librarians in deploying AI-powered library services, finding that librarians need to develop a deeper understanding of AI and its applications in libraries [3].

Potential Benefits of AI and Technology

The potential benefits of artificial intelligence (AI) and technology in libraries have been extensively discussed in the literature. Studies have highlighted the potential of AI and technology to improve library services, enhance user experience, and increase efficiency.

According to a study by Breeding (2020), AI-powered technologies can automate routine tasks, freeing up librarians to focus on more complex and value-added services (Breeding 2020). The study highlights the potential of AI to improve the efficiency and effectiveness of library operations.

Another study by Fernández (2020) found that AI-powered chatbots can provide 24/7 support to library users, answering frequently asked questions and directing users to relevant resources (Fernández 2020). The study emphasizes the potential of AI-powered chatbots to enhance user experience and provide personalized support.A study by Kaushik (2019) explored the potential of AI to improve information retrieval in libraries; finding that AI-powered search algorithms can provide more accurate and relevant search results (Kaushik 2019)

Expected Outcome

The study aims to provide insights into the perception and readiness of librarians in university libraries in Katsina State towards the adoption and utilization of artificial intelligence and technology for innovative service delivery in the libraries. The findings of this study will inform strategies for enhancing the adoption and effective utilization of AI and technology in university libraries.

Gap in Existing Research

Existing research has focused on the adoption of AI in libraries in general, but there is a lack of studies that specifically examine the perception and readiness of librarians in university libraries in Katsina State. This study aims to address this gap and provide insights into the challenges and opportunities associated with the adoption of AI and technology in university libraries in Katsina State.

Methodology of the study

This study employed a survey research design to assess the perception and readiness of librarians in deploying artificial intelligence and technology for innovative service delivery in university libraries in Katsina State. The population of this study involved 274 library staff of three universities in Katsina State. This include Federal University Dutsinma (177), Umaru Musa Yar'adua University, Katsina (66) and Al-qalam University, Katsina (31). A proportionate random sampling technique was used to draw a sample of 132 respondents for the study. Statistical Package for Social Sciences (SPSS version 20.0) application software was used to analyze the data collected. Simple percentages were chosen for easier analysis and interpretation of the empirical data collected.

Presentation and Analysis of Data Collected

This section presented and analyzed the empirical data obtained from the respondents of the study. This was in an attempt to answer the research objectives of the study. The data presented in this chapter was drawn from questionnaires administered to the 152 respondents of the study.

Response rate

The level of response rate in social research is considered an important and crucial factor in assessing the value of the research findings (Baruch and Holton 2008). At this point every researcher should aim to attain approximately 60% response rate (Fincham 2008:1). In line with this, the response rate for this study was obtained from the questionnaires administered was reasonably acceptable. The response rate was 84%, and this was recorded as a result of the strong follow ups by the researchers. Table 1 below shows the distribution of the response rate.

Table 1: Response rate

S/N	University	No Of Library Staff	Sample	No. Of quest adm	No. Of ques returned	%
1	FUDMA	177	82	82	72	88
2	UMYU	66	34	34	27	79
3	AUK	31	16	16	12	75
	Total	274	132	132	111	84

Table 1 above shows that 82 questionnaires were administered at FUDMA and 72 (88%) were duly completed and returned. At UMYU, 34 questionnaires were administered and 27 (79%) were duly completed and returned, while at AUK 16 were distributed and 12 (75%) were completed and returned.

The Perception of Librarians towards the Deployment of Artificial Intelligence and Technology in University Libraries

In this section, the opinion of the respondents were solicited regarding the perception of Librarians towards the Deployment of Artificial Intelligence and Technology in University Libraries and Table 3 below shows the result.

Table 3: Perception of Librarians towards the Deployment of Artificial Intelligence and Technology in University Libraries

S/N	Items	Yes	%	No	%
1	Are you aware of the concept of artificial intelligence (AI) in libraries?	110	(83.3 %	22	16.7 %
2	Do you think AI can improve service delivery in university libraries?	115	87.1 %	17	12.9 %

3	Are you interested in learning more about AI and technology in libraries?	117	88.6 %	15	11.4 %
4	Do you believe AI and technology can enhance user experience in university libraries?	120	90.9 %	12	9.1%
5	Are you concerned about the potential impact of AI on librarians' roles?	114	86.4 %	18	13.6 %
6	Do you think AI and technology can help librarians in cataloging and classification?	107	81.1 %	25	18.9 %
7	Are you willing to participate in training programs on AI and technology?	127	96.2 %	9	3.8%
8	Do you believe AI and technology can improve information retrieval in university libraries?	116	87.9 %	16	12.1 %
9	Are you aware of any AI-powered library services currently being used in other libraries?	18	13.6 %	11 4	86.4 %
10	Do you think AI and technology can support research and innovation in university libraries?	128	97%	4	3%

Based on the findings of the study, Table 3 above reveals that the majority of librarians (83.3%) were aware of the concept of AI in libraries, indicating a good foundation for further development, most librarians (87.1%) believed AI could improve service delivery, showing optimism about its potential benefits. The table shows that, Librarians were eager to learn more about AI and technology, with 88.6% expressing interest. A significant majority (90.9%) believed AI and technology could enhance user experience. Many librarians (86.4%) were concerned about the potential impact of AI on their roles. Likewise it revealed that most librarians (81.1%) thought AI could help in cataloging and classification. An overwhelming majority (96.2%) were willing to participate in training programs. As it shows that Librarians believed AI and technology could improve information retrieval. However, most librarians (86.4%) were unaware of AI-powered library services currently being used. Almost all librarians (97%) believe AI and technology could support research and innovation.

Therefore, this study reveals a positive perception of AI and technology among librarians, with a strong interest in learning more and participating in training programs. However, there is a need for awareness about AI-powered library services and addressing concerns about the impact of AI on librarians' roles.

The readiness of librarians in deploying artificial intelligence and technology for innovative service delivery in university libraries

In this section, respondents were asked to indicate their opinion on the readiness of librarians in deploying artificial intelligence and technology for innovative service delivery in university libraries. Table 4 below reveals their opinions as indicated.

Table 4: The readiness of librarians in deploying artificial intelligence and technology for innovative service delivery in university libraries

S/N	Items	Yes	%	No	%
1	Do you have the necessary skills to work with AI and technology in libraries?	16	12.1%	116	87.9%
2	Have you received any training on AI and technology in libraries?	10	7.6%	122	92.4%
3	Are you confident in your ability to use AI-powered library tools and services?	17	12.9%	115	87.1%
4	Do you have access to the necessary infrastructure and resources to support AI and technology in your library?	11	8.3%	121	91.7%
5	. Are you willing to adapt to new roles and responsibilities that may arise from the adoption of AI and technology?	114	86.4%	18	13.6%

6	Are you familiar with the potential benefits and challenges of AI and technology in libraries?	34	25.8%	98	74.2%
7	Do you believe your library provides adequate support for professional development in AI and technology?	27	20.5%	112	79.5%
8	Do you think your library has a clear plan for implementing AI and technology?	16	12.1%	116	87.9%
9	Have you collaborated with IT professionals or experts in AI and technology on library projects?	11	8.3%	121	91.7%
10	Are you ready to take on new challenges and opportunities presented by AI and technology in libraries?	111	84.1%	21	15.9%

Table 4 above revealed that most librarians (87.9%) lacked the necessary skills to work with AI and technology. It also showed that few librarians (7.6%) received training on AI and technology. However, most librarians (87.1%) lacked confidence in using AI-powered library tools. Most libraries (91.7%) lacked the necessary infrastructure and resources. as it revealed that most librarians (86.4%) were willing to adapt to new roles and responsibilities. Many of them (74.2%) were unfamiliar with the potential benefits and challenges. However, mostlibraries79.5%) did not provide adequate support. And (87.9%) of the libraries lacked a clear plan. The data showed that only few librarians (8.3%) collaborated with IT professionals. Likewise, it revealed that most librarians (84.1%) were ready to take on new challenges.

Therefore, in this study, it is clear that librarians were willing to adapt and take on new challenges, but lacked the necessary skills, training, infrastructure, and support. As such libraries needed to invest in training, infrastructure, and planning to support the adoption of AI and technology.

The potential benefits of artificial intelligence and technology in enhancing service delivery in university libraries

In this section, opinions of the respondents were solicited on the potential benefits of artificial intelligence and technology in enhancing service delivery in university libraries as shown in Table 5 below.

Table 5: The potential benefits of artificial intelligence and technology in enhancing service delivery in university libraries

S/N	Items	Yes	%	No	%
1	Do you think AI and technology can improve the efficiency of library services?	125	94.7%	7	5.3%
2	Can AI-powered tools enhance the accuracy of cataloging and classification?	105	79.5%	27	20.5%
4	Do you believe AI and technology can provide 24/7 support to library users?	117	88.6%	15	11.4%
5	Can AI and technology help librarians provide personalized recommendations to users?	120	90.9%	12	9.1%
6	Do you think AI -powered chatbots can effectively answer frequently asked questions?	101	76.5%	31	23.5%
7	Can AI and technology improve the discovery and access to library resources?	97	73.5%	35	26.5%
8	Can AI and technology help librarians in analyzing user behavior and preferences?	27	20.5%	105	79.5%
9	Do you think AI and technology can support research and innovation in university libraries?	126	95.5%	6	4.5%
10	Can AI and technology improve the overall quality of library services?	117	88.6%	15	11.4%

From the data in Table 5 above, it revealed that most librarians (94.7%) believed AI and technology could improve service efficiency. (79.5%) librarians thought that AI-powered tools could enhance cataloging and classification in the libraries. However, most librarians (88.6%) believed AI and technology could provide 24/7services and support in the libraries. The study revealed that many librarians (90.9%) thought that AI and technology could help in providing personalized services in the libraries. Most librarians (76.5%) believed AI-powered chat bots could effectively answer FAQs. Likewise, the data revealed that many librarians (73.5%) were of the opinion that AI and technology could improve discovery and access to information. But few librarians (20.5%) thought AI and technology could help analyze user behavior. However, (95.5%) believed AI and technology could support research and innovation. Most librarians (88.6%) thought AI and technology could improve the overall quality of services. The findings revealed that librarians believed AI and technology could bring numerous benefits, including improving efficiency, providing 24/7 services, and supporting research and innovation. However, there wss less confidence in AI's ability to analyze user behavior.

Conclusions

This study revealed a positive perception of AI and technology among librarians, with a strong interest in learning more and participating in training programs. However, librarians lacked the necessary skills, training, infrastructure, and support to effectively utilize AI and technology. The study also highlighted the potential benefits of AI and technology, including improving efficiency, providing 24/7 support, and supporting research and innovation.

Recommendations

1. The study recommended training and development programs to enhance librarians' skills and confidence in using AI and technology.
2. The study recommended investment in infrastructure and resources to support the adoption of AI and technology in libraries.
3. The study recommended clear plans and strategies for implementing AI and technology in libraries.
4. The study recommended collaboration between librarians and IT professionals to support the adoption of AI and technology.
5. The study recommended incentives for librarians to participate in training and workshop

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Perception and Use of Google Search Engine for Web Searching by Postgraduate Students in Federal University Dutsin-Ma, Katsina State, Nigeria

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Abstract

This study investigates the perception and use of Google Search Engine for web searching by postgraduate students in Federal University Dutsin-Ma, Katsina. The study is driven by the increasing reliance on Google search engine for web searching on scholarly work and other engagements, the need to evaluate the extent to which postgraduate student use Google for web searching becomes imperative. The objectives include examining the frequency of Google Search Engine usage for web searching among postgraduate students, assess the postgraduate students' level of dependence on Google Search Engine as their primary tool for web searching, to examine the extent to which postgraduate students have received formal training on effective web searching using the Google Search Engine, and to determine the perception of postgraduate students on the use of Google search engine for web searching. A descriptive survey design was adopted, and data were collected using a structured questionnaire administered online. The study employed a three-point Likert scale to investigate perception and usage of Google search engine for web searching. The findings reveal that (82.4%) used it frequently for social media/entertainment, while 307 students (90.3%) did so for news and job-related searches, and 73.5% (250 students) reported that they heavily rely on Google as their primary academic tool for web searching, Despite the widespread use, a substantial 60% (204 out of 340) of postgraduate students reported no training at all in effectively using Google Search. Based on these findings, the study recommends integrating digital literacy training into postgraduate curricula, organizing library-led workshops on advanced search techniques; institutions should provide targeted training on advanced search techniques and academic resource evaluation to help students use Google more effectively and critically for academic purposes. Additionally, libraries should promote awareness and accessibility of institutional databases to complement students' heavy reliance on Google

Keywords: *Google Search Engine, Web Searching, Postgraduate Students, Federal University Dutsin-Ma.*

Introduction

Google search engine is the world's most widely used search engine, handling over 8.5 billion searches per day globally (Statista, 2023). This search engine provides users with access to a vast amount of information across websites, news, images, videos, and scholarly content.

In many countries, including Nigeria, Google is the dominant search platform due to its speed, accuracy, and user-friendly interface. According to DataReportal (2024), over 98% of Nigerian internet users rely on Google Search for daily information needs. Locally, it plays a key role in business visibility, education, and digital marketing, making it an essential tool in both urban and rural digital ecosystems (Okon & Etim, 2022).

Google continuously improves its algorithms with features like voice search, AI-driven suggestions, and localized results to better serve users around the world. Its global influence and local adaptability have cemented its role as an indispensable part of the modern internet landscape.

Locating information on the internet through World Wide Web using search engines like Google, Bing, or Yahoo is referred to as web searching. It is a vital component of digital literacy and modern communication, allowing users to access diverse sources of information for education, business, research, health, and daily life. With over 5.3 billion internet users globally (Internet World Stats, 2023), web searching has become a key gateway to knowledge in today's digital society.

In most of the Universities, particularly among the postgraduate students, the growing penetration of mobile internet and digital devices has increased reliance on search engines by the students. Reports show that over 98% of internet users in Nigerian Universities use Google Search for daily information needs, particularly academic content, news, government data, tutorials, and more (DataReportal, 2024). As such, web searching plays a fundamental role in promoting digital inclusion and access to knowledge in both developed and developing regions. It is against this background that this paper investigates the perception and use of google search engine for web searching by postgraduate students of Federal University Dutsin-Ma, Katsina.

Statement of the Problem

In the digital age, search engines like Google have become indispensable tools for web searching and information retrieval. Globally, Google Search dominates the search engine market, with over 90% market share, making it the primary tool for online information access (StatCounter, 2023). Despite this widespread use, studies suggest that users especially student often lack the critical search skills needed to evaluate and utilize information effectively (Head & Eisenberg, 2010). This issue is more pronounced in developing contexts where digital literacy is still evolving.

Based on a preliminary investigation carried out by the researchers at Federal University Dutsin-Ma in Katsina State, it was discovered that postgraduate students increasingly depend on Google Search for web searching, despite the many and varied search engines available and accessible to use for searching the web. However, their perception of its reliability, and their actual proficiency in using its advanced features (such as Boolean operators, scholarly filters, and search modifiers), as well as the justifications for the continued use of google search engine remain largely unresearched especially in the study area. Studies in Nigeria have revealed gaps in students' understanding of effective web searching strategies, resulting in shallow information use and academic inefficiencies (Adeleke & Adebayo, 2020; Okon & Etim, 2022).

Therefore, it is essential to investigate the postgraduate students' perception of and use Google Search engine by postgraduate students in FUDMA. This will help identify skill gaps, information digital literacy initiatives, and enhance the quality of academic research in Nigerian higher education.

Research Objectives

The objectives of the study are:

1. To determine the frequency of Google Search Engine usage for web searching by postgraduate students in Federal University Dutsinma.
2. To assess the postgraduate students' level of dependence on Google Search Engine as their primary tool for web searching in Federal University Dutsinma.
3. To examine the extent to which postgraduate students have received formal training on effective web searching using the Google Search Engine in Federal University Dutsinma.
4. To determine the perception of postgraduate students on the use of Google search engine for web searching in Federal University Dutsinma.

Literature Review

The Google Search engine has become a fundamental tool for postgraduate students worldwide in accessing academic, personal, and general information. Its user-friendly interface, vast information base, and free accessibility make it the go to search engine for many students.

Google Search Usage among Postgraduate Students

The rise of internet-enabled academic research tools has made search engines like Google an indispensable part of postgraduate education. Understanding how much time postgraduate students spend using Google 24/7 provides insight into study patterns, research behaviors, and the integration of digital tools into academic workflows. **Adetimirin and Omeluzor (2020)** surveyed postgraduate students at the University of Ibadan and found that **73% of respondents used Google Search daily,** with an average of **8–10 hours per week.** Most of this time was spent searching for journal articles, thesis materials, and general research support. Similarly, **Adeleke and Emeahara (2016)** reported that postgraduate students at the University of Ibadan spent **more than 1 hour daily (approximately 7–14 hours weekly)** on Google and related platforms. The study also highlighted that students from the humanities spent slightly more time compared to those in engineering and physical sciences.

Studies consistently show that postgraduate students use Google extensively for academic purposes, though reported usage hours vary by institution and discipline. While on the other hand, **Okon et al. (2021)** observed that while many students used Google heavily, few had training in optimizing search time or applying advanced search techniques, potentially increasing the time spent per session.

Additionally, **Singh and Singh (2019)** found that postgraduate students in Indian Universities used Google Search for approximately **12–15 hours weekly**, with engineering and medical students often exceeding this due to project demands. In the same vein, **Majid and Abazova (2015)** surveyed postgraduate students at a Malaysian Public University and found that students spent **9–11 hours weekly** on Google Search, using it mostly for literature reviews and course-related research.

Integration of digital technologies into higher education has transformed how students percieved and use information. Among these tools, Google Search stands out as the most commonly used search engine. Its accessibility, speed, and ease of use have made it an essential tool for postgraduate students in Nigerian universities. However, its use also raises questions about information credibility, academic integrity, and digital literacy.

Several studies have documented the widespread use of Google Search among students in Nigerian higher institutions.

Adebayo and Adetimirin (2015) reported that over 80% of students at selected Nigerian universities relied primarily on Google to locate academic information. The convenience and volume of resources available were

major motivating factors. In another study by **Adetimirin and Omeluzor (2020)** found that students used Google more frequently than library databases, often bypassing institutional e-resources due to perceived complexity or access issues. Similarly, **Nwosu and Ugwulebo (2012)** found that students appreciated the broad spectrum of topics Google could deliver, from lecture content to assignment help.

In the same vein, **Ajiboye and Tella (2007)** emphasized the role of Google in supporting self-directed learning, especially among students in remote or underfunded institutions.

Additionally, **Ani and Ahiauzu (2008)** argued that Google helps bridge the information divide by offering students immediate access to global knowledge repositories that were previously inaccessible.

Web Searching

Web searching refers to the process of using internet-based search engines to locate and retrieve information on various topics. It is a fundamental part of online research, education, and general information retrieval. Several studies have investigated how users engage with search engines, search behavior, algorithms, and the challenges faced in optimizing web search results.

According to **Okorie (2018),** web searching behavior in Nigeria has shifted significantly due to growing internet penetration, with users preferring search engines like Google for academic research, social networking, and commercial transactions. Similarly, **Chikomo & Nyoni (2019)** highlight the growing influence of local search engines within Zimbabwe. They argue that search engines designed with local languages, such as Shona and Ndebele, offer better access to information, leading to more effective information retrieval.

Use of Google Search as Primary Tool for Web Searching among Postgraduate Students

Google Search has become the most widely used search engine globally, particularly in academic settings. Among postgraduate students, its dominance is evident due to ease of use, availability, and access to a broad array of information. This review investigates how many postgraduate students in Nigeria and selected Asian countries regard Google as their **primary** or **default** search engine.

A number of studies conducted consistently show that **Google Search is the most preferred and widely used tool** for web-based academic research among students.

Adetimirin and Omeluzor (2020) reported that **91%** of postgraduate students at the University of Ibadan and Covenant University used **Google Search as their primary search tool,** significantly ahead of institutional library portals or academic databases like JSTOR and ScienceDirect. Similarly, **Adeleke and Emeahara (2016)** reported that **over 80%** of postgraduate students in their sample used Google Search more than any other information resource, including library databases like JSTOR or EBSCOhost. In the same vein, **Okon et al. (2021)** also confirmed that postgraduate students generally lacked awareness of academic databases and mostly used Google for both academic and non-academic queries. Google was considered the default because of its ubiquitous presence and broad indexing. Furthermore, **Nisha and Ali (2013)** reported that **94%** of postgraduate students in Indian universities regarded **Google as their primary source of information,** ahead of academic repositories and university digital libraries.

Information Literacy and Digital Skills

The effectiveness of Google use is strongly linked to students' information literacy.

A study conducted by **Adetimirin (2016)** concludes that while most students are proficient in using Google, few possess advanced skills such as Boolean searching, source evaluation, or citation management. In the same vein, **Okon et al. (2021)** stressed the need for integrating information literacy into university curricula to improve the quality of student research and reduce misuse of online sources. Accordingly, **Hargittai (2010)** found similar patterns, where digital natives still required structured training to navigate online information effectively.

Challenges Associated with Google Use

Despite its popularity, the use of Google for academic purposes presents several challenges

A study by **Adebayo and Adetimirin (2015)** found that a significant portion of students did not verify the authority of sources found through Google. This entails that many students lack the skills to differentiate between reliable academic sources and commercial or misleading content. Similarly, **Oladokun (2016)** noted that students often select information from the top of the search results page, neglecting to examine deeper or more credible resources. This implies that there is a shallow research habit among the students. Additionally, **Eze and Eze (2018)** observed a correlation between excessive reliance on Google and increased instances of plagiarism, primarily due to copy and paste practices without proper citation.

Research Methodology

This study adopted a **quantitative research method**, employing a **descriptive survey design** to examine the perception and use of Google search engine by postgraduate students in Federal University Dutsin-Ma, Katsina State. The approach allowed for systematic collection and analysis of numerical data to identify usage patterns, frequency, and user perceptions. The target population consisted of all postgraduate students enrolled

at Federal University Dutsin-Ma during the 2024/2025 academic session. As obtained from the College of postgraduate studies in the University under study, 7,774 postgraduate students were enrolled. This figure encompasses a diverse range of programs, including Ph.D., MPhil, MSc, and Postgraduate Diploma (PGD) courses.

Cluster sampling technique was used to draw a sample size for this study in order to ensure representation from different departments, faculties, or programs. In recognition of the fact that the population of the study is very large and further divided into mutually exclusive groupings/clusters, and then select randomly among the clusters to form a sample, (Simkus, 2022). In order to ensure equal representation from each cluster, proportionate simple random sampling was adopted to select respondent from the study. In all, the total of 381 postgraduate students were selected as sample size using Yamane's formula (1967) simplified sample size calculation. A structured questionnaire titled "Perception and Use of Google Search Engine for Web Searching (PUGSEWS)" was used as an instrument for collecting data from the postgraduate students.

Table 1: *Population Distribution and Sample Size of the Study*

S/N	Faculty/School	% of Total PGs	PG Population	Sample Size
1	Social Sciences	20%	1,555	76
2	Science	15%	1,166	57
3	Education	15%	1,166	57
4	Agriculture & Agricultural Technology	10%	777	38
5	Management Sciences	10%	777	38
6	Art & Humanities	10%	777	38
7	Medical & Health Sciences	10%	777	38
8	Law	5%	388	19
9	Environmental & Urban Planning	3%	233	11
10	Others	2%	155	9
Total		**100**	**7,774**	**381**

Findings and Discussion

Out of the 381 copies of the questionnaire distributed to the postgraduate students drawn from the faculties, departments and programs, a total of 340 copies were duly completed, returned and found usable for this study. This gave the response rate of (89.2%). The data collected for this research were presented and analyzed using frequency distribution tables and simple percentages. The analysis of the responses of the respondents was presented below:

Table 2: Frequency of Google Search Engine Usage for Web Searching

To determine the frequency of Google search engine use for web searching by postgraduate student, a list of web searching activities were presented as follows: Social media access and updates, entertainment content, news and current events, job and career opportunities, online Shopping and price comparison, health and medical information, travel information, technology and gadgets, games and online gaming platforms and academic purposes were given for them to indicate the one that is applicable using a three-point Likert scale of measurement. The options are rarely, sometimes, and frequently.

Web Searching Activity	Rarely	Sometimes	Frequently	Total Respondents
Social media access and updates/ Entertainment content	30	30	280	340
News and current events/ Job and career opportunities	13	20	307	340
Health and medical information/Online shopping and price comparison	35	50	255	340
Travel information/ Games and online gaming platforms	42	60	238	340
Academic Purposes	90	105	145	340

The analysis of responses from 340 postgraduate students shows a clear pattern in web search behavior. A majority reported using Google frequently for non-academic purposes, particularly for social media, entertainment content, news, and job searches. Specifically, 280 students (82.4%) used it frequently for social media/entertainment, while 307 students (90.3%) did so for news and job-related searches. This indicates the growing relevance of Google as a tool for real-time information and career development needs.

These findings are consistent with studies conducted by Adeleke and Adebayo (2020) who found that Nigerian students commonly use search engines like Google for a wide range of personal and academic purposes, with preference given to its speed, accessibility, and breadth of content.

Similarly, health and online shopping searches were also frequent, with 255 students (75%) using Google to find information in these categories, reflecting its role in addressing students' daily lifestyle needs. Travel and gaming-related activities followed closely with 238 respondents (70%) using the search engine frequently.

In contrast, only 145 students (43%) reported frequent use of Google for academic purposes, while a notable 90 respondents (26.5%) said they rarely used it for scholarly activities. This gap may reflect challenges in filtering quality academic content or reliance on institutional databases. According to Onyancha (2019), many African students rely heavily on general-purpose search engines like Google for academic work due to limited access to subscription-based academic databases, though their usage remains uneven across disciplines.

Table 3: Postgraduate Students' Level of use of Google for Web Searching

This is aimed to determine the proportion of postgraduate students who use Google search engine as their primary tool for web searching.

Level of use of Google search engine	Number of Respondents	Percentage (%)
Do not rely on Google for web searching	18	5.3%
Use Google occasionally/as a supplementary tool for web searching	72	21.2%
Heavily depend on Google as a primary academic tool for web searching	250	73.5%

The data reveals a high use of Google search engine as a web searching tool by postgraduate students. Out of 340 respondents, a significant 73.5% (250 students) reported that they heavily rely and use Google as their primary academic tool for web searching. This highlights Google's dominant role in information access, particularly among students seeking quick, wide-ranging, and user-friendly resources.

A moderate proportion (21.2%, 72 students) use Google occasionally or as a supplementary tool, which suggests that while they recognize Google's convenience, they may also incorporate institutional databases, library catalogues, or subject-specific repositories in their research activities.

Only 5.3% (18 students) indicated that they do not rely on Google, possibly due to awareness of its limitations in academic accuracy or due to stronger familiarity with curated academic databases.

These findings are consistent with Umunna and Ekechukwu (2020), who reported that Nigerian students significantly prefer Google for both academic and non-academic information needs due to its speed, accessibility, and broad coverage. Similarly, Lawal and Abubakar (2018) found that students at Nigerian universities commonly adopt Google search for educational tasks, often due to limited access to premium academic databases and insufficient digital library resources.

Table 4: Training Received in Using Google Search Effectively

To evaluate the students' preparedness and competence in using Google Search for academic research, respondents were asked if they had received any form of training.

Type of Training	Number of Respondents	Percentage (%)
No training at all	204	60.0%
Received formal training	39	11.5%
Had informal exposure to training	97	28.5%
Total	**340**	**100%**

The findings showed that a substantial 60% (204 out of 340) of postgraduate students reported no training at all in effectively using Google Search. This suggests a significant gap in digital information literacy, especially concerning the strategic and critical use of search engines for academic purposes.

Only 11.5% (39 students) had received formal training, likely through library instruction sessions or ICT-related courses, while 28.5% (97 students) reported having informal exposure, possibly from peers, workshops, or self-directed learning.

These findings align with Anyaoku et al. (2015) who emphasized that Nigerian university students often depend on trial-and-error methods in digital searching due to limited information literacy training provided by academic institutions.

This underscores the need for structured training programs to improve students' capacity to locate credible and relevant academic resources effectively. As Issa, Amusan, & Daura (2014) pointed out, integrating information literacy skills into the postgraduate curriculum is vital for improving research quality in Nigerian universities.

Table 5: Perception on Effectiveness of Using Google Search Engine for Web Searching

Perception of Effectiveness	Number of Respondents	Percentage (%)
Highly effective	217	63.8%
Moderately effective	92	27.1%
Not effective	31	9.1%
Total	**340**	**100%**

The data shows that a significant majority of postgraduate students perceive Google Search as an effective tool for academic web searching. Out of 340 respondents:

63.8% (217 students) rated Google Search as **highly effective**, reflecting strong confidence in its ability to retrieve relevant academic information quickly and conveniently.

27.1% (92 students) viewed it as **moderately effective**, suggesting that while useful, they may still encounter limitations such as non-academic results or credibility concerns.

Only **9.1% (31 students)** considered Google Search to be **not effective**, indicating that a small proportion either prefer more scholarly databases or are critical of the quality of information retrieved via Google.

These findings align with the study by **Omeluzor et al. (2016)**, which revealed that Nigerian students widely use Google Search due to its **ease of access**, **speed**, and **broad coverage**. However, the authors also noted that students often lack adequate information literacy skills to evaluate the credibility of search results, which may contribute to the perception of moderate or low effectiveness among some users.

Similarly, **Adeleke and Adebayo (2020)** emphasized that while search engines like Google are heavily relied upon by students, structured training and guidance are necessary to help them navigate academic versus non-academic content effectively.

Recommendations

Based on the findings of this study, it is therefore recommended that:

- Universities should integrate digital literacy training into postgraduate programs to help students transition from casual to academic-focused use of Google. This will enhance their ability to evaluate and apply online information effectively for scholarly purposes.
- Institutions should provide targeted training on advanced search techniques and academic resource evaluation to help students use Google more effectively and critically for academic purposes. Additionally, libraries should promote awareness and accessibility of institutional databases to complement students' heavy reliance on Google.
- It is recommended that universities implement formal training programs on effective web searching and digital literacy, especially focusing on academic use of search engines like Google. This will help bridge the knowledge gap and equip postgraduate students with the skills needed to locate and evaluate scholarly information effectively.
- Based on the positive perception of Google Search, academic institutions should leverage its popularity by integrating it into research training while emphasizing strategies for filtering credible academic content. This approach will enhance students' ability to use Google effectively while minimizing reliance on non-scholarly sources.

Conclusion

The findings reveal that postgraduate students heavily rely on Google Search for both academic and non-academic purposes, with a majority perceiving it as highly effective. However, most lack formal training in its academic use, highlighting a significant gap in digital literacy. To address this, institutions should integrate structured web search training into academic programs and promote balanced use of both Google and scholarly databases to enhance research quality and information literacy.

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Perceptions of Librarians Towards the Adoption of Robotics in Library and Information Services Delivery in Chukwuemeka Odumegwu Ojukwu University Libraries

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Abstract

This study examines the perceptions of librarians towards the adoption of robotics in library and information services delivery at Chukwuemeka Odumegwu Ojukwu University libraries. It adopted a descriptive survey design to examine perceptions of librarians towards the adoption of robotics in library and Information services delivery at Chukwuemeka Odumegwu Ojukwu University libraries. The total population of the study was forty (40) library staff. Thirty-seven (37) out of forty (40) library staff responded to the questionnaire. Thirty-seven (37) respondents were therefore, used for the study. The responses were elicited from the population using Google Forms 31 item Statements. The data collected for this study were analyzed using mean scores; with the adoption of a criterion mean point of 2.50. The findings of the study indicated that integration of robotics in libraries is transforming the way information is accessed, interacted with, and utilized. The study revealed that librarians at Chukwuemeka Odumegwu Ojukwu University agree on the benefits of robotics, including location of books, face and security recognition, fast information retrieval, enhanced user experience, record keeping, and increased efficiency. However, challenges such as job loss, lack of funds, and technical issues, need to be addressed. The findings also highlighted the importance of staff training and development to ensure successful implementation of robotic technologies. The study concluded that the future of robotics in libraries involves the development of smart resources and the integration of AI technologies to enhance library services. Collaboration, open communication, and strategic planning are essential for libraries to harness the opportunities of robotics and give quality service delivery. It is recommended that libraries should invest in staff development/ training, prioritize reliable power supply and data protection to support the implementation and maintenance of robotic technology.

Keywords*: Robotics, Library and Information Services Delivery, Librarians' Perceptions.*
Paper Type: Empirical Research
Keywords: robotics, library and Information services delivery, librarians' perceptions,

Introduction

The birth of the Fourth Industrial Revolution (4IR) has brought about unprecedented technological developments, changing the way we live, interact and work. The 4IR is known by the occurrence of physical, digital, and biological systems, enabled by technologies like artificial intelligence (AI), robotics, and the Internet of Things (IoT). As we transition into the Fifth Industrial Revolution (5IR), which stresses human-centered innovation and sustainability, the role of robotics in revolutionizing service delivery is becoming increasingly outstanding.

Robotics is a part of artificial intelligence that came with the 4th industrial revolution. The general use of robots in the society is fast growing. Robots have been increasingly deployed in agriculture, banking, healthcare, and mining as well as in libraries

Libraries are changing from being considered quiet study areas and places to store actual books to becoming vibrant hubs for learning and creativity (De Sarkar, 2023). In the context of library and information services, robotics has the ability to change the way we work, access, interact with, and utilize information. From automated book sorting and shelving to AI-powered chatbots and robotic assistants, the possibilities are vast and exciting. However, the successful integration of robotics in library services depends on the perceptions of librarians, who play vital roles in shaping the user experience and delivering high-quality services.

Technological advancement has forced academic libraries to start adopting emerging technological trends to respond to the changing information needs of their users, who are now more technologically inclined and prefer remote and timely access to information. Smart technologies are the recent trend in academic libraries. Smart technologies have the potential to enhance academic library services provision and also support the distance learning environment, especially now as higher education embraces online and distant learning.(Hamad, Al-fedel & Fakhouri, 2022).

This study explored the perceptions of librarians towards the adoption of robotics in library and information services delivery. By examining the applications, benefits, challenges, and future directions associated with robotic technologies, this research seeks to provide insights into the potential of robotics to enhance library and information services delivery, improve user experience, and support the evolving information needs of library patrons.

Statement of the Problem

There is an increase in the global adoption of robotics in enhancing library and information service delivery, the integration of such technologies in Nigerian academic libraries however, seems to be limited and largely unexplored. While the potential benefits such as improved service efficiency, enhanced user satisfaction, and automated processes are significant, the challenges such as fear of job displacement, inadequate funding, and technical limitations may hinder progress. It is against this ground that the study seeks to investigate the perceptions of librarians towards the adoption of robotics in library and information services' delivery at Chukwuemeka Odumegwu Ojukwu University, Anambra state, Nigeria.

how librarians perceive the adoption of robotics and identify the factors that may support or impede its integration in academic library settings.

Purpose of the Study

This study aims at examining perceptions of librarians towards the adoption of robotics in library and information services' delivery at Chukwuemeka Odumegwu Ojukwu University, Anambra state, Nigeria.

Specifically, the study aims to;

1. Examine the areas where robotics should be applied in the library
2. Identify benefits of robotics in library and Information service delivery
3. Identify challenges and barriers of robotics in libraries.
4. Recommend ways to tackle the challenges and barriers of robotics in library and information services delivery.
5. Ascertain the future directions of robotics in library and Information service delivery

Research Questions

The following research questions guided the study:

1. Which areas in the library should robotics be applied?
2. What are the benefits of robotics in library and information service delivery?
3. What are the challenges and barriers of robotics in libraries?
4. What are the ways to tackle the challenges and barriers of robotics in library and information services delivery?
5. What are the future directions of robotics in library and Information services delivery?

Literature Review

Conceptualizing Robotics

The study of robots is called "robotics." Robotics is a branch of artificial intelligence that involves the application of machines, designed to perform tasks originally done by humans. Sujatha, (2021) opined that robotics creates machines that can substitute for people and imitate human activities. Robotics is an emerging synthetic science concerned with programming work. A robot is an autonomous machine that follows a computer program to complete difficult tasks (Shahzad, Khan & Iqbal, 2024). Robot technologies are quickly advancing beyond the insights of the existing science (Koditschek, 2021).

In library and information centres, robotics is the use of robots which are parts of to enhance swift and effective services to users. Robotics refers to automated machines used to perform tasks like sorting, shelving, and assisting users. Sharma, Chauhan, Jakhar & Mishra, (2020) listed five major primary areas of robotics as operator interface, mobility or locomotion, manipulator & effectors, programming, sensing & perception. These areas are used to build the robots to perform specific tasks in the library.

Robotics has a direct impact on libraries and information (and social) environments in which libraries and librarians of all types work (Owolabi et al., 2022). The presence of robots in libraries gives librarians more time to focus on other important information service delivery to today's dynamic needs (Teller & Ajani, 2022). Harisanty et al., (2020) listed shelving and locating library materials, security, inquiries and answering of repetitive reference and directional queries, outreach and public relations as some of the areas where robotics have been applied to library operations.

A study carried out by Owolabi et al., (2021) on the awareness and perception of the artificial intelligence in the management of the university libraries in Nigeria, showed that librarians in academic libraries are aware of the existence of AI usage in the university libraries and that they are afraid of job loss in the adoption of the technologies; in as much as they are know that the innovative technologies will enable them provide effective information services to their users. The findings further revealed that academic librarians were made to know that the integration of artificial intelligence in the library does not equate to loss of jobs. Libraries must follow technological trends in order to give a user-satisfactory services.

History of Robotics

The origin of the term "robot," which means "forced labor," was from Czech playwright Karel Capek's 1920 play. However, the concept of robotics has its roots in ancient Greece, with Aristotle's theories on "automated tools." Other influential figures in the history of robotics include: Leonardo da Vinci, who designed a mechanical knight, Henry Ford, who pioneered assembly-line production and Isaac Asimov, who explored robotics in science fiction

Norbert Wiener laid the foundation for modern robotics in 1948, with his development of cybernetics principles. The first autonomous robots surfaced in the late 20th century. Installation of Unimate, the first

digitally controlled and programmable robot, for stacking and removing hot metal parts from a die-casting machine in 1961, and George C. Devol's invention of the first modern robots, including the reprogrammable manipulator "Unimate" in 1950s are notable milestones in robotics. Today, robots are extensively used in various industries and fields, which include manufacturing, packaging, mining, transportation, space exploration, healthcare, weaponry, defense, education and even in libraries.
However, early research and implementation of robotics in library and information centres focused on automating repetitive and labor-intensive tasks such as book retrieval, shelving, and circulation management. The primary motivation was to reduce routine tasks for staff, increase the speed and accuracy of information retrieval, and improve general service productivity (Asemi et al., 2020; St. Patrick Duncan, 2024).

Types of Robots used in Libraries
Tella and Ajani, (2022) examined artificial intelligence (AI) humanoid robots for public libraries reference services. The study aimed to discuss AI and draw the link between it and robotic technology. It adopted conceptual analysis and review of literature on AI humanoid robots for public libraries reference services. The study, however, did not focus only on humanoid robots but also found out that there are other types of robots relevant to libraries which include chatbot, telepresence and shelve-reading robots as well as general robots such as aerospace robots, drones and army robots, commercial entertainment robots, industrial robots and medical-surgical robots. The paper also reported the usefulness of robots in libraries, and the impact of humanoid robots on reference services in public libraries.

Humanoid Robots
Humanoid robots, such as the Nao model and Pepper, are increasingly being used in libraries for interactive tasks. These robots can perform tasks such as guiding visitors, answering reference queries, and even teaching coding to children and teens. Their human-like appearance and ability to engage in basic conversations make them particularly appealing for educational and interactive purposes. (Teller & Ajani, 2022),(Harada, 2017), (Lewis,2015).
Tella, & Ajani, (2022)in their study "robots and public libraries." discovered not only humanoid robots but also other types of robots relevant to libraries including chatbot, telepresence and shelve-reading robots as well as general robots such as aerospace robots, drones and army robots, commercial entertainment robots, industrial robots and medical-surgical robots. This paper also reported the usefulness of robots in libraries, and zero in on robots and reference services in the library. Lastly, this study reported the impact of humanoid robots on reference services in public libraries.

Library Assistant Robots
Library assistant robots are programmed to help librarians in their day-to-day tasks such as book inventory management, book delivery, and shelf organization. These robots often employ technologies like RFID for book tracking and line-following mechanisms to navigate library spaces efficiently. They help reduce the manual workload of librarians, allowing them to focus on more complex tasks. (Kukade, 2024; Kim, 2020; & Prabhu, Abinaya, Archana, & Aishwarya, 2020).

Telepresence and Chatbot Robots
Telepresence robots and chatbots can help to improve communication and information retrieval in libraries. These robots can facilitate remote interactions between library staff and patrons, providing assistance and answering queries without the need for physical presence. This type of robot is particularly useful in large libraries or during times when in-person interaction is limited. (Teller & Ajani, 2022)

Specialized Robots
Some libraries employ specialized robots for specific tasks. For example, auto-tracking booktracks and robotic suits like HAL assist with the physical handling of books, reducing the strain on library staff. Additionally, animal-type guiding robots are used to create a more engaging and friendly environment for visitors. (Kim, 2020)

Collaborative Robots
Collaborative robots, also known as "CollaBots," work together to provide tailored services to library users. These robots are designed to assist each other in performing tasks, enhancing the overall efficiency and service quality in libraries. Library patrons prefer these collaborative systems, appreciating their ability to work in collaboration to meet diverse user needs.(Kang, Hwang, & Kwak,2024)..

Applications of Robotics in Libraries and Information Centres
Robots are currently being used in libraries for a variety of tasks, including managing shelves, controlling circulation workflows, assisting in document retrieval, and transporting articles. They also serve as subject guides and attend to reference queries, thereby improving service productivity and creating a more engaging environment for users (De Sarkar, 2023; Asemi, Ko, & Nowkarizi 2020; & Li, 2022). Additionally, robots are employed in book retrieval and the use of chatbots and voice assistants for library services. (Luca, Narayan, & Cox, 2022).
De Sarkar, (2023) in his study "implementing robotics in library services," explored how robots are being used in the library to transform library services and what the future possibilities of application of robots in libraries

are. In his findings with the practical examples of libraries using different types of robots, summarized diverse activities of artificial intelligence-mediated robots: managing the shelf, controlling circulation workflow, assisting in document retrieval, transporting articles, acting as subject guides, attending reference queries, etc. Originality/value this paper highlights how the introduction of robots in libraries improves the service productivity and creates a more engaging environment with the user group. The benefits and challenges of using robots in the library and the future possibilities are also discussed.(De Sakar, 2023).

Benefits of Robotics in Library and Information Services Delivery

While most students prefer human librarians, there is a significant interest in introducing robots for specific tasks such as giving directions, ensuring security, and answering questions. Robots are seen as effective in performing difficult and time-consuming jobs, which can enhance the overall efficiency of library services (Adetayo, Abwage, & Odunola, 2023).The introduction of intelligent robot technology is expected to improve service efficiency and expand the capabilities of libraries (Li, 2022).

Enhanced User Experience: libraries are placing considerable emphasis on improving the user experience to provide engaging and seamless interactions. Leveraging sophisticated algorithms, users can anticipate receiving personalized recommendations that align with their interests and preferences (Rathod et al. 2024). This high level of enhanced service ensures a more enriching and personalized library experience, enabling users to explore resources that meet their specific needs without much effort.

Challenges and Barriers Robotics in Library and Information Services Delivery

The adoption of robotic technologies in libraries faces several challenges, including technical issues, financial constraints, and ethical considerations. There is also a fear of job loss among library staff and a shortage of skilled manpower to manage these technologies. Organizational planning and addressing these barriers are crucial for the successful implementation of robotic applications in libraries (Shahzad, Khan, & Iqbal, 2024).

Hamad, Al-fedel and Fakhouri, (2022). conducted a research on the provision of smart service at academic libraries and associated challenges. The study identified challenges such as resistance to change the librarians face in their attempt to embrace smart technology to offer smart services. Also, privacy and confidentiality appeared to be one of the top rated challenges libraries have to deal with when planning for smart services deployment. Moreover, financial-related issues, such as poor infrastructure and staff training were among the main challenges librarians face to develop/offer smart services. Most importantly, challenges negatively affect the level of smart services at academic libraries in Jordan. The paper provides insights for academic librarians and decision-makers in planning for the provision of smart services at their libraries. It highlights the main challenges that might hinder the implementation and provision of smart services.

Future Directions of Robotics in the Library

The future of robotics in libraries involves the development of smart resources and the integration of AI technologies to enhance library services. Libraries are encouraged to collaborate with institutions and governments to create strategic plans for adopting cutting-edge technologies. Open communication between library management and staff is essential to facilitate the acceptance and use of robots Oladokun, et al, 2023; Tella, and Ajani, (2022). . Additionally, there is a need for educational opportunities for library and information science students to learn about AI and robotics (Luca, Narayan, Cox, 2022).

Priya and Rayon, (2023) in their study proposed an AI-based conversational agent named InfoRef to provide reference services by creating an interactive interface between library services and users. The application works on the AAA (Anytime, Anywhere, Anyone) model and routes the users to the available information. It provides access to 24/7 information to users. The free version of Dialog flow (a natural language understanding engine by Google) was used for building the InfoRef application. After its development, the InfoRef was integrated with different online platforms like the website, Koha ILS, and Telegram. The integration worked well and generated a similar response on all platforms.

Indraji, Satishkumar and Dominic, (2024) proposed autonomous robots for complex tasks. He opined that "A greater variety of complex tasks may be able to be completed independently by next-generation robots. Robots may do maintenance duties, handle event setup and management, and dynamically sort and organize books based on real-time data. These robots would be able to engage with people securely and travel more effectively if they had improved sensors and AI systems." Also, in the same work, he proposed Integrated Augmented Reality (AR) and Virtual Reality (VR): Experiences at libraries could be changed by fusing AI and robotics with VR and AR technology. To boost participation and create distinctive educational possibilities, libraries could provide immersive learning spaces, virtual tours, and interactive exhibitions. These experiences might be customized by AI to suit the requirements and tastes of each use

Methodology

This study adopted a descriptive survey design to examine perceptions of librarians towards the adoption of robotics in library and information services delivery at Chukwuemeka Odumegwu Ojukwu university libraries. The total population of the study was forty (40) library staff. Thirty-seven (37) out of forty (40) library staff responded to the questionnaire. Thirty-seven (37) respondents were therefore, used for the study. Census sampling was used because the population small and manageable. The responses were elicited from the population using Google Forms 31 item Statements. The data collected for this study were analyzed using mean scores; with the adoption of a criterion mean point of 2.50.

Data Analysis and Results

Table 1: Frequency distribution of Respondents by campus libraries

Campus	F	%
Igbariam Campus	27	73
Uli Campus	8	21.6
Awka Campus	2	5.4
Total	37	100

Table 1 reveals that Igbariam Campus has the highest frequency of respondents, with 27 individuals representing 73% of the total respondents, Uli Campus has 8 respondents, accounting for 21.6% of the total and Awka Campus has the lowest frequency, with only 2 respondents making up 5.4% of the total.

Table 2 : Mean Ratings for Which Areas in the Library Should Robotics be Applied

S/N	Item Statements	SA	A	D	SD	Mean	Remarks
1.	Collection development and acquisition.	17	12	5	3	3.16	Agreed
2.	Cataloguing and classification	20	16	1	0	3.51	Agreed
3.	Serials Management	19	15	2	0	3.38	Agreed
4.	Shelving and shelf-reading	17	10	8	2	3.14	Agreed
5.	Reference and information retrieval	18	15	1	3	3.30	Agreed
6.	Indexing and abstracting	21	16	0	0	3.57	Agreed
7.	Circulation	20	13	2	2	3.38	Agreed
Grand Mean						**3.35**	**Agreed**

Table 2 shows that the librarians at Chukwuemeka Odumegwu Ojukwu University agree with the statements that collection development and acquisition, cataloguing and classification, serials management, shelving and shelving-reading, reference and information retrieval, indexing abstracting as well as circulation are areas in the library where robotics should be applied. This is seen in their individual means, (3.16), (3.51), (3.38), (3.14), (3.30), (3.57), and (3.38) and also the grand Mean, (3.35).

Table 3: Mean Ratings for the benefits of robotics in library and information service delivery

S/N	Items Statements	SA	A	D	SD	Mean	Remarks
1.	Robots can locate missing or out-of-sequence books	22	15	0	0	3.60	Agreed
2.	Robots can aid security and face recognition.	19	13	3	2	3.32	Agreed
3.	Robots can aid easy and fast information retrieval	20	13	3	1	3.41	Agreed
4.	Robots give librarians moretime to focus on other important information service delivery to today's dynamic needs	16	13	8	0	3.22	Agreed
5.	Robots can help to keep accurate records of library inventories.	19	14	2	2	3.35	Agreed
6.	Robots can be used to greet visitors and provide directions	16	12	6	3	3.11	Agreed
7.	Robots can help to do complex work without stress.	16	14	7	0	3.24	Agreed
8.	Improved User Experience.	17	10	8	2	3.14	Agreed
Grand Mean						**3.30**	**Agreed**

Table 3 shows the mean ratings for the benefits of robotics in library and information services delivery. The grand mean rating, (3.30), indicates that respondents generally agreed that robotics can bring benefits to library and information services delivery.

The results suggest that respondents see robotics as a valuable tool for improving library operations, particularly in areas such as book location, information retrieval, and inventory management. The lower ratings for benefits related to user experience and visitor greeting may indicate that respondents are more focused on the operational benefits of robotics rather than its potential to enhance user interactions.

Table 4: Mean Ratings for the challenges and barriers of robotics in libraries?

S/N	Item Statements	SA	A	D	SD	Mean	Remarks
1.	Job loss	20	13	4	0	3.43	Agreed
2.	Lack of funds	19	13	3	2	3.32	Agreed
3.	High cost of maintaining the robots	19	12	4	2	3.30	Agreed
4.	Robotics technology may not be reliable because of poor power supply.	16	13	4	4	3.11	Agreed
5.	Declination in human interaction	15	13	3	6	3.00	Agreed
6.	Trust and security issues	15	12	5	5	3.00	Agreed
7.	Needs technical expertise	20	10	5	1	3.30	Agree
Grand Mean						**3.21**	**Agreed**

Table 4, shows the mean ratings for the challenges and barriers of robotics in libraries. The grand mean shows that respondents generally agree that these challenges and barriers that would be encountered while introducing robotics into library and information services delivery.

The results highlight the need for libraries to address concerns around job loss, funding, and maintenance costs when introducing robotics technology. Libraries should also consider strategies to mitigate the decline in human interaction and address trust and security issues related to robotics.

Table 5: Mean Ratings on the ways to tackle the challenges and barriers of robotics in library and information services delivery

S/N	Item Statements	SA	A	D	SD	Mean	Remarks
1.	Library staff should upgrade their technical skills and also follow the new trends in technology to avoid losing their jobs.	20	16	1	0	3.51	Agreed
2.	Adequate funds should be allocated to libraries in order to implement and maintain robotic technology.	20	13	2	2	3.38	Agreed
3.	There should be constant power supply in the library in order to make sure that battery of the robots are always fully charged.	20	15	1	1	3.46	Agreed
4.	Libraries must make sure that they place strong safeguards to protect user data and handle any issues about privacy.	19	16	1	1	3.43	Agreed
5.	Librarians should make sure they interact with library users because robots are machines not humans.	19	16	1	1	3.43	Agreed
Grand Mean						**3.44**	**Agreed**

Table 5, presents the mean ratings on the ways to tackle the challenges and barriers of robotics in library and information services delivery.

The grand mean is (3.44), revealing that respondents generally agree that Library staff should upgrade their technical skills and also follow the new trends in technology to avoid losing their jobs, adequate funds should be allocated to libraries in order to implement and maintain robotic technology, there should be constant power supply in the library in order to make sure that batteries of the robots are always fully charged, libraries must make sure that they place strong safeguards to protect user data and handle any issues about privacy, and librarians should make sure they interact with library users because robots are machines not humans are effective ways to tackle he challenges and barriers of robotics in libraries.

Table 6: What are the future directions of robotics in library and Information services delivery?

S/N	Item Statements	SA	A	D	SD	Mean	Remark
1.	Advanced Conversational AI	20	15	2	0	3.49	Agreed
2.	Autonomous Robots for Complex Tasks.	20	16	0	1	3.50	Agreed
3.	Smart Environment Management	16	13	8	0	3.22	Agreed
4.	Integrated Augmented Reality (AR) and Virtual Reality (VR)	19	14	3	1	3.38	Agreed
Grand Mean						**3.40**	**Agreed**

Table 6, which presents the future directions of robotics in library and information services delivery.
The grand mean, (3.40) indicates that respondents generally agree that these directions are important for the future of robotics in libraries.
The results highlight the need for libraries to invest in autonomous robots and advanced conversational AI to improve operational efficiency and user experiences, explore the potential of integrated AR and VR technologies to enhance information delivery and user engagement and create comfortable and sustainable learning environments.

Recommendations

Arising from the findings of this study and according to the rank of the responses, the following recommendations are hereby made:

1. Library staff should upgrade their technical skills and also follow the new trends in technology to avoid losing their jobs.
2. There should be constant power supply in the library in order to make sure that the batteries of the robots are fully charged.
3. Libraries must make sure that they place safeguards to protect user data and handle any issues about privacy.
4. Librarians should make sure that the interact with library users because robots are machines not humans.
5. Adequate funds should be allocated to libraries in order to implement and maintain robotic technology.

Conclusion

Robotics in library and information services offers significant potential to transform how libraries operate and serve their patrons. While there are challenges to overcome, the benefits of increased efficiency and enhanced user experiences make the integration of robotics a promising avenue for the future of library and information services delivery.
However, the adoption of various types of robots in libraries is not intended to replace librarians but to complement their efforts, enhancing quality service delivery and operational efficiency. As technology advances, the role of robots in libraries is expected to expand, offering new opportunity for interaction and service provision.

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Preparedness of Nigerian Libraries for the Fifth Industrial Revolution (5IR)

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Abstract
The emergence of the Fifth Industrial Revolution (5IR) represents a paradigm shift toward a human-centric integration of advanced technologies such as artificial intelligence (AI), robotics, and immersive media with ethical innovation and digital inclusivity. As critical knowledge hubs, libraries are integral to enabling societal transitions to 5IR through technological infrastructure, workforce development, and digital service delivery. This paper's objectives evaluate the readiness of Nigerian libraries for 5IR, focusing on the availability of infrastructure, the proficiency of library personnel, and the supportive roles of governmental, institutional, and professional bodies. Findings reveal significant infrastructural deficits including unstable internet connectivity, limited implementation of Integrated Library Systems (ILS), and minimal adoption of AI-driven services (Nwosu & Ugboma, 2022; Okafor & Okonkwo, 2021). Furthermore, extended reality (XR) technologies and cybersecurity frameworks are largely underdeveloped due to financial constraints and inadequate technical expertise (Adetimirin & Fagbola, 2021; Ogunmodede, Adeyemi & Lawal, 2022). In terms of human capital, only a fraction of Nigerian librarians possessed advanced ICT skills, with professional development efforts often limited to basic training (Adeleke & Olorunsola, 2021). Leadership gaps and insufficient change management further hinder progress. Despite these challenges, the paper highlights promising efforts by the government, such as policy reforms by the National Information Technology Development Agency (NITDA), and interventions from professional bodies like the Nigerian Library Association (Akinyemi, 2021; Obajemu, Edewor & Akintoye, 2022). Educational institutions also contribute to workforce readiness through curricular innovations and digital library integration (Oladokun, 2021; Adebayo, 2022). The study concludes with a call for intensified investment in infrastructure, training, and strategic collaborations to fully equip Nigerian libraries for the demands and opportunities of the 5IR.
Keywords: Libraries Preparedness, Nigerian Libraries, Human-machine collaboration, Artificial Intelligence (AI), Internet of Things (IoT).

Introduction

The advent of the Fifth Industrial Revolution (5IR) marks a significant shift from the automation and artificial intelligence-driven Fourth Industrial Revolution (4IR) to a more human-centric, collaborative approach integrating advanced technologies with human intelligence and ethical considerations (Schwab, 2021). As knowledge hubs, libraries play a crucial role in ensuring access to emerging technologies, fostering digital literacy, and supporting innovative research (Echezona, Nnadozie, & Ifeanyi, 2020). This paper examines the readiness of Nigerian libraries for 5IR, with a focus on the availability and adequacy of technological infrastructures, workforce capabilities, including digital literacy, technical skills, and professional development initiatives.

Objective of the Study

The following objectives guided the paper:

i. an overview of the fifth industrial revolution
ii. review of technological infrastructures in Nigerian libraries for the 5IR
iii. review of workforce readiness in Nigerian libraries for the 5IR
iv. identify challenges and prospects for Nigerian libraries for the 5IR
v. supports to Nigerian Libraries for the 5IR

Overview of the Fifth Industrial Revolution

The Fifth Industrial Revolution stresses the convergence of human expertise with artificial intelligence, robotics, and immersive technologies to create a more personalized and ethical digital experience, which requires a workforce that is not only technologically adept but also capable of ethical decision-making and innovative problem-solving (Pradhan, Kumari, & Sahoo, 2022). Unlike 4IR, which prioritized automation, 5IR integrates empathy-driven innovation, requiring institutions, including libraries, to provide technological support that enhances user experience and digital engagement, and ensure that their staff are equipped with skills to harness artificial intelligence, machine learning, and digital curation for enhanced information services (Ghobakhloo, 2020). The 5IR is the trend, and Nigerian libraries should adopt and move with the trend.

Review of Technological Infrastructures in Nigerian Libraries

1. **Internet Connectivity and Digital Access:** Internet connectivity remains a significant challenge in Nigerian libraries, with many institutions struggling to provide reliable broadband access (Adeleke & Olorunsola, 2021). According to a study by Nwosu and Ugboma (2022), only 40% of academic libraries in Nigeria have stable internet services, limiting access to online databases and digital resources. This is a major aspect or basis of technological infrastructure and should be provided and functional too.
2. **Library Automation and Digital Services:** Most Nigerian libraries have yet to fully embrace library automation systems, such as Integrated Library Systems (ILS) and cloud-based services (Ojedokun & Moahi, 2020). While some institutions have adopted software like Koha and Evergreen, the integration

of AI-driven cataloging and retrieval systems remains underdeveloped (Okafor & Okonkwo, 2021). Integration of AI-based tools will make work easy and services rendered seamless, and such should be encouraged.

3. **Artificial Intelligence and Smart Technologies:** The application of artificial intelligence (AI) in library operations, such as chatbots for user queries and machine learning for predictive indexing, is still at an experimental stage in Nigeria (Ugwuanyi, Umeh & Nwankwo, 2023). Most libraries lack the technical expertise and funding necessary to implement AI solutions effectively (Edewor, Okeke & Olowu, 2022). Funding and deficiency of technical expertise are major challenges in this area, there is a need to find alternatives to conquer these challenges and harness these innovations.
4. **Extended Reality (XR) in Information Services:** Virtual and augmented reality (VR/AR) technologies are vital components of 5IR but remain largely absent in Nigerian libraries due to cost constraints and lack of skilled personnel (Adetimirin & Fagbola, 2021). Comparative studies show that while developed nations are integrating XR into library services, Nigerian libraries still rely on traditional information dissemination methods (Bello, Yusuf & Aliu, 2022). There is dire need to adopt these innovations to improve services in our libraries.
5. **Cybersecurity and Data Management:** With increasing digital interactions, cybersecurity has become a pressing concern. Research indicates that most Nigerian libraries lack robust data protection frameworks and advanced cybersecurity measures to safeguard user information (Ogunmodede, Adeyemi, & Lawal, 2022). The absence of institutional policies on data privacy further hampers the adoption of digital transformation strategies (Adeyemi, Ogunmodede, & Lawal, 2023). Nigerian libraries need to take this seriously with the passage of the Cyber Crimes Law, so as not to contravene any aspect of the law.

Review of Workforce Readiness in Nigerian Libraries

1. **Digital Literacy and ICT Proficiency:** Many librarians in Nigeria still face challenges in acquiring digital literacy skills, which are essential for operating modern library systems (Adeleke & Olorunsola, 2021). A study by Nwosu and Ugboma (2022) revealed that only 35% of librarians in Nigerian academic institutions possess advanced ICT competencies, limiting their ability to integrate emerging technologies into library services. There is still phobia for technological skills which should not be heard in this time and era.
2. **Training and Professional Development:** Continuous professional development (CPD) programs are crucial for ensuring workforce readiness for 5IR. However, limited funding and inadequate training opportunities have hindered librarians from acquiring new skills in artificial intelligence, big data analytics, and digital resource management (Ojedokun & Moahi, 2020). Okafor and Okonkwo (2021) highlight that most training initiatives in Nigeria focus on basic ICT skills, leaving gaps in more advanced technical competencies. Emerging technologies are erupting with the speed of light; Nigerian Libraries should make a conscious effort to have a Training and Development programme well planned to cover every aspect of the library to keep up with the technological trends.
3. **Adoption of Artificial Intelligence in Library Services:** Artificial intelligence (AI) applications, such as chatbots, predictive indexing, and automated cataloguing, require specialized expertise that many Nigerian librarians currently lack (Ugwuanyi et al., 2023). Research by Edewor et al. (2022) indicates that only a few university libraries have implemented AI-driven systems, and the lack of skilled personnel is a major obstacle to full-scale adoption. This has become very necessary to make work easy and to devote quality time to user-centred services and community engagement.
4. **Leadership and Change Management:** The transition to 5IR necessitates leadership that can drive innovation and manage technological change effectively (Adetimirin & Fagbola, 2021). Bello et al. (2022) argue that library managers in Nigeria often lack the strategic foresight needed to implement technology-driven policies, resulting in slow adoption rates for emerging tools and practices. This is a wake-up call for our Library administrators to encourage the adoption of 5IR and not to be a cog in the wheel because they have to lead in this movement.
5. **Collaboration and Knowledge Sharing:** One of the key aspects of 5IR is the emphasis on collaboration and interdisciplinary knowledge sharing. Nigerian libraries are yet to fully embrace collaborative learning models, open-access research, and cross-institutional partnerships that enhance workforce development (Anunobi & Ukwoma, 2021). Enhancing collaboration with global library networks could improve capacity-building initiatives and knowledge exchange (Ojo & Akinwale, 2022). No profession is an island, more so Librarianship is interdisciplinary so Nigerian libraries should collaborate more and keep relevance.

Challenges and Prospects

Nigerian libraries face several challenges in their transition to 5IR readiness, including inadequate funding, poor infrastructure, and low digital literacy among librarians (Anunobi & Ukwoma, 2021), resistance to technological change, and a shortage of qualified personnel (Ogunmodede et al., 2022). However, initiatives such as public-private partnerships and government-driven digital literacy programs offer a pathway for improvement (Ojo & Akinwale, 2022). To bridge the gap and prepare librarians for the demands of 5IR, investment in capacity-building, international training collaborations, technology adoption, and policy frameworks, among others, is essential (Onwuchekwa & Ekwueme, 2023). There is a great need to explore ways to address these challenges or minimize them, partnership with NGOs and organizations interested in library and information services, search for grants, exchange programs with libraries doing better etc.

Government's Role in Supporting Nigerian Libraries for the Fifth Industrial Revolution

The government plays a pivotal role in fostering an environment conducive to the readiness of Nigerian libraries for the 5IR. According to Obajemu, Edewor and Akintoye, (2022), the Nigerian government has made efforts through policy reforms to support the integration of digital technologies in libraries, such as the National Information Technology Development Agency (NITDA) initiatives. These policies aim to foster information literacy, digital skills, and access to technological infrastructure.

Additionally, governmental bodies like the National Library of Nigeria (NLN) have introduced programs aimed at improving library services through the adoption of modern technologies. The Nigerian Library Association (NLA) has also highlighted the government's need for more robust funding for technological upgrades in libraries (Akinyemi, 2021). These actions align with the global shift toward the 5IR, which demands a convergence of physical and digital infrastructures.

Role of Library Associations in Advancing Digital Transformation for the Fifth Industrial Revolution

The Nigerian Library Association (NLA) have been central in promoting policies and professional development to prepare libraries for technological advancements. The NLA's efforts include organizing workshops, conferences, and training programs aimed at equipping librarians with digital skills necessary to manage and curate information in a 5IR landscape (Akintoye, 2020). Additionally, the NLA has advocated for the government's increased investment in library infrastructure to ensure libraries have the necessary resources to support the digitalization process (Akinyemi, 2021).

The NLA's commitment to digital transformation is also reflected in their collaboration with global library associations and government agencies to develop standards and guidelines for technology integration (Jiboku, 2020). Furthermore, the association has pushed for legislative advocacy to create a more conducive legal and financial framework for libraries in the digital age.

Educational Institutions' Impact on Library Readiness for the Fifth Industrial Revolution

Educational institutions, especially the tertiary institutions, have been at the forefront of supporting library modernization through research and development in digital information management. According to Oladokun (2021), Nigerian tertiary institutions have increasingly integrated digital library systems into their curricula, thus preparing students for the demands of a technologically driven world. Additionally, these institutions provide research funding and collaborate with libraries to implement e-learning platforms, cloud-based services, and digital repositories that align with the needs of the 5IR.

In terms of curriculum development, universities have introduced specialized courses on information technology and digital libraries, directly contributing to librarians' skills development and preparing the workforce for the challenges and opportunities of the 5IR (Adebayo, 2022). These efforts are significant because a well-trained workforce is crucial for ensuring libraries can effectively manage and disseminate knowledge in an increasingly digital world.

Conclusion

While Nigerian libraries have made some progress in digital transformation, they are not yet fully prepared for the demands of the Fifth Industrial Revolution. Addressing infrastructure gaps, improving internet access, and integrating AI and XR technologies are critical steps toward ensuring their relevance in the evolving digital landscape. The Fifth Industrial Revolution adaptation for Nigerian libraries depends significantly on workforce capabilities. While some progress has been made in digital literacy and training, gaps remain in AI adoption, leadership, and professional development. To enhance readiness, Nigerian libraries must prioritize staff training, embrace AI-driven solutions, and foster collaborative knowledge-sharing environments. Their readiness for the Fifth Industrial Revolution is influenced by the concerted efforts of the government, library associations, and educational institutions. The government has made strides with policies aimed at modernizing library infrastructure, while library associations have facilitated professional development. Educational institutions have equipped librarians with the skills necessary to navigate the changing landscape. However, much remains to be done to ensure comprehensive integration, particularly regarding sustainable funding and continued collaboration across these sectors.

Call for Action

A lot has been done, on the part government, library associations, and institutions, though there's room for improvement. It is now for us, Librarians, to apply ourselves and do the needful so as to move with the trend. Be a tech-savvy librarian and be ready for the Fifth Industrial Revolution!

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Proactive Librarianship vs. Reactive Librarianship: Navigating Present Realities in Information Service Provision in Nigerian Libraries

By

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Abstract

This paper explores the contrasting paradigms of proactive and reactive librarianship in the context of Nigerian libraries, highlighting the transformation brought about by advancements in information and communication technologies (ICTs). Proactive librarians are depicted as forward-thinking professionals who anticipate user needs, embrace technological innovation, and engage in continuous professional development, thereby enhancing the effectiveness and relevance of library services. In contrast, reactive librarians focus on immediate responses to user queries, often struggling with limited resources and outdated practices. The paper identifies key challenges faced by Nigerian libraries, including insufficient funding, inadequate technological infrastructure, and resistance to change among staff which inhibits their ability to meet evolving user expectations. It further discusses strategies for fostering a proactive culture, such as regular training, encouraging initiative, and leveraging technology. By adopting a proactive approach, Nigerian libraries can overcome existing barriers, significantly enhance service delivery, and assert their position as vital information hubs in an increasingly digital society.

Keywords: Information Service Provision, Library Challenges, Nigerian Libraries, Proactive Librarianship, Reactive Librarianship

Introduction

Libraries have undergone significant transformations in recent years, driven by the rapid advancement of information and communication technologies (ICTs). These changes have revolutionized the modes of providing information services, shifting from traditional methods of dissemination to electronic and digital communication. The integration of ICT into library operations has enhanced information access and delivery while introducing new roles and responsibilities for librarians. As noted by Emezie and Nwaohiri (2013), the librarian's role has evolved from being a passive custodian of books to an active gateway to a diverse array of information sources.

In Nigeria, libraries including public, academic, national, special, private, and school libraries are established to fulfill the missions of their respective parent institutions (Quadri, 2014). Despite their varied contexts, these libraries share the common objective of providing efficient and effective information services. However, the approach taken by librarians plays a critical role in achieving this goal. Proactive librarians anticipate user needs, embrace emerging technologies, and develop innovative service models. In contrast, reactive librarians focus primarily on addressing immediate demands, which can limit their capacity to adapt to the evolving expectations of users (Potnis et al., 2020; Allison, Eddy-Ugorji, & Okorafor, 2023).

The importance of proactive librarianship was particularly evident during the COVID-19 pandemic when the International Federation of Library Associations (IFLA, 2020) highlighted several proactive roles librarians assumed. These included maintaining communication with users, organizing virtual events such as digital story times, promoting digital libraries, increasing access to eBooks, and raising awareness of online resources. Such initiatives underscore the necessity of adopting forward-thinking strategies to remain relevant and serve users effectively.

Despite the opportunities presented by technological advancements, Nigerian libraries face numerous challenges. Inadequate funding limits the acquisition of resources, infrastructure development, and staff training (Aina, 2020). Additionally, the slow pace of technology adoption impedes the ability of libraries to meet the demands of increasingly tech-savvy users (Agboola & Oyediran, 2022). Furthermore, evolving user expectations place pressure on libraries to deliver fast, reliable, and accessible services, often with limited resources (Ogunleye, 2021).

Nevertheless, proactive librarianship offers a pathway to address these challenges. By leveraging technology to digitize collections, enhance service delivery, and improve user engagement, libraries can reposition themselves as vital knowledge hubs. Collaboration with stakeholders, including governmental and non-governmental organizations, provides additional opportunities to bridge funding and capacity gaps. Moreover, the growing demand for digital resources and information literacy presents a chance for libraries to reaffirm

their relevance in the modern information ecosystem (Aina, 2020; Agboola & Oyediran, 2022). Therefore, proactivity is indispensable for the modern Nigerian librarian to navigate the complexities of contemporary library service provision. By anticipating needs, embracing innovations, and adapting to change, proactive librarians can ensure the continued relevance of libraries, foster user satisfaction, and contribute to institutional growth. Without such an approach, Nigerian libraries risk stagnation and diminished impact in an increasingly digital and information-driven society (Kaffashan Kakhki et al., 2022).

Proactive Versus Reactive Librarianship

Proactive Librarianship refers to a forward-thinking approach in which librarians anticipate user needs, identify potential challenges, and implement innovative strategies to enhance service delivery. Proactive librarians engage in continuous professional development, leverage technological advancements, and foster collaborations to create user-centered services. They aim to stay ahead of trends and changes, ensuring that library services remain relevant, accessible, and effective in meeting the evolving demands of their patrons (Aina, 2020; Allison, Eddy-Ugorji, & Okorafor, 2023). According to IFLA (2020), proactive librarians during the COVID-19 pandemic employed strategies such as promoting digital resources, offering virtual engagement activities, and adopting flexible borrowing policies to sustain user satisfaction. On the other hand, **Reactive Librarianship**, on the other hand, is characterized by a response-oriented approach in which librarians primarily address immediate needs, user requests, or crises as they arise. This approach often focuses on maintaining existing operations and resolving problems rather than preemptively addressing future needs or opportunities, and they ~~. Reactive librarians~~ may lack the resources, skills, or strategies to adapt quickly to new challenges, limiting their capacity to innovate and meet the expectations of a dynamic user base (Potnis et al., 2020; Agboola & Oyediran, 2022). In essence, proactive librarianship emphasizes innovation, preparation, and adaptability, while reactive librarianship is driven by situational responses and problem-solving within existing frameworks. The contrast between these approaches underscores the importance of adopting proactive strategies to ensure the sustainability and relevance of library services in an ever-changing information landscape.

Proactive librarians exemplify a dynamic and forward-thinking approach to information service provision, characterized by several key attributes that ensure the effective and innovative delivery of library services, summarized by the acronym **A-TEI-FAC**. This acronym stands for the core characteristics of proactive librarianship: Anticipation, Technology, Engagement, Innovation, Foresight, Adaptability, and Continuous Learning.

1. Anticipation of User Needs (A)

Proactive librarians actively anticipate the evolving needs of their users, enabling them to deliver timely and relevant information. By analyzing trends, user feedback, and emerging technologies, these librarians ensure that library resources and services align with contemporary demands. Potnis et al. (2020) emphasize the importance of preemptively addressing user requirements to maintain satisfaction and relevance in library services.

2. Embracing Technology (T)

Proactive librarians leverage emerging technologies to enhance service delivery and streamline library operations. This includes the integration of electronic resources, digital libraries, and automated cataloging systems. El-Kalash, et. El (2024) note that adopting technological advancements helps libraries meet the expectations of tech-savvy users and improves access to diverse information resources.

3. User Engagement (E)

Fostering strong relationships with library users is a key trait of proactive librarianship. Through outreach programs, workshops, training sessions, and feedback mechanisms, proactive librarians engage users and gather insights to refine their services. According to IFLA (2020), proactive librarians organized digital story-times, promoted e-resources, and enhanced communication with users during the COVID-19 pandemic, demonstrating their commitment to user engagement even during challenging times.

4. Innovation (I)

Proactive librarians embrace creativity and introduce new ideas to improve library services. They explore and implement cutting-edge technologies, such as AI-driven search tools, e-lending platforms, and virtual reference services, to enhance the user experience. Innovation is essential for libraries to remain relevant and competitive in a rapidly evolving digital age (El-Kalash, et. El 2024). For example, introducing maker spaces and media labs in libraries demonstrates innovation that meets users' modern needs.

5. Foresight (F)

Foresight refers to the ability of proactive librarians to anticipate future trends and prepare for them in advance. By keeping abreast of changes in technology, user behavior, and educational needs, these librarians can adapt services to stay ahead of demand. Emezie and Nwaohiri (2013) emphasize that proactive librarians are not reactive custodians but strategic thinkers who ensure the library is positioned to meet future challenges and opportunities.

6. Adaptability (A)

Adaptability is the capacity to respond effectively to changing circumstances, such as new technologies, shifts in user expectations, or external disruptions like pandemics. Proactive librarians adjust their services, resources, and strategies to maintain relevance and efficiency. For instance, during the COVID-19 pandemic, many libraries transitioned from physical to digital services, demonstrating adaptability to unprecedented challenges (IFLA, 2020).

7. Continuous Learning (C)

Continuous learning involves a commitment to professional development and skill enhancement. Proactive librarians engage in training, attend workshops, and pursue certifications to stay updated with the latest trends and tools in librarianship. Emezie and Nwaohiri (2013) highlight that in a knowledge-driven society, librarians must constantly upgrade their skills to effectively serve as information gateways. This ongoing learning ensures they can handle new roles and provide advanced services.

Reactive librarians exemplify a response-focused approach to information service provision, summarized by the acronym **R-TALTARS**, representing Response-Driven Service, Technological Lag, Avoidance of Risk, Limited User Interaction, Traditional Practices, Adaptation Delays, Reactive Problem Solving, and Short-Term Thinking. Each characteristic highlights the challenges faced by reactive librarians in addressing the demands of modern library users.

1. **Response-Driven Service (R)**
   Reactive librarians primarily respond to user inquiries and immediate needs rather than proactively identifying potential issues or opportunities. This approach often results in delayed service improvement and an inability to anticipate future trends (Emezie & Nwaohiri, 2013).
2. **Technological Lag (T)**
   Reactive librarians often delay adopting new technologies, waiting for a clear demand before integrating them. This results in outdated systems and missed opportunities to enhance service delivery (Agboola & Oyediran, 2022).
3. **Avoidance of Risk (A)**
   Reactive librarians prefer to maintain the status quo, avoiding risks that could lead to innovation. This risk-averse behavior limits their ability to experiment with new strategies or tools that could improve user experiences (Allison, Eddy-Ugorji, & Okorafor, 2023)
4. **Limited User Interaction (L)**
   Engagement with library users is minimal, often limited to answering direct queries or addressing complaints. This lack of proactive outreach prevents meaningful relationships and the refinement of services based on user feedback (Potnis et al., 2020).
5. **Traditional Practices (T)**
   Reactive librarians rely heavily on conventional methods of information service delivery, which may not suffice in the rapidly evolving digital age. This resistance to change hampers the library's relevance and appeal (Ogunleye, 2021).
6. **Adaptation Delays (A)**
   Reactive librarians adapt to changes only after they occur, such as responding to a new technological trend long after it has become widespread. This delayed response can lead to diminished user satisfaction (IFLA, 2020).
7. **Reactive Problem Solving (R)**
   Problem-solving in reactive librarianship often occurs after issues escalate, rather than preemptively addressing potential challenges. This approach can lead to inefficient library operations and reduced user trust (Aina, 2020).
8. **Short-Term Thinking (S)**
   Reactive librarians focus on immediate tasks rather than developing a long-term strategy or vision. This narrow focus limits the library's ability to innovate and adapt to future challenges (Emezie & Nwaohiri, 2013).

The R-TALTARS framework underscores the limitations of reactive librarianship in a modern context, highlighting the need for a proactive approach to remain relevant, efficient, and user-focused.

Present Realities in Nigerian Libraries

Nigerian libraries face numerous challenges that significantly impede their ability to deliver effective and modern information services. These challenges range from insufficient funding and limited technological infrastructure to resistance to change and inadequate training, creating a complex environment for libraries striving to meet the evolving demands of their users. However, addressing these issues presents an opportunity for transformation and innovation in the sector.

1. Insufficient Funding and Resources

Budget constraints remain a critical issue for Nigerian libraries, limiting their capacity to acquire up-to-date resources and technologies. Libraries often operate with outdated funding systems that fail to meet the demands of modern service delivery. According to Ubogu (2021), insufficient funding affects every aspect of library operations, from resource acquisition to staff development. This financial inadequacy leads to outdated collections, inadequate access to digital resources, and poorly maintained infrastructure, hampering the ability of libraries to meet user needs effectively. Owolabi, Salaam, and Ugbala (2019) emphasize that a lack of funding restricts libraries' potential to innovate and expand services, especially in adopting technology.

2. Limited Technological Infrastructure

Many Nigerian libraries lack the necessary Information and Communication Technology (ICT) infrastructure, including computers, reliable internet access, and modern digital tools. This deficiency restricts users' ability to access digital information resources and limits the libraries' ability to offer online services. Ejiroghene (2019) highlights that poor internet connectivity and outdated hardware further exacerbate the problem,

making it challenging for libraries to compete in the digital era. Ukwoma and Onyebinama (2021) argue that investing in robust ICT facilities and reliable internet connectivity is critical for libraries to provide seamless access to information and remain relevant in a technology-driven world.

3. Resistance to Change Among Staff and Users
Resistance to change is a significant barrier to progress in Nigerian libraries. Cultural inertia among library staff often stems from a lack of training and familiarity with new tools, while users may also be hesitant to adopt new technologies or methodologies. Ubogu (2021) observes that this reluctance limits the implementation of innovative services and hinders libraries' ability to evolve. Additionally, the inability of many librarians to acquire advanced ICT skills further compounds this challenge, as noted by Owolabi et al. (2019). Overcoming this resistance requires targeted initiatives to promote a culture of innovation, including training programs and awareness campaigns.

4. Inadequate Training and Professional Development
A significant skills gap exists among library staff in Nigeria, with many lacking proper training in digital resource management and emerging technologies. This deficiency affects their ability to provide modern services and meet user expectations effectively. Ukwoma and Onyebinama (2021) stress the importance of continuous professional development to equip librarians with the skills needed to adapt to technological advancements. Ejiroghene (2019) also highlights the slow progress in ICT literacy initiatives, which has perpetuated this skills gap and undermined service delivery. Investing in ongoing training programs and workshops is essential for librarians to remain competent in a rapidly evolving digital landscape.

5. Evolving User Expectations
The digital age has significantly transformed user expectations, with library patrons increasingly demanding fast and seamless access to information in both physical and digital formats. According to Ubogu (2021), users now expect libraries to provide e-books, online databases, and virtual services tailored to their convenience. Meeting these demands requires libraries to modernize their operations and actively engage with users to understand and address their needs. Owolabi et al. (2019) argue that libraries must adopt a user-centric approach by leveraging technology and fostering collaboration to deliver personalized and efficient services.
These challenges create a complex environment for Nigerian libraries as they strive to meet the evolving demands of their users. However, addressing these issues through increased funding, improved technological infrastructure, targeted training programs, and fostering a proactive culture in libraries will be crucial for enhancing the effectiveness of library services in Nigeria. By embracing innovation and collaboration, Nigerian libraries can transform themselves into dynamic hubs of knowledge and information in the 21st century.

Suggestions for Fostering a Proactive Culture in Libraries
Training and Development: Regular training workshops and seminars should be organized to focus on essential skills like innovation, leadership, and strategic planning. E-learning platforms and certifications can provide librarians with the latest knowledge in library technologies and trends. Establishing mentorship programs will also allow less experienced librarians to learn from proactive mentors, fostering a continuous growth environment.

Encourage Initiative: Librarians should be given platforms to propose and test new ideas, such as an idea submission program with rewards for creativity. Providing autonomy in their roles and encouraging pilot projects for innovative initiatives will cultivate confidence and ownership. This approach allows librarians to explore and implement strategies that align with user needs.

Foster a Culture of Continuous Improvement: Libraries should create mechanisms for regular feedback where librarians and users can share suggestions for improvements. Benchmarking against best practices from successful institutions will inspire innovation. Incentives for staff who excel in proposing and implementing improvements will motivate continuous efforts to enhance services.

Leverage Technology: Libraries can adopt analytics tools to understand user behaviors and predict future needs. Automating routine tasks will allow librarians to focus on strategic activities, and staying updated on technology trends ensures the library remains relevant. Providing training on emerging technologies will empower staff to integrate these tools effectively into their workflows.

Recognize and Reward Proactivity: Librarians who demonstrate proactive behavior should be publicly recognized through awards, newsletters, or social media features. Establishing recognition programs tied to career advancement, such as leadership roles or promotions, will motivate others to emulate proactive behaviors. Highlighting these efforts during staff meetings reinforces a culture of innovation.

Implementation Plan for Fostering a Proactive Culture in Libraries
Assess the Current State: Conduct a baseline assessment to determine the existing culture and behaviors in the library. Use surveys, interviews, and observation to collect data on how proactive or reactive the current practices are.

Develop a Strategic Roadmap: Create a detailed plan outlining specific actions for implementing the above suggestions. Each action should include timelines, responsible personnel, and desired outcomes. The roadmap should prioritize high-impact initiatives like training programs and recognition systems.

Engage Stakeholders: Involve librarians, administrative staff, and library leadership in the planning and execution process. Hold workshops and brainstorming sessions to ensure collective ownership and alignment with institutional goals.

Launch Pilot Programs: Start with small-scale implementations, such as a pilot program for idea submissions or recognition awards. Monitor these programs closely to identify what works and gather feedback for improvement.

Monitor and Evaluate Progress: Establish key performance indicators (KPIs) to measure the effectiveness of each initiative, such as participation in training, number of new ideas submitted, or improvements in user satisfaction. Regularly review the results and adjust the strategies to address challenges and enhance outcomes.

Sustain the Initiatives: Institutionalize successful programs by integrating them into library policies and annual activities. Regularly update and evolve these initiatives to align with changing trends and needs, ensuring a sustainable proactive culture in the library.
This comprehensive approach will foster a proactive culture in libraries, improving both staff engagement and user satisfaction.

Conclusion

In navigating the present realities of information service provision in Nigerian libraries, the distinction between proactive and reactive librarianship becomes pivotal. Proactive librarians embrace innovation, foresight, and adaptability to anticipate user needs, leverage technology, and engage users effectively, thereby positioning libraries as indispensable resources in the digital age. Conversely, reactive librarianship is characterized by a response-oriented approach in which librarians primarily address immediate needs, user requests, or crises as they arise. This approach often focuses on maintaining existing operations and resolving problems rather than preemptively addressing future needs or opportunities. To transition towards a proactive culture, libraries must prioritize training, encourage initiative, leverage technology, and establish robust mechanisms for continuous improvement. By fostering a proactive mindset, Nigerian libraries can overcome challenges, enhance service delivery, and remain relevant as vital hubs of knowledge and innovation in a rapidly changing world.

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Prospect of Industry 5.0 On Medical Libraries in Delta and Rivers States of Nigeria

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Abstract

The paper examined the prospects of the Fifth Industrial Revolution on Nigerian libraries particularly medical libraries in Delta and Rivers state. Succinctly examining the Fifth Industrial Revolution otherwise known as Industry 5.0; it explained the various forms in which they are available for optimal use by libraries. The paper also stated the benefits of the Fifth Industrial Revolution such as digital transformation, intelligent libraries, enhanced user experiences, collaborative spaces, community engagements, sustainable practices, global connectivity etc. and also discuss the focus of Nigerian libraries in ensuring sustainability of the various technologies in the Fifth Industrial Revolution as well as the integration of Artificial intelligence (AI) which is the major focus of Fifth Industrial Revolution, the infusion of human and machine learning. The paper also discussed the various technologies in the Fifth Industrial Revolution era in Nigerian libraries such as Artificial Intelligence (AI),) Data Analytics and Big Data, Internet of Things (IoT), Blockchain Technology (BT), Virtual Reality (VR), Robots and Robotics, Cloud Computing etc. in order to justify their need and the extent at which they can be utilized. The paper further explain the many challenges Nigerian Libraries experience which are: unskilled librarians, apathy towards technology, inability to adapt to time and changes and changes by University and library heads, unavailability of funds, lack of trainings amongst others. The paper makes various recommendations which includes, Institutional investment in infrastructure and technology, partnering with tech providers and educational bodies to deliver professional development on technologies, review institutional policies, creation of networks to share best practices and tools to manage emerging technology in order to provide a lasting solution to the problems identified during the cause of our research.

Keywords: Fifth Industrial Revolution, Industry 5.0, Intelligent and Smart Libraries, Medical, Artificial Intelligence (AI), Librarians, Internet of Things (IoT), Technologies.

Introduction.

The Fifth Industrial Revolution (Industry 5.0) signifies a shift from the automation centred Fourth Industrial Revolution to a more human-centric approach that emphasizes collaboration between humans and technology (Whitley 2025). This revolution integrates technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data analytics, Virtual Reality (VR), and robotics to create intelligent systems that enhance human capabilities (Chander et al., 2022). In the context of libraries, Industry 5.0 offers to transform traditional library services into efficient, and sustainable systems (Ekwueme, 2024).

Rafiq (2025) highlight that the integration of emerging technologies in academic libraries has led to efficiency, streamlined operations, and better access to digital resources, promoting inclusivity and improved user engagement. Similarly, Tella and Ajani (2022) discuss the potential of robotic technology in public libraries to improve information service delivery, emphasizing tasks such as organizing books, providing guidance, and offering multilingual support. These studies underscore the relevance of Industry 5.0 technologies in modernizing library services and meeting the unquenchable needs of users. Furthermore, the integration of AI-driven chatbots in Nigerian university libraries has been explored by Abiolu and Akinyemi. (2025), who found that such technologies can enhance user engagement, improve accessibility, and streamline library queries. However, challenges such as infrastructure issues, resistance from librarians, and lack of skilled personnel were identified as barriers to effective implementation.

Statement of the Problem.

In Nigeria, libraries have historically played an important role in supporting education, research, and information dissemination (Katamba and Ibrahim, 2024). However, the integration of advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Blockchain, Virtual Reality (VR), and Cloud Computing remains limited when it comes to the library (Alabi et al.,2024), but then the advent of the Fifth Industrial Revolution brought a shift in the way libraries around the world operates, particularly with the introduction of technologies such as Artificial Intelligence (AI), The Internet of Things, Blockchain, Virtual Reality and Cloud Computing. These innovations have the ability to transform libraries into user-centred and more efficient institution.

However, despite these prospects, Nigerian libraries appear unprepared for this evolution. Several studies like Ajani et al. (2023) indicate that while the libraries around the is transitioning into smart, technology-driven ecosystems, Nigerian libraries continue to face barriers in adopting these technologies. These include the lack of technical know how, limited financial resources, poor infrastructural development, resistance to change,

and an overall apathy toward the adoption of new technologies (Asifo and Ogbomo,2024). In many cases, librarians are ill-equipped to integrate emerging tools such as AI and Data analytics into library systems, thereby hindering their ability to provide enhanced user experiences and efficient services (Igbo et al., 2025)
Moreover, the sustainability of these technologies in the Nigerian libraries remains a concern. Without strategic planning, continuous professional development, and supportive policies from institutional leaders and government bodies, the benefits of Industry 5.0 may remain out of reach. This underscores an urgent need to assess the current state of preparedness among librarians, identify prevailing challenges, and explore strategies to ensure that Nigerian libraries, most especially medical libraries not left behind in this new industrial era.

Research Objectives:
The following are specific objective for theses study:

1. To assess the current level of awareness, preparedness, and adoption of Fifth Industrial Revolution technologies among librarians in Medical libraries in Delta and Rivers States.
2. To identify the benefits and potential of Industry 5.0 technologies such as AI, IoT, Big Data, and VR in transforming Medical library services in Delta and Rivers States.
3. To explore the challenges facing Nigerian libraries in the integration and sustainability of Industry 5.0 technologies and suggest viable solutions

Literature Review
Awareness, Preparedness, and Adoption of Industry 5.0 Technologies in Nigerian Medical Libraries.
The adoption of Industry 5.0 technologies in Nigerian medical libraries remains inevitable because of the importance of this library to such an important field. While there is a growing awareness of the benefits of these technologies, there are challenges hindering their widespread adoption. Adeleke et al. (2024) identify key prerequisites for implementing AI in Nigerian academic libraries, including the availability of policy frameworks, digital infrastructure, human capital development, and data security measures. Aminu (2024) found that while some AI technologies like OPAC and search engines are in use, advanced technologies such as robots and RFID are yet to be adopted. Haruna et al. (2025) emphasize the importance of improving library services through AI in Nigerian libraries. They discuss how AI can improve services like circulation, reference services, and cataloguing. As these technologies will actually enhance service delivery.
Building on this, Okon and Ibrahim (2023) note that the lack of planning and funding in medical libraries has slowed the pace of AI and Industry 5.0 adoption. They argue that until health-sector libraries are fully integrated into national digital transformation plans, technological adoption will remain fragmented. Similarly, Umeh and Chukwuma (2022) highlight the gap in staff training as a core issue; their study found that while librarians express a willingness to adopt new technologies, only a minority have received formal training in AI tools or machine learning applications.
Furthermore, Eze and Ogunyemi (2021) assert that increasing awareness campaigns and targeted workshops in medical institutions can help technology-ready culture among medical librarians. Their findings underscore the need for universities, medical libraries, and health tech companies to work together to accelerate digital integration. Meanwhile, Nwachukwu and Okafor (2020) stress the ethical and legal implications of AI in medical information services, calling for context-specific policy development to guide implementation in sensitive fields like medicine.
Taken together, Nigerian medical libraries are aware of Industry 5.0 technologies, actual preparedness and adoption remain uneven. A strategy that combines infrastructure investment, workforce development, policy reform, and institutional effort is essential for medical libraries to fully benefit from Industry 5.0.

Benefits and Potential of Industry 5.0 Technologies in Transforming Medical Library Services.
The integration of Industry 5.0 technologies is evidently a way to transform medical library services in Nigeria as it is seen in various research and discussions. Artificial intelligence (AI) can be beneficial for personalized information retrieval, predictive analytics, and automated cataloguing, which significantly improve user experience and operational efficiency (Waghmare et al., 2024). Internet of Things (IoT) devices facilitate real-time monitoring of library resources, enabling better management and availability tracking, while Big Data analytics offer valuable insights into user behavior and resource utilization patterns (Opele & Adeyeye, 2024). Virtual Reality (VR) technologies, on the other hand, provide concrete learning experiences that are particularly beneficial for medical education and professional training, enriching understanding of complex concepts in medicine (Mistry et al., 2023).
Research by Mabawonku and Buraimo (2025) explored the application of AI tools in African university libraries, revealing practical implementations of chatbots, RFID, and robots for services such as answering reference queries, cataloguing, and self-checkout systems. Their findings highlight how these technologies streamline library operations and improve service delivery. Similarly, Ibrahim (2025) examined the benefits of AI adoption in Nigerian university libraries, emphasizing enhanced functionalities like automated indexing, content management, and user engagement. However, Ibrahim also stresses the importance of establishing ethical framework to manage concerns related to data privacy, security, and algorithmic issues that are crucial in sensitive especially in field like medicine and surgery, diagnosis and other aspect.

Challenges in Integrating and Sustaining Industry 5.0 Technologies in Nigerian Libraries.
Despite the numerous benefits, several challenges continue to impede the integration and sustainability of Industry 5.0 technologies in Nigerian libraries. Joel (2025) identifies key issues such as inadequate funding,

lack of technical know how, insufficient infrastructure, and resistance to change among library staff. Similarly, Igbo et al. (2025) highlight the high costs associated with establishing AI systems and the scarcity of skilled personnel as constraiins to adoption. George and George (2023) further emphasize issues like hardware and software obsolescence, along with inadequate training programs that leave library staff ill-prepared to leverage new technologies effectively.

Moreover, digital divide remains a pressing concern for Nigerian libraries. Limited internet connectivity, outdated equipment, and insufficient access to up-to-date digital resources hamper effective usage and service delivery. These deficits are exacerbated by the absence of well though ICT policies and strategic planning at institutional and national levels, resulting in fragmented efforts and underutilization of existing technologies (Rawayau, 2024). The lack of coordinated governance frameworks often leads to inconsistent implementation and sustainability challenges.

Addressing these challenges requires a multi-faceted approach. Investment in digital infrastructure is critical, alongside capacity-building to enhance staff skill. Furthermore, establishing a clear and enforceable policies dedicated to technology integration can ensure progress in Nigerian Medical libraries. As noted by Chukwuma and Nwosu (2022), institutional commitment and stakeholder collaboration are indispensable in overcoming issues and enabling conducive environment for Industry

5.0 adoption.

Methodology.

Research Design and Method.

These sections describe the method adopted in carrying out the study on the Prospects of the fifth industrial revolution on Nigerian libraries: a case study of medical libraries in Delta and Rivers State. It includes the design, population and sample, and instrument used for data collection, data analysis, and presentation of results. The study adopts a qualitative method obtaining response through an open-ended survey. The qualitative method allows for a broader discussion and where the respondent will be able to discuss and point out their view. The population for this study includes 10 medical librarians from 5 Medical libraries in Rivers and Delta State. This study did not extend beyond the selected institutions and respondents because of the nature of research being carried out, which requires professionals who are medical librarians

An open-ended survey that features practical questions relating to the three objectives of the study was developed and was shared to 10 medical librarians but only 7 returned. The survey featured instructions on how to respond to the questionnaire.

Respondents were reached online, through sending an already prepared open-ended questionnaire (survey) through an online platform (Google Form) that was sent to the respective respondent's contacts.

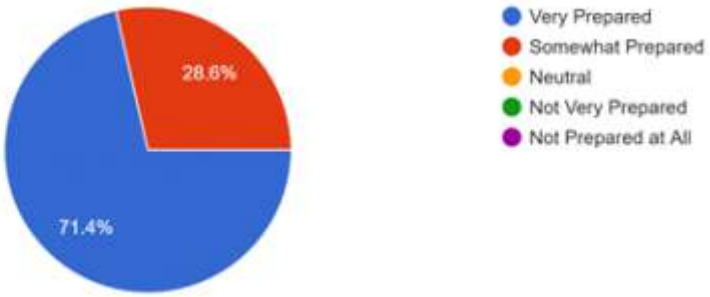
Respondents were made to give wiling consent on the use of their response and made to know that none of their personal data will be released to the public, and their response will only be used for this one-time research purpose. This is to protect the privacy right of the respondents and align directly with ethical standards.

Findings and Discussion.

This section explains the analyzed data based on each question asked and their outcome

Librarians' Awareness Preparedness and Institutional Support.

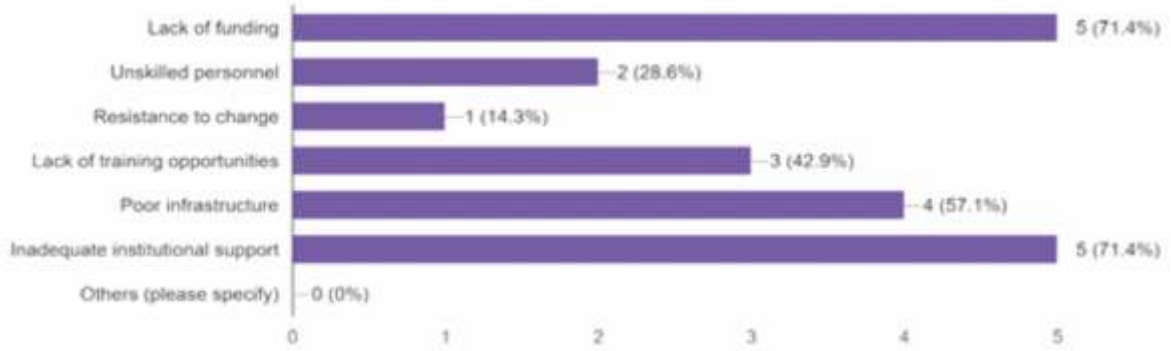
When librarians were asked about the level of preparedness and also the institutional support through training and infrastructures. 71.4% rated themselves as "*Very Prepared"* to work with advanced technologies. Yet, 71.4% said their institution had not provided any training. The remaining 28.6% pointed out hat they had training on key facilities such as *"Training on Google tools for student registration, barcoding, and collaboration." "Introduction to AI and Cloud Computing."*



Benefits and Potential of Industry 5.0 Technologies.

When respondents were queried on their perception on Fifth industrial revolution, they all show a positive mindset. They all stated that the technology is already benefiting Library Operations. Respondents cited real benefits such as "*Quick access to information." "In reference and circulation services." "Exposing technology to library users so they become familiar with it."* And the pointed-out improvements they anticipate such as *"Global development." "Enhanced teaching, learning, and research through online access." "Online search capabilities for users."*

Challenges in Integrating and Sustaining Industrial 5.0 Technologies in Nigerian Library.
When respondents were asked on the challenges facing the integration of Fifth Industrial revolution tools, the picked Lack of funding, inadequate institutional support, poor infrastructure, Lack of training opportunities, uunskilled personnel, Resistance to change. They all went on to make recommendations to tackle these challenges, they stated solutions on Regular training workshops and capacity building Dedicated budget for technology, updating institutional policies to align with technological initiative. *"Training for personnel, providing infrastructure and funding." "More investment in infrastructure and supportive institutional policies." "Workshops to improve computer literacy among librarians." "Include budgeting for new technologies in institutional plans."*



Discussion of Findings
Librarians' Awareness Preparedness and Institutional Support.
The research result shows a disconnect between librarian preparedness and institutional preparedness and support. Librarians feel ready, but institutions aren't equipping them, possibly due to individual initiative, administrative view, finance and other constrain. These justify why there should be more investment in to technological and digital aspect of the library by key stakeholders
While many librarians feel ready, their institutions haven't provided the training or support needed to back this up. Only a few mentioned having received any form of training, such as sessions on using Google tools or introductions to artificial intelligence and cloud computing. The rest reported no formal support at all.
This gap suggests that librarians may be developing these skills on their own, driven by personal desire rather than institutional planning. It also points to possible challenges within the institutions themselves whether it's financial constraints, a lack of strategic focus on technology, or simply slow-moving administrative processes.
What this tells us is that the enthusiasm and readiness of librarians need to be matched with equal energy from their institutions. If libraries are going to stay relevant, there must be more intentional investment in training, digital infrastructure, and professional development. Librarians are clearly ready to lead the way, but they need their institutions to catch up and provide the support that will turn potential into progress.

Benefits and Potential of Industry 5.0 Technologies.
The result shows that librarians understand the benefit that comes with the Fifth industrial revolution. This showcases a perfect understanding of the whole concept and benefit that comes with Fifth Industrial revolution. The benefit stated shows enthusiasm towards advance technological tools in libraries in Delta State and Rivers State and in Nigeria generally. Bearing in mind that these is the only way for libraries to compete internationally.
The responses from librarians paint a positive picture when it comes to the Fifth Industrial Revolution. There's a clear sense that they not only understand what this new wave of technology is all about, but also fully appreciate the impact it is having on library operations. From quicker access to information, to improvements in reference and circulation services, librarians are seeing firsthand how advanced tools can make their work more efficient and responsive to users' needs.
It's not just about having new gadgets, it's about what those tools can do to transform the role of libraries in the society. What's needed is the right support and investment to turn that vision into reality, not just locally, but across Nigeria as a whole.

Challenges in Integrating and Sustaining Industrial 5.0 Technologies in Nigerian Library. The research shows that there are challenges but the reality is that there are solutions to them. Respondents identified several challenges that hinder the 5IR transition. Chief among these were lack of funding, inadequate institutional support, poor infrastructure, insufficient training opportunities, a shortage of skilled personnel, and resistance to change. These factors collectively point to structural weaknesses that must be addressed to fully realize the benefit of 5IR technologies.
The consistent mention of funding and infrastructure highlights the importances of financial and physical resources in supporting technological advancement. Without investment, institutions will struggle to acquire, maintain, and upgrade the tools necessary for digital transformation. In the same vein, inadequate institutional support and policy misalignment further compound the problem by creating environments that are not conducive to innovation.

Fortunately, respondents show a positive mindset by providing a range of practical recommendations to overcome these challenges. Which include regular training workshops and capacity-building programs aimed at equipping personnel with the skills required to operate and manage 5IR technologies effectively. Additionally, respondents stressed the importance of higher and consistent budget for technology, emphasizing that financial planning must include allocations for new tools, upgrades, and training programs. Other notable suggestions included the updating of institutional policies to work with these technological trends and to support innovation.
Overall, the findings show a clear understanding among respondents of both the existing barriers and the strategic measures needed to overcome them. Their insights suggest that with the right insertion of fund, policy reform, infrastructure development, and human capital investment, institutions can successfully transition fully into the era of the Fifth Industrial Revolution.

Conclusion.
This study paints a picture of high rate of digital enthusiasm but low institutional backing. Librarians are aware of the relevance of AI, cloud tools, and digital services, but suffer from lack of access to proper tools and infrastructure, inconsistent training opportunities, limited policymaking inclusion within their institutions. Some libraries have begun integrating these technologies (e.g., online access to resources, barcoding, Google tools), this suggests that transition has started, albeit slowly and unevenly. For medical libraries in Nigeria to fully embrace the Fifth Industrial Revolution, there must be intentional leadership commitment, Investment in infrastructure, proper professional development and Policy changes to reflect aid modern technology usage. Finally, the success of the integration of Fifth industrial revolution tool depends not only on librarians but also on users. Training users (students, researchers, and medical staff) on how to interact with AI tools, institutional repositories, and digital catalogues will maximize service delivery and satisfaction.

Recommendations.
Based on the findings of this study, the following recommendations are made to facilitate the adoption and effective utilization of Fifth industrial revolution technologies in Nigerian medical libraries.
1. Institutional Investment in Infrastructure and Technology is important, The Library management and governing institutions should prioritize funding for emerging technologies such as Artificial Intelligence, Cloud Computing, and Internet of Things (IoT). This justifies he claim by Ogbomo and Okuonghae (2019) that without adequate infrastructure, the awareness and preparedness of librarians cannot translate into practical transformation. Thus, Institutions should allocate annual budget specifically for library technology upgrades and digital transformation.
2. Despite high self preparedness, many librarians reported that their institutions do not offer formal training. Regular workshops, certification courses, and digital literacy programs must be organized to ensure sustainable knowledge and skills acquisition. This aligns with the view of Okunlaya et al. (2022) that partnering with tech providers and educational bodies to deliver professional development on technologies like AI, cloud services, and digital content management, as this will be beneficial to service delivery in the library.
3. Institutional policies should be reviewed to integrate technological innovation in library operations. Strategic plans should made towards performance indicators tied to tech adoption and service automation, this aligns with the goal of NITDA in it 2020 publication that development and implementation of technological Roadmaps is important in every sector and this does not leave medical library behind.
4. Medical libraries should create networks to share best practices and tools to manage emerging technologies. This will accelerate learning and reduce duplication of effort. Thus, there should be Establishment of networking platforms of medical libraries to share digital platforms and technological based ideas and discovery.

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Redefining Librarianship and Information Service Delivery through Technological Transformation

By

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Abstract

The essence of librarianship has rapidly evolved to remain relevant in our changing society. Traditionally, librarians served as custodians of books, journals, and periodicals. However, as libraries transition from merely lending and storing materials to becoming hubs of self-development and community engagement, librarians' roles are transforming as well. With the digital revolution reshaping information access, there is a need to redefine their responsibilities in information delivery. Libraries are integrating artificial intelligence (AI) bots, digital libraries, and mobile applications to enhance user experience and streamline operations. This article explores the transformative impact of technology on libraries, emphasizing how these innovations are reshaping information access, curation, and dissemination. It will also examine the challenges posed by this digital shift, including data privacy concerns, the digital divide, and the necessity for continuous professional development among librarians. By analysing current trends, this article underscores the importance of embracing technological transformation to ensure that libraries remain relevant, accessible and inclusive in an increasingly digital world.

Keywords: *Librarianship, Technologies, Transformation, Information Service Delivery, Innovation*

Introduction

Technology has the ability to completely change the way in which industries operate. Libraries are not immune to the effects that emerging transformation and technology can have on the services they provide to patrons. Walter and Lankes (2015) opines that transformation in academic libraries should be broadly defined to include changes in existing library service programs according to the changing needs of users, new service programs that are enabled by new digital technologies and new services that support new paradigms of teaching and research. Islam, Agarwal and Ikeda (2015) argue that for the academic library to remain relevant to its users, it must redefine its role and innovate to create responsive and convenient services. Therefore, the need to bring information to various users has encouraged the creation of many innovative services linking new technology with traditional library information services. The emergence of digital technologies and information and communications technology (ICT) tools in libraries has encouraged the implementation of a wide range of applications and services such as digital libraries, the use of social media tools, dynamic websites in order to make services visible, embedding electronic resources into e-learning platforms, etc. In the changing information environment, technological advances, changing customers and needs, intensified competition and changing business environment have been the dominant drivers (Basahuwa, 2017).

Redefining librarianship and information service delivery through technological transformation means leveraging advancements in technology to fundamentally change the way libraries operate, transitioning from primarily physical repositories of books to dynamic hubs of digital information access, personalized learning experiences, and community engagement, where librarians act as information curators, data analysts, and technology guides, rather than just bookkeepers, to better serve diverse user needs in the digital age. Musangi (2015a) observed that 21st century academic libraries have witnessed a lot of technological changes, which cannot be ignored. Reference librarians in academic libraries cannot stay static or traditional in their services or outreach to users, they need to harness technology and its capabilities in order to provide the information and literacy skills needed today by the 'net-gen' generation of users. The library users of today in the academic libraries coupled with the advancement of technology has changed the physical makeup of libraries and their functions and, thus, has made an impact on the way information is delivered, as libraries strive to redefine their services in order to meet users' needs and expectations.

The traditional models of libraries offering information services are not working for the current generation of students. The current generation of library users can be termed as 'digital natives'. These digital natives have grown up in an environment surrounded by rapidly evolving technologies. This means that today's academic library users think about technology and information differently than previous generations and expect instant access to information. With this kind of environment and expectations, academic libraries need to evolve by changing to offer user-oriented services and following users into their social spaces by allowing users to participate in the creation of content, keeping the users constantly updated and building services based on their feedback. To achieve this, libraries need to incorporate transformative technology tools in the way they provide services.

The importance of service innovation in an academic library environment cannot be overemphasized. Consequently, there is a need for librarians to move with the current trend in society not only to innovate library and information services, but to consolidate and sustain the already implemented innovative services and practices. Librarians should develop themselves by seeking ICT training; take full advantage of training and development and take advantage of the knowledge and education offered by conferences and workshops; ICT skill should be accorded priority in recruiting and retaining librarians; the LIS curriculum should include 21st century advancements, to avoid churning out fresh librarians with obsolete skills.

The Changing Role of Librarians

Technological advancement has significantly altered the role of librarians, shifting their focus from traditional collection development and management to more dynamic and user-centred services. According to a study by Fourie and Kraai (2017), 'librarians need to adapt to new technology and redefine their roles to remain relevant in the digital age'. The evolving role of librarians beyond traditional book repositories reflects their adaptability and commitment to meeting the changing needs of their communities. While books remain an essential part of their offerings, librarians have expanded their scope to become innovative. The changing roles of librarians and the services they provide through transformative technology are:

Information Literacy and Digital Literacy Education: Libraries empower individuals with information literacy skills, enabling them to critically evaluate sources, distinguish credible information from misinformation, and make informed decisions. Librarians guide patrons through the process of finding reliable information in an era of information overload. Libraries are at the forefront of promoting digital literacy skills. They offer workshops, classes, and one-on-one training to help individuals navigate the digital landscape. Patrons learn how to use computers, smartphones, and other devices effectively, access online resources, and understand basic digital security practices.

Maker Spaces, Innovation and Virtual Services: Many libraries now feature maker spaces equipped with tools like 3D printers, laser cutters, and robotics kits. These spaces encourage hands-on learning, creativity, and innovation. Patrons can experiment with emerging technologies, develop prototypes, and engage in DIY projects. Librarians have extended their reach through virtual services. Online databases, digital reference services, and virtual events such as webinars and book clubs allow patrons to engage with library resources and programs from anywhere. Libraries provide collaborative spaces for individuals and groups to work, study, and collaborate. These spaces are equipped with technology, presentation tools, and comfortable seating, fostering a conducive environment for learning and teamwork.

Education, Lifelong Learning, Local Archive and Entrepreneurial Support: Libraries support education at all stages of life. They offer educational programs, tutoring services, and access to online courses, catering to students of all ages and lifelong learners. Many libraries function as repositories of local history and culture. They house historical documents, photographs, and records that preserve the heritage of their communities. Libraries provide resources and services to support entrepreneurs and small business owners, including business planning tools, market research databases, and workshops on business development.

Access to Technology, Technology Training and E-Learning Support: Libraries bridge the digital divide by offering free access to computers, high-speed internet, and other technology resources. This access is vital for individuals who lack these resources at home, enabling them to search for jobs, complete online forms, connect with others, and engage in lifelong learning. Librarians help users develop skills in using software, applications, and digital tools relevant to various fields. This training empowers individuals to participate more effectively in the modern workforce. Libraries offer resources for e-learning, supporting students of all ages in their educational pursuits. They provide access to online courses, tutoring services, and educational tools that enhance learning outcomes.

Online Resources and Open Access to Information: Libraries provide access to a wide range of digital resources, including e-books, academic journals, online databases, and educational platforms. Patrons can access these materials remotely, enhancing their research capabilities and learning opportunities. Libraries uphold principles of open access by providing free access to a wide range of information and resources. This commitment to openness supports research, innovation, and intellectual freedom.

Digital Archive, Curation and Citizenship: Libraries play a critical role in preserving digital heritage by archiving websites, online publications, and other digital content. This ensures that valuable digital resources are available for future generations. Libraries can also curate and organize digital content, making it easier for patrons to discover authoritative and relevant information. This curation enhances the value of the information provided by libraries. Libraries educate users about responsible online behaviour, privacy, and online etiquette. By promoting ethical digital practices, they contribute to a safer and more respectful digital environment.

Community Outreach and Technology Centre: Libraries extend their digital literacy efforts beyond their physical spaces by engaging with the community through social media, webinars, and online resources. They share tips, tools, and resources to promote digital literacy and responsible online behaviour. Libraries serve as community technology centres, offering a welcoming and supportive environment for individuals to explore

and experiment with new technologies. Patrons can learn about coding, robotics, and other emerging technologies.

Digital Hubs and Citizenship Education: Libraries will evolve into digital hubs that provide access to a vast array of digital resources, including e-books, virtual reality experiences, online courses, and digital archives. They will serve as gateways to the digital world for individuals of all ages. Libraries will educate patrons about responsible digital citizenship, including online privacy, ethical behaviour, and critical evaluation of digital information. They will play a role in creating informed and responsible digital citizens.

Innovation and Creativity Centres: Libraries will continue to offer spaces for innovation, creativity, and hands-on learning. Maker spaces equipped with advanced technologies like 3D printers, robotics, and virtual reality setups will become commonplace, encouraging patrons to experiment and create. Libraries will be lifelong learning centres, providing a range of educational resources and programs for people at all stages of life. They will offer personalized learning paths, professional development opportunities, and skills training to adapt to changing job markets.

Technological Innovations in Librarianship

Technological innovations in librarianship have revolutionised the way libraries operate, transforming traditional roles and services. From digital libraries and online resources to emerging technologies like artificial intelligence and virtual reality, librarians are leveraging technology to enhance user experiences, improve access to information, and stay relevant in the digital age.

The landscape of librarianship has undergone significant transformations in recent years, driven by rapid technological advancement. Traditional library services have evolved to incorporate digital resources, online platforms and innovative technologies. Librarians now navigate a complex environment where information is accessed, managed and shared in diverse ways. Isiaka, Soliu, Aremu, Bamidele, Saba-Jibri and Ibitoye (2024); Akinola (2023), technological innovations in librarianship encompass various developments which include:

Artificial Intelligence (AI) and Machine Learning: AI refers to the simulation of human intelligence in machines, enabling them to perform tasks that typically require human intelligence, such as problem-solving and decision-making (Ali, M. Y., Naeem, S. B., & Bhatti, R., 2020). Machine learning, a subset of AI, involves the development of algorithms that allow computers to learn from and make predictions or decisions based on data. The rapid development of artificial intelligence (AI) technologies, particularly machine learning, has led to the widespread use of these technologies in academic libraries. The ultimate goal of AI is to develop intelligent agents that can perceive their environment, reason about it, make decisions, and take actions to achieve specific goals (Ali et al. 2020).

One area where AI is being applied is machine translation, which involves using information technology to translate one language into another. In today's digital age, machine translation has become an important tool in multilingual environments, serving various purposes such as personal communication, office work, and business translation. As academic libraries strive to be more accessible and available globally, it is likely that new advancements in machine translation will be integrated into library systems to facilitate the dissemination of information worldwide. Although current machine translation tools are not perfect, they do provide a starting point for improving human translation. Interestingly, the text does not mention the most powerful free machine translation software available currently. The speech recognition technology, also known as speech-to-text technology, allows for the conversion of human speech signals into written text through human-computer interaction.

This technology finds applications in academic libraries, specifically in the area of data entry. While wired keyboards are currently the primary means of data entry, speech recognition technology offers a wireless alternative, transforming the way users interact with computers. With voice recognition software, users can input documents and request audio/video files from digital libraries. Furthermore, this technology enhances the accessibility of academic libraries by enabling users with disabilities to access and search electronic collections. Ultimately, speech recognition technology provides a range of powerful tools and opportunities to enhance interaction and accessibility within academic library environments.

Big Data and Data Analytics: Big data and data analytics are closely intertwined because the volume, velocity, and variety of Big Data make traditional data analysis techniques insufficient. Advanced analytics, including machine learning, are often used to extract insights from Big Data, helping organizations gain a competitive edge, improve operations, and make data-driven decisions. Big data technologies enable the collection, storage, and analysis of vast datasets, leading to insights that drive business decisions, scientific research, and more. Big Data refers to extremely large and complex datasets that are too voluminous, varied, and dynamic to be processed and analysed using traditional data management and processing tools. Big Data represents the vast, diverse, and fast-moving datasets, while analytics is the process of extracting valuable insights from data. The integration of Big Data and analytics enables organizations to harness the potential of large datasets to inform decision-making, solve complex problems, and drive innovation in various domains. Big data and data analytics enable data-driven decision-making for collection development and resource allocation, allowing libraries to optimize their resources and services. Analytics can also enhance user experiences through personalized recommendations and improved resource discovery. Additionally, data analytics can help libraries assess their performance, measure their impact and identify areas for improvement.

By leveraging data insights, libraries can better understand their users' needs and behaviours, ultimately leading to more effective services and strategic planning.
Virtual Reality (VR) and Augmented Reality (AR): VR immerses users in a simulated environment, while AR overlays digital information onto the real world. These technologies have applications in fields like gaming, education, and training. VR and AR are immersive technologies that alter the way we perceive and interact with the physical and digital worlds. While they share some similarities, they have distinct concepts and applications: Virtual Reality (VR) is a technology that creates a computer-generated, immersive, and interactive three-dimensional environment that users can explore and interact with. It aims to completely replace the real world with a simulated digital environment. Augmented Reality (AR) on the other hand, is a technology that overlays digital information, such as graphics, sounds, or other data, onto the real world. It enhances the user's perception of reality by adding virtual elements to their surroundings. These innovative technologies provide immersive learning experiences, interactive simulations and creative opportunities for libraries. They enable users to engage with information in new ways such as virtual tours, 3D modelling and interactive storytelling. They can also enhance education, research and community engagement making libraries more dynamic and appealing spaces (Halburagi & Mukarambi, 2023).

Robotics: Advances in robotics are transforming industries by enhancing efficiency and precision. Robot systems are being used in libraries, manufacturing, logistics, and even healthcare. Robotics is a field that involves the use of machines, software, and technologies to perform tasks with minimal human intervention (Jatto, Olayemi and Fakunle, 2024). Robotics is a multidisciplinary field of science and engineering that focuses on the design, construction, operation, and application of robots. Robots are mechanical or electromechanical devices capable of performing tasks autonomously or semi-autonomously. Robotics and automation are pivotal in improving productivity, safety, and efficiency across various industries. They involve the use of technology to perform tasks autonomously or semi-autonomously and have a profound impact on how we work and live. Robotics in libraries can enhance services and operations by providing assistance, automation, and interactive experiences. Robots can help with tasks such as assisting patrons with information queries or navigation and supporting literacy and learning programs through interactive activities. They can also automate tasks like book sorting and shelving, freeing staff to focus on more complex tasks. Robotics can also create engaging experiences for users, promoting STEM education and sparking curiosity about technology. By integrating robotics, libraries can offer innovative and interactive services, supporting learning, community engagement and operational efficiency.

Blockchain: This technology involves the secure and transparent recording of transactions in a distributed and decentralized manner. Blockchain has applications in areas such as finance, supply chain management, and digital identity verification. Blockchain is a revolutionary and transformative technology that serves as the foundation for cryptocurrencies like Bitcoin while also finding applications in a wide range of industries beyond finance. At its core, blockchain is a decentralized and distributed digital ledger that records transactions across multiple computers in a way that ensures the integrity, security, and transparency of the data. Blockchain is a decentralized, secure, and transparent ledger technology that has the potential to disrupt various industries beyond finance. It provides a tamper-resistant record of transactions and is being explored for a wide range of applications in both public and private sectors. Blockchain technology can enhance library services by providing a secure, transparent and decentralised way to manage digital content, resource sharing and authentication. It ensures the integrity and security of digital assets, provides a clear record of transactions, and enables secure management of resources. By leveraging blockchain, libraries can enhance trust, security and efficiency in their digital services. As technology continues to evolve, librarians must adapt and innovate to meet changing user needs and stay relevant in the digital age (Isiaka, et al 2024).

Impact of Technological Transformation on Information Service Delivery

The rapid evolution of technological innovations has transformed the landscape of information service delivery, revolutionizing the way libraries and information centres operate. These advancements have enabled faster, more efficient and more accessible information services, meeting the changing needs of users. Technological innovations have reshaped the information landscape, offering new opportunities for service delivery, user engagement, and resource management. This impact is multifaceted, influencing various aspects of information service delivery from resource discovery to user experience.
Computers and the internet have brought in a new impact to the library and information usage. In libraries, innovative technology has assisted library professionals to provide value added quality information service and give more remote access to the national as well as internationally available information resource. According to Kaur (2018), innovative technology is impacting on various aspects of libraries and the information profession. Advancements in information technologies and the widespread use of ICT is resulting in digital information sources and digital media replacing and becoming the dominant form of information storage and retrieval. The term library services no longer refer only to be given in physical buildings located in a specific geographic location but also services to the users can be given through digital or virtual libraries that can be accessed from anywhere.
Today's highly sophisticated information technology facilitates the storage of huge amounts of data or information in a very compact space. Information technologies promise fast retrieval of stored information and revolutionize our concept of the functions of a traditional library and a modern information centre. Recently technological developments have dramatically changed the mode of library operations and services (Jyoti, 2024). Technological innovations have significantly impacted information service delivery in several ways:

Library Networking: Library networking provides access to online information through the internet or intranets to its users at remote places. Information such as online databases, e-journals, e-books, government publications can be used digitally through networked systems.
Electronic Document Delivery: The electronic document delivery has reduced the postal services in the libraries. Traditional method to send documents to users or carry out interlibrary lending has been replaced by electronic networks and now documents can be delivered in various formats e.g. PDF straight to users' desktops (Futalibrarian, 2013; Mishra 2022)

Electronic Reference Services: Electronic reference services tools are replacing the conventional means of postal, phone or in person reference services. Libraries are now providing reference services through email, subject gateways, FAQs, chat rooms, virtual reference desk, and ask-me. SDI (Selective dissemination of information) or Current Awareness Services (CAS) and virtual reference desks, announcements of new acquisitions and other reader advisory services can be made easier through the internet. Users can have online interaction with the reference staff.

Library Cooperation and Resource Sharing: Library cooperation and resource sharing improves access and service through borrowing and lending from other libraries. Cooperation and sharing have been transformed from a print to a digital by information technology. Libraries can create and share bibliographic records and other information resources in digital format.

Institutional Repositories: Institutional repositories are publications that originate locally from within the university community such as theses, dissertations, reports, conference papers and seminar papers. These resources can preserve for future access by any users from anywhere.

Online User Education or Tutorials: This can be given by libraries through internet or CD-ROMS to educate their users or carry out information literacy programmes. Virtual tours can be offered online making user education more convenient for all.

Streamlined Services: Automation and self-service options reduce the workload for library staff, allowing them to focus on more complex tasks. Users can also complete tasks more efficiently, such as checking out books or renewing loans.

New Services and Opportunities: Libraries can now offer innovative services like digital literacy programs, makerspaces and digital creation tools. These services support learning, creativity and community engagement, helping libraries stay relevant and valuable to their users.

Enhanced Accessibility: With technology, users can access library resources and services remotely, any time of the day. This increased accessibility benefits users with mobility issues, those living in remote areas, or those with busy schedules. Mobile apps like Libby and OverDrive let users borrow e-books at midnight, while AI-driven platforms like EBSCO Discovery provide single-search access to journals, databases, and multimedia. This shift to "anytime, anywhere" access aligns with global trends but demands robust IT infrastructure—a challenge for rural Nigerian libraries lacking stable electricity.

Improved Resource Discovery: Advanced discovery systems and search tools enable users to quickly find relevant resources. Personalized recommendations also help users discover new resources and topics that match their interest.

Challenges and Ethical Consideration of Technological Advancements
Despite the benefits and positive impact of innovative technologies in transforming library and information services delivery, there are some challenges libraries face. The integration of innovative technologies in library services presents several challenges. As libraries strive to stay relevant and meet the evolving needs of their users, they must navigate issues related to funding, staffing, user adoption and technological compatibility. Additionally, ensuring the security and privacy of user data, as well as the long-term sustainability of these technologies, are crucial considerations. These challenges require careful planning and strategic management to ensure successful implementation and adoption of innovative technologies in library services. Eje and Dushu (2018) citing Okere and Ekere (2008); Oduwole, 2005; Adedoyin, 2005, Igun, 2006) noted some challenges which are:

Increase in the number of published materials
It is necessary for information practitioners to sharpen their skills and competencies in their professional areas to enable them to cope effectively with the large volume of information resources available for use. The implication of this development is that the Library and Information Science (LIS) curricula would need to be strengthened to be able to detect the authenticity of published materials.

Lack of Skilled Personnels
Following the trend of innovation technologies, there is the challenge of inadequate skilled library personnel that could meet professional requirements. This view was also corroborated by Choi (2006) in Eje and Dushu (2018), who opined that "without well-educated digitals librarians, digital libraries cannot reach their full potential". Library staff need training and retraining to effectively use and support new technologies.

The era of digitization has challenges for both libraries and librarians; the sheer volume of information available in e-books, databases, archives and other digital materials has spurred innovation in the organization, management and distribution of library resources. For some time, some believed that just as bookstores and libraries were becoming irrelevant, that librarians would too. However, this could not be further from the truth. Search engines do provide a plethora of information, quickly and easily, but there is no guarantee of the quality of the information.
In the delivery of this innovation, there have been seeming challenges. These include problems of adequate skilled manpower, problem of access, connectivity, funding, literacy, bandwidth and cost implication and good governance. These challenges require careful planning, resource allocation, and strategic management to ensure successful implementation and adoption of innovative technologies in library services.

Future Trends of Libraries as Technology Continues to Evolve
According to Isiaka, et al (2024), as technology continues to evolve, libraries will play an even more dynamic and essential role in society. Future trends in the libraries are expected to be shaped by technological advancement, changing community needs, and a growing focus on sustainability and inclusion. They further explained the following as some predictions for the future role of libraries:
Data Literacy and Personalized Services: Libraries will promote data literacy skills, helping individuals understand and make informed decisions based on data. They will provide resources and training to navigate the world of big data and analytics. Libraries will leverage artificial intelligence to offer personalized services, such as tailored reading recommendations, customized learning plans, and interactive learning experiences.

Digital Hubs and Citizenship Education: Libraries will evolve into digital hubs that provide access to a vast array of digital resources, including e-books, virtual reality experiences, online courses, and digital archives. They will serve as gateways to the digital world for individuals of all ages. Libraries will educate patrons about responsible digital citizenship, including online privacy, ethical behaviour, and critical evaluation of digital information. They will play a role in creating informed and responsible digital citizens.

Remote Access, Virtual Services and Community Meeting Points: Libraries will offer expanded remote access to resources and services, allowing patrons to engage with library offerings from anywhere. Virtual events, workshops, and reference services will become standard. Libraries will remain vital community meeting points, offering spaces for people to gather, collaborate, and engage in discussions on a wide range of topics. These spaces will foster inclusivity, cultural exchange, and social cohesion.
Sustainable and Green Spaces: Libraries will incorporate sustainable technologies and practices, emphasizing energy efficiency, green architecture, and eco-friendly initiatives. They will serve as models for environmentally conscious community spaces.

Industry and Interdisciplinary Collaboration: Libraries will collaborate closely with industries, businesses, and startups to offer resources, expertise, and space for innovation. They will serve as innovation incubators and support local economic growth. Libraries will collaborate with diverse fields such as health, science, technology, and the arts to provide cross-disciplinary resources, programs, and services that cater to multidimensional interests. Libraries will advocate for digital equity, working to close the digital divide and ensure that all members of society have access to technology and information resources.

Innovation and Creativity Centres: Libraries will continue to offer spaces for innovation, creativity, and hands-on learning. Maker spaces equipped with advanced technologies like 3D printers, robotics, and virtual reality setups will become commonplace, encouraging patrons to experiment and create. Libraries will be lifelong learning centres, providing a range of educational resources and programs for people at all stages of life. They will offer personalized learning paths, professional development opportunities, and skills training to adapt to changing job markets.

Cultural Preservation and Continuous Adaptation: Libraries will continue to serve as guardians of cultural heritage, preserving both physical and digital artifacts for future generations. They will digitize and archive historical materials to ensure their accessibility and longevity. Libraries will remain agile and adaptable, embracing emerging technologies, and continuously evolving to meet the changing needs of their communities in an increasingly digital and interconnected world. These trends will shape the future of libraries, enabling them to remain relevant, responsive and impactful in a rapidly changing world.

Conclusion
Libraries are not relics of the past but beacons of the future. As technology evolves, librarians must champion a dual mandate: harnessing AI's efficiency while nurturing the human connections that machines cannot replicate. By investing in digital infrastructure, continuous staff training, and community-centric programs, Nigerian libraries can lead Africa's journey toward inclusive, tech-driven knowledge ecosystems. The words of Ashurbanipal's scribes, etched on clay tablets millennia ago, remind us: Preservation is progress. Today, that progress is digital.

Suggestions
Based on the literature reviewed, the researchers made the following suggestions:

1. There is need to deliberately work towards the realisation of modern library system using advanced technological tools capable of showcasing the capability of modern technologies to transform libraries and information centres.

2. Policymakers and stakeholders should develop strategic frameworks that promote innovation, encourage upskilling, and ensure librarians are central to digital transformation initiatives.
3. There should be a good IT infrastructure supported by adequate bandwidth and necessary infrastructure is needed. This will guarantee a platform to build a solid information technology foundation that is sustainable and enduring.
4. It is a known fact that IT cannot achieve world class practice without effective and efficient power supply. Apart from electricity supply from the national grid, standby generator or inverter should be provided to check incessant power outages.
5. For a meaningful transformation process, all stakeholders should be adequately taken through the various areas of information management for a detailed understanding.

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Research Skills of Library and Information Science Postgraduate Students in the 5th Industrial Revolution

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Abstract

The fusion of human-centric innovations and collaborative technologies is aiding research in the current era. This study explored the research skills of library and information science (LIS) postgraduate students in the current age of the 5th Industrial Revolution. The study employed a descriptive research design with a population of 62 postgraduate students in the department of LIS, Delta State University, Abraka in the 2024/2025 academic session. A total enumeration sampling technique was used for the study. A questionnaire was used as the instrument of data collection. Mean, frequency and percentage were used for data analysis. It was found that the students have a moderate level of skills to conduct postgraduate research. The study further found that the transformative technological advancements of the 5th industrial revolution require integrating digital literacy and emerging technologies such as artificial intelligence and machine learning into LIS postgraduate education. The strategies for enhancing the research skills of students include the integration of interdisciplinary learning and advanced technology into research in LIS education. It was recommended that LIS postgraduate students should leverage the 5th Industrial Revolution tools to enhance their research skills.

Keywords: *Research Skills, Library and Information Science, Postgraduate Students, 5th Industrial Revolution, Universities*

Introduction

Technology has pervaded all areas of human life, leaving an indelible mark of transformation and advancement. The 5th Industrial Revolution which incorporates the 4 Industrial Revolution technologies such as Artificial Intelligence, robotics and machine learning with human-centric value has heralded unprecedented advancements in human history, especially in the area of education and research (Pathak et al., 2019). In the 5th Industrial Revolution noted for the swift progression of technologies, there is a need to enhance the research skills of postgraduate students for effective research performance toward successful completion of their studies. The current fast-paced, technology-driven world necessitates students to move further than traditional research approaches and accept novel, interdisciplinary approaches modern research requires (Adekoya & Adedimeji, 2021). These skills will enable the students to navigate the complexities of emerging technologies. Postgraduate students need robust research skills to make significant contributions in both academic world and professional life, while remaining adjustable in a continuously changing environment (Adekoya, 2018).

Postgraduate education requires thorough research for graduation. Research serves as a critical driver of societal development and modernization. The industrial sector depend greatly on research findings from universities (Cunningham & Link, 2015). Thorough research is the key way for knowledge production. Universities accentuate research as a fundamental value together with learning and community service (Akuegwu, & Nwi-ue, 2018). The results of research are what transform society. Discoveries and inventions required to improve society and solve a series of problems are the results of research (Busayo et al., 2024). Proficient research performance needs scholars to have essential research skills. It is expected that postgraduate students should apply the rigour of the research process to tackle emerging societal challenges, and make meaningful contributions to global advancement through analytical, objective, and critical methods. As such, postgraduate students have to possess the required research skill. The evolution of the 5th Industrial Revolution era is essentially connected with how different research tools such as Artificial Intelligence, Chatbots, and Chatgps, among others can be harnessed to advance the quality of research emanating from higher educational institutions.

Research is an essential component of postgraduate education in Library and Information Science (LIS). Research skills are the driving force behind diverse innovations in library education and practice (Cunningham & Link, 2015). Research skills furnish students with the scholarly complexities, ingenuity, and intuition required to tackle known glitches Adekoya, 2018). Nevertheless, some postgraduate students do not possess the crucial research skills needed for their dissertations. This usually leads to frustration in their studies. Meanwhile, it is expected that postgraduate students leverage the technological advancements that the 5th Industrial Revolution brings as a way of advancing their research prowess. In this regard, the development of research skills which help in bridging knowledge gaps in diverse areas of LIS becomes imperious. The evolution of the 5th Industrial Revolution challenges universities to reconsider and adapt existing systems and structures to equip postgraduate students with the research skills needed to succeed in their postgraduate research. This study therefore investigates the research skills of LIS postgraduate students in the 5th Industrial Revolution.

Objectives of the Study

The objectives of the study are to:

1. investigate the current research skills of LIS postgraduate students in the 5th Industrial Revolution;
2. assess the extent of the current research skills of LIS postgraduate students in the 5th Industrial Revolution;

3. identify the factors affecting the research skills among LIS postgraduate students in the 5th Industrial Revolution; and
4. determine the strategies for enhancing the research dkills of LIS postgraduate students in the 5th Industrial Revolution

Literature Review

The 5th Industrial Revolution and Research

The 5th Industrial Revolution is an era in which the use of Artificial Intelligence, robotics, and personalized technologies became commonplace (Pathak et al., 2019), especially in research. Different from the 4th Industrial Revolution whose focus was essentially automation and data exchange, the 5th Industrial Revolution prioritises collaboration between humans and machines for sustainable and ethical progress (Affum & Dwomoh, 2023). Some of the AI tools such as Chatgpt, Grammarly and Chatbots are specifically meant for research and correction of grammatical errors in intellectual work. This has greatly improved the quality of research in the modern day. In the face of the integration of technologies and human-centric value, postgraduate students are in a unique position to tackle evolving confrontations such as data management, digital literacy, and information ethics. Nevertheless, the level of alignment of their research skills with the demands of the 5th Industrial Revolution depends on the readiness of the students for thorough ground-breaking research.

Research Skills of LIS Postgraduate Students in the 5th Industrial Revolution

The contemporary educational dispensation requires postgraduate students to have the appropriate research skills for effective performance in their dissertation (Ain et al., 2019). Research skills are the skills for identifying problems, knowing the appropriate source of information required to answer the problem, searching those sources proficiently, evaluating the quality and appropriateness of the collected information, and applying the information commendably to resolve the problem Akuegwu, & Nwi-ue, 2018). Successful completion of postgraduate studies depends significantly on possessing the research skills that can assist in writing and presenting a research dissertation (Jones et al., 2021). The required skills for effective performance of postgraduate students in their dissertation are growing and changing in the 5th Industrial Revolution. Adekoya (2018) affirmed that research-based academic studies stimulate higher order learning results (critical thinking) which are the transferable research-related skills required of higher education. Research skills offer the avenue to conduct research that is globally acceptable.

In the era of the 5th Industrial Revolution, there is an increasing expectation from postgraduate students to possess different types of research skills that incorporate evolving technologies, collaborative thinking, and high knowledge of complex challenges across the globe. Among the major skills needed for postgraduate research is skill in data science and analytics (Sern et al., 2017). As huge volumes of data are found in almost all fields of research, there is a need for postgraduate students to study the way to manage, interpret, and draw insights from large datasets (Cunningham & Link, 2015). This entails understanding tools and methods which include machine learning, data visualization, and statistical analysis. This allows students to recognize arrangements, developments, and relationships that may be tough to distinguish.

Ain et al. (2019) referred to skills which include creative thinking, learning-to-learn, information literacy, ICT, and oral presentation skills as the 'cross 21st century skills'. According to Akpochafo (2016), research skills include reading, writing, critical thinking, oral presentation, learning-to-learn, and media literacy skills. Ereh and Orji (2021) recognised research skills which include searching skills, knowledge of research methods, knowledge of data collection methods, abilities to apply qualitative and quantitative techniques for data analyses, rhetorical skills for creating a persuasive and logical argument, written and oral presentation skills, computer skills, capabilities to work in collaboration, and abilities to continuously improve to find new ways of solving problems. Adekoya (2018) noted that there is largely a lack of direct measures of the research skills generally possessed by postgraduate students as well as the relative strength of those skills upon graduation because those skills change over time.

Digital literacy is a vital skill. It entails the capability to use advanced software tools that support research (Akuegwu, & Nwi-ue, 2018). Because AI, automation, and cloud computing are reshaping the conduct of research in the contemporary era, there is a need for students to enhance their proficiency in navigating a wide-ranging series of digital tools, from collaborative platforms such as Google Scholar and Mendelin to specialized software for data collection, analysis, and simulation.

Studies have shown that some problems require multidisciplinary approach to address them (Komba, 2016; Asogwa et al., 2014). As such, postgraduate students have to develop interdisciplinary thinking because the 5th industrial revolution requires a comprehensive method to answering difficult problems. The current challenges in libraries such as remote answering of users' queries, development of integrated library management software, and development of institutional repositories cannot be addressed by librarians alone. There is a need to draw on insights from engineering and computer science, and blend knowledge to produce ground-breaking results.

In the current era of the 5th Industrial Revolution, postgraduate students have to develop robust ethical and critical thinking skills. As AI and other advanced technologies are progressively incorporated into research, students have to be fortified to circumnavigate intricate ethical dilemmas about confidentiality, unfairness, and the general effects of novel technologies. Having knowledge of the ethical implications of research and guaranteeing that their research conforms to principles of equality, openness, and responsibility is necessary

(Komba, 2016). Also, there is a need for students to painstakingly assess the information and technologies they use, and also distinguish between reliable sources and possibly damaging misrepresentation (Ereh & Orji, 2021). The capability to ponder analytically concerning the moral, and societal aspects of research guarantees that postgraduate students can make meaningful contributions to the advancement of knowledge in manners that can be of benefit to society while alleviating dangers connected with swift technological advancement (Akuegwu, & Nwi-ue, 2018).

1. **Critical Thinking Skill**: This encompasses analysing the facts, authenticity, and reliability of a particular event/ it also deals with assessing ideas and issues in research (Adekoya, 2018). Critical thinking improves the intellectual creativity of students. The role of universities in preparing a workforce that is intellectually prepared to ensure national development requires that universities promotes the ability of critical thinking in their students (Ain et al., 2019). As the cognitive capacity for judgment, critical thinking is the process of vigorously and proficiently theorizing, creating, and measuring information to arrive at a solution or conclusion. As a fundamental component of scientific inquiry, critical thinking encompasses observation, interpretation, analysis, inference, evaluation, and explanation.
2. **Problem-Solving Skill:** This is the aptitude to ascertain, describe, and evaluate matters involved in research. Since research is all about finding solutions to identified problems, problem-solving skill facilitates the formation and evaluation of solutions. Effective problem-solving relies on imaginative and innovative thinking to find modern approaches to tackle challenges (Adekoya, 2018).
3. **Analytical Skill:** This is the skill needed to collect and analyze data using synthesis and data reduction methods. This skill is usually lacking among students (Ereh & Orji, 2021).
4. **Computer Proficiency:** This skill entails using statistical software and databases. It also entails creating records and publications using programmes such as Microsoft Office.
5. **Information Literacy Proficiency:** This is the skill needed to understand the sources and structure of information. Information literacy encompasses the capability to identify when information is required and to find, assess, and make effective use of information building upon the personal knowledge base of an individual. In the 21st century, information literacy depends on the ability to access and manipulate information using technology responsibly.
6. **Writing Proficiency:** Postgraduate students are anticipated to have advanced writing skills. The poor writing skills of some students cause supervisors to expend substantial time editing and correcting the work of their theses supervisees.
7. **Oral Presentation skill:** This is the skill for effective presentation of research dissertations to a large number of academic professionals. Oral presentation skill takes care of weaknesses related to communication and public speaking
8. **Statistical Analysis Skill:** This is the ability to analyse, interpret, and present statistical data. In modern times, computer software applications are used for performing large-scale data analyses which involve statistical measures such as mean, standard deviation, chi-square, z-score, and hypothesis testing (Ain et al., 2019). **Statistical analysis skill** helps in determining the accurate meaning and larger picture of data sets.

Factors Affecting Research Skills among LIS Postgraduate Students in the 5th Industrial Revolution

The quality of research carried out by the vast majority of the postgraduate students is usually low and undependable. This is because some factors affect the research skills of the students. Among the factors is a lack of readiness of the students to carry out independent research. Meanwhile, the expectation is that students who enroll for doctoral programmes are ready and adequately self-assured to survive the social and academic complexities of research. Nonetheless, some postgraduate students do not possess the required research skills to proficiently circumnavigate the rigours of research dissertations. This often leads to great dropout rates and elongation of programme durations.

Postgraduate students are expected to possess skills to conduct original research which is devoid of plagiarism, fabrication and falsification of data (Ekpoh, 2016). Research misconduct which includes fabrication, falsification, and plagiarism, repeatedly weakens the ability of postgraduate students to conduct research. This usually happens when the researchers do not have adequate research skills. This can cause compromised research results that cannot tackle practical problems in library and information science (Asogwa et al., 2014). Plagiarism as academic dishonesty is a grave scientific misconduct. In some cases, postgraduate students cunningly plagiarize the research carried out by other scholars. Consequently, checkmating plagiarism and other sharp practices in research dissertations require postgraduate students to subject their works to plagiarism (Afolabi, 2022). This often causes drop-out and withdrawal of study among postgraduate students who do not possess the needed research skills to carry out standard research.

Effective and result-oriented research in the era of the 5th Industrial Revolution requires that research skills be instilled in the students by their departments/faculties (Affum & Dwomoh, 2023). Asogwa et al. (2014) noted that many postgraduate students in Nigerian universities lack the required research skills that can guarantee them an easy sail in their research dissertation. Cunningham and Link (2015) asserted that a lack of research skills kills researchers. Due to lack of research skills, some postgraduate students contract out their research dissertation to research experts without personal intellectual input. The performance of some is woeful during thesis presentation because they either have little or no knowledge of what is contained in the dissertation. Some even do not have oral presentation skills or have phobia of facing a large number of people.

One of the key factors affecting the research skills of postgraduate students is the lack of adequate preparation in research skills before carrying out research (Afolabi, 2022). Postgraduate students should have suitable and adequate research skills to contribute meaningfully to scholarly advancement (Cargill & Smernik, 2016). Some postgraduate candidates enter the programme with inadequate prior knowledge and skills in carrying out research. This leads to research efforts that do not have the potency and novelty needed for research accomplishment. This inefficiency can harmfully affect their research performance. It is expected that doctoral students who have experienced demanding research training in their previous education should possess adequate research knowledge to support their doctoral studies (Cunningham & Link, 2015).

Despite of the challenges postgraduate students face while carrying out research, some students may be unwilling to be mentored in research. Meanwhile, mentorship is an essential tool for developing relationships and transferring knowledge and skills from more experienced individuals (mentors) to less experienced ones (mentees) (Olibie et al., 2015).

Strategies for Enhancing Research Skills of LIS Postgraduate Students

Possessing research skills is essential for postgraduate academic engagement (Cargill & Smernik, 2016). Having noted that some of the postgraduate students do not possess some of the required research skills, there is a need to come up with strategies for developing and enhancing such skills (Asogwa et al., 2014). Meanwhile, a research dissertation as a requirement for graduation in LIS postgraduate education is a collaborative effort between supervisors and supervisees. The era of the 5th industrial revolution is such that research is becoming progressively collaborative. Postgraduate students are expected to engage in innovative and interdisciplinary collaborative research by integrating modern technologies. The future of librarianship can only be determined by enhancing the research skills of LIS students to enable them to adapt to new and changing demands in the educational environment (Adekoya, 2018). The collaboration can even be interdisciplinary. People are carrying out research across digital platforms to tackle multifarious difficulties. Students have to be encouraged to participate in cross-disciplinary collaborations through which they can be exposed to different methods, perspectives, and proficiency that can enhance their research experience and broaden their knowledge (Undelikwo et al., 2022). The values of collaboration have to be instilled in the students so that they will be well-prepared to work in an interrelated research environment.

Enhancing the research skills of students requires integrating interdisciplinary learning into the teaching of research. Because the challenges and prospects of the 5th Industrial Revolution cover different areas, there is a necessity to encourage LIS students to get insights from diverse related disciplines which include computer science, information technology, software engineering and behavioural studies. The interdisciplinary method will assist in understanding the wider effects of research and enhance inventiveness and modernization (Cargill & Smernik, 2016). Research courses have to integrate collaboration with students from different educational trainings, and allow them to tackle difficulties from numerous viewpoints and improve their capability to answer difficult, real-life problems (Adekoya, 2023).

The various technological tools of the 5th Industrial Revolution such as artificial intelligence, machine learning, and big data can be incorporated into research methods (Eiriemiokhale & Sulyman, 2023). Students have to be taught how to use these tools to analyse large datasets, and automate repetitive activities to come up with novel insights. Provision of practical knowledge with innovative tools which include data analysis platforms, and AI-driven tools can greatly improve the capability of students for effective management, interpretation, and utilisation of data. These tools can form an essential part of research needed to build the capability of the students, and prepare them for the complexities of carrying out bround-breaking research in the 5th industrial revolution.

Using the 5th Industrial Revolution technologies such as AI and robotics requires that the critical thinking and digital literacy of the students are enhanced. Though access to advanced tools can boost research performance, there is a need for students to study the way to critically appraise the data and information they want to use. This entails having knowledge of the ethical implications of using AI and data, and assessing the reliability and sources of data. Reinforcing analytical skills enables students to proficiently use technological tools and likewise helps them make thoughtful and ethical use of the skills.

Postgraduate students have to be mentored by experts in librarianship who are similarly knowledgeable in steering the technological and ethical challenges of contemporary research (Undelikwo et al., 2022; Adekoya & Fasae, 2021). Mentorship programmes have to accentuate not merely research methods and procedures but likewise leadership on invention, professional development, and ethical decision-making in research in line with realities of the 5th industrial revolution (Olibie et al., 2015).

Methodology

The study adopted a descriptive survey research design. The population comprised 62 postgraduate students in LIS at Delta State University, Abraka, during the 2024/2025 academic session. Due to the small size of the population, a total enumeration sampling technique was employed. Data were collected using a structured questionnaire. A senior lecturer in Measurement and Evaluation at Delta State University, Abraka validated the research instrument. To ensure the reliability of the instrument, 10 copies of the questionnaire were administered to LIS postgraduate students at Ambrose Alli University, Ekpoma. The reliability of the instrument was tested using the Cronbach's Alpha method, yielding a coefficient of 0.69, which indicates an acceptable level of reliability. To achieve a high response rate, the questionnaires were distributed to students immediately after their final examination paper for the first semester. Of the 62 copies of the questionnaire

administered, 45 were completed and returned, resulting in a response rate of 73%, which was deemed adequate for the study. Data analysis was carried out using mean, frequency, and percentage, with the aid of SPSS version 21.

Results

Research skills of LIS postgraduate students in the 5th Industrial Revolution

Table 1: Research Skills of LIS Postgraduate Students in the 5th Industrial Revolution

S/N	Research Skills	SA	A	N	D	SD	Mean (x̄)	Std Dev.
i	Information literacy proficiency	18	27	0	0	0	4.40	.495
ii	Oral presentation skill	18	23	4	0	0	4.22	.850
iii	Author citing and referencing skills	16	14	8	5	2	3.82	1.173
iɓ	Critical thinking skill	13	18	6	8	0	3.80	1.057
ɓ	Writing proficiency	13	14	8	4	6	3.53	1.358
ɓi	Problem-solɓing skill	9	15	6	7	8	3.22	1.412
ɓii	Interdisciplinary thinking skill	7	13	9	8	8	3.07	1.355
ɓiii	Analytical skill	9	10	8	8	10	3.00	1.462
iɗ	Statistical analysis skill	7	7	13	9	9	2.87	1.342

Note: SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree

Table 1 reveals the research skills of LIS postgraduate students in the 5th Industrial Revolution. The skills include information literacy proficiency (x= 4.40, SD = 0.495), oral presentation skill (= 4.22, SD = 0.850), and author citing and referencing skills (= 3.82, SD = 1.173). These skills will aid their research performance.

Extent of the current research skills of LIS postgraduate students in the 5th Industrial Revolution

Table 2: Extent of Research Skills of LIS Postgraduate Students in the 5th Industrial Revolution

S/N	Research Skills	VGE	GE	ME	LE	VLE	Mean (x̄)	Std Dev.
i	Information literacy proficiency	24	16	5	0	0	4.42	.690
ii	Critical thinking skill	22	20	3	0	0	4.42	.621
iii	Problem-solɓing skill	17	11	12	3	2	3.84	1.147
iɓ	Oral presentation skill	10	20	11	4	0	3.80	.894
ɓ	Writing proficiency	10	17	13	4	1	3.69	.996
ɓi	Author citing and referencing skills	13	12	9	10	1	3.58	1.196
ɓii	Analytical skill	9	18	9	6	3	3.53	1.160
ɓiii	Interdisciplinary thinking skill	4	7	9	9	16	2.42	1.357
iɗ	Statistical analysis skill	3	9	7	11	15	2.42	1.323
	Aɓerage Mean						3.57	

Note: VGE=Very Great Extent, GE=Great Extent, ME=Moderate Extent, LE=Low Extent, VLE=Very Low Extent

As shown in Table 2, the average mean is 3.57. This indicates a high extent of research skills of LIS postgraduate Students in the 5th Industrial Revolution. Except for interdisciplinary thinking skills (x=2.42, SD=1.357), and statistical analysis skills (=2.42, SD=1.323), the extent of research skills of the students in other areas is high.

Factors affecting research skills among LIS postgraduate students in the 5th Industrial Revolution

Table 3: Factors Affecting Research Skills among LIS Postgraduate Students in the 5th Industrial Revolution

S/N	Factors	SA	A	N	D	SD	Mean (x̄)	Std Dev.
i	Inadeƙuate intellectual preparation necessary for adßanced scholarship	20	16	4	2	3	4.07	1.156
ii	Inadeƙuate institutional support	14	20	7	3	1	3.96	.976
iii	Inadeƙuate self-confidence in research	4	13	19	6	3	3.20	1.014
iß	Research misconduct such as fabrication, falsification, and plagiarism	6	5	13	13	8	2.73	1.268
ß	Inadeƙuate access to research software packages	5	7	6	11	16	2.42	1.406
ßi	Inadeƙuate predisposition to research collaboration	4	3	5	17	16	2.16	1.242
	Unwillingness to be mentored in research	3	5	5	10	22	2.04	1.296

Note: SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree

Table 3 reveals that the factors affecting research skills among LIS postgraduate students in the 5th Industrial Revolution include inadequate intellectual preparation necessary for advanced scholarship (x=4.07, SD=1.156), inadequate institutional support (=3.96, SD=0.976), and lack of self-confidence in research (=3.20, SD=1.014). However, inadequate access to research software packages (=2.42, SD=1.406), lack of predisposition to research collaboration (=2.16, SD=1.242), and unwillingness to be mentored in research (=2.04, SD=1.296) do not affect research skills among the students.

Strategies for enhancing the research skills of LIS postgraduate students in the 5th Industrial Revolution

Table 4: Strategies for Enhancing the Research Skills of LIS Postgraduate Students in the 5th Industrial Revolution

S/N	Strategies	SA	A	N	D	SD	Mean (x̄)	Std Dev.
i	Engagement in innoßatiße and interdisciplinary collaboratiße research	16	26	3	0	0	4.29	.589
ii	Integration of interdisciplinary learning into the teaching of research	18	21	1	1	4	4.20	.869
iii	Integration of modern technologies in carrying out research	12	28	5	0	0	4.16	.601
iß	Incorporation of 5th Industrial Reßolution technologies such as artificial intelligence, machine learning, and big data into research methods	12	26	5	1	1	4.04	.824
ß	Attending mentorship programmes	12	19	9	2	3	3.78	1.106

Note: SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree

Table 4 shows the various strategies for enhancing the research skills of LIS postgraduate students in the 5th Industrial Revolution. These include engagement in innovative and interdisciplinary collaborative research (x=4.29, SD=0.589), integration of interdisciplinary learning into the teaching of research (=4.20, SD=0.869), and integration of modern technologies in carrying out research (=4.16, SD=0.601).

Discussion

The 5th Industrial Revolution requires possessing relevant research skills for research progress. This study found that the current research skills of LIS postgraduate students in the 5th Industrial Revolution Information literacy proficiency include critical thinking skills, problem-solving, oral presentation skills, writing proficiency, author citing and referencing skills, and interdisciplinary thinking skills. This agrees with the position of Adekoya (2018) that critical thinking skill which improves the intellectual creativity of students is needed for effective research. A related study by Asogwa et al. (2014) reveals that analytical skill is needed to collect and analyze data using synthesis and data reduction methods.

The findings indicate a great extent of research skills among LIS postgraduate students in the era of the Fifth Industrial Revolution. This suggests that the students are capable of conducting prolific research. Given their adequate levels of information literacy, critical thinking, oral presentation, and writing proficiency, their performance in dissertation and thesis work is expected to be strong. However, there is a need to improve their interdisciplinary thinking and statistical analysis skills. A similar study by Komba (2016) identified a low level of statistical analysis skills among students in Nigerian universities. Likewise, Adekoya (2023) emphasized the importance of acquiring interdisciplinary thinking skills as a means to enhance research performance in the current ICT-driven era.

It was also found in this study that the factors affecting postgraduate research among LIS postgraduate students in the 5th Industrial Revolution include lack of intellectual preparation necessary for advanced scholarship, lack of institutional support, lack of self-confidence in research, and lack of access to research software packages. This is in agreement with the finding of Komba (2016) that lack of adequate preparation in research skills before carrying out research is among the key factors hindering conducting acceptable research dissertation in universities. Also, Adekoya (2018) posited that research misconduct which include fabrication, falsification, and plagiarism, repeatedly weakens the ability of postgraduate students to conduct acceptable research.

As was found in this study, the strategies for enhancing the research skills of LIS postgraduate students in the 5th Industrial Revolution include engagement in innovative and interdisciplinary collaborative research, integration of interdisciplinary learning into the teaching of research, and integration of modern technologies in carrying out research. The finding that research collaboration is needed among the LIS postgraduate students, Adekoya (2018) asserted that postgraduate research success requires a collaborative effort between supervisors and supervisees. Adekoya (2023) advised that the students can likewise engage in interdisciplinary research. This is necessary due to the multidimensional approach required in tackling global challenges that require effective research for solutions.

Conclusion

The 5th Industrial Revolution has impacted several disciplines. It has altered the way research is conducted by leveraging technological research tools such as AI. The onus is on LIS postgraduate students to leverage these tools to enhance their research skills. The fact that the students possess skills such as information literacy proficiency, critical thinking skills, problem-solving skills, oral presentation skills, and writing proficiency will enable them to make headway in their research. Meanwhile, the lack of intellectual preparation necessary for advanced scholarship, lack of institutional support, and lack of self-confidence in research are acknowledged as the factors affecting postgraduate research among LIS postgraduate students in the 5th Industrial Revolution. However, the students can leverage strategies such as rngagement in innovative and interdisciplinary collaborative research, integration of interdisciplinary learning into the teaching of research, and integration of modern technologies in researching to enhance their research performance.

Recommendations

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

1. The LIS postgraduate students should leverage the 5th Industrial Revolution tools to enhance their research skills so that they can make headway in their research effort.
2. The students should improve their interdisciplinary thinking skills, as solving research problems in the contemporary era requires a multidisciplinary approach.
3. The students should make adequate preparation for the rigorous exertion of intellectual energy that postgraduate research entails, and also shy away from research misconduct such as fabrication, falsification, and plagiarism.
4. The students should enhance their research skills by engaging in innovative and interdisciplinary collaborative research, integrating interdisciplinary learning into the teaching of research, and adopting modern technologies that research entails.

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Resistance to Technological Change in Selected Academic Libraries in Nigeria: A Multi-Level Analysis in the Era of Fifth Industrial Revolution

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Abstract

This paper explores the multi-level factors; (individual, organizational and environmental) that contributes to resistance among library professionals. Specifically, it aimed to: (1) identify key factors contributing to resistance, (2) analyze the multi-level dimensions of resistance affecting technological adoption, (3) examine the impact of resistance on the implementation of 5IR-related technology, and (4) propose evidence-based strategies for overcoming resistance. The study adopted mixed methods approach, incorporating survey and in-depth interview. The population comprised library personnel in academic libraries of 10 selected federal universities across Northwestern Nigeria. A total of 150 respondents were selected through purposive sampling based on their roles in library technology services and management. The quantitative data were analyzed using descriptive statistics, correlation analysis and multiple regressions, while the qualitative data were analyzed using thematic analysis. The findings reveal that resistance is driven by concern over job security, lack of technical skills especially AI literacy, inadequate training and organizational culture. Institutional policies, leadership and external pressures also play a significant role in shaping attitudes towards AI adoption. The multi-level analysis indicated that resistance at individual, organizational, and systematic levels independently and collectively influenced the adoption of 5IR technologies, with individual resistance emerging as the strongest predictor. Based on the findings, the study recommends strategies interventions such as AI-focused training, participatory decision making and leadership-driven digital transformation to foster AI integration in academic libraries. This paper offers insights into overcoming resistance and ensuring seamless transition into AI-enhanced library services.

Keywords: *Fifth Industrial Revolution, human AI-collaboration, academic libraries, technological change resistance, change management.*

Introduction

The Fifth Industrial Revolution (5IR), characterized by the synergy of human intelligence and advanced technologies such as artificial intelligence (AI), robotics and quantum computing has redefined operations in academic libraries. The 5IR marks a new phase in technological advancement by ensuring seamless collaboration between humans and AI. As the trajectory of library and information science has always been influenced by technological innovation, the 5IR brings a paradigm shift by focusing on integration of human creativity with machine precision (Jain and Kataria, 2023). The Fifth Industrial Revolution (5IR) builds on the digital transformation of the Fourth Industrial Revolution (4IR) by emphasizing human-AI collaboration rather than full automation. That is to say, the 4IR ensures automation and digital transformation, while, 5IR focuses on human-AI-synergy, where AI augments human capabilities rather than replacing them (Schwab and Davis, 2021). Academic libraries the world over, as centers of knowledge dissemination, are increasingly integrating AI-driven services such as chatbots, automated cataloguing, predictive analytics, and AI-powered research assistance for better information access, storage and retrieval (Tzoc and Mililiken, 2022).

Academic libraries are expected to evolve into hybrid knowledge ecosystems, leveraging AI, big data and intelligent systems. However, resistances to such transitions remain pervasive (Abubakar and Haruna, 2020). This study explores the nature and determinants of resistance to technological change in academic libraries through a multi-level analysis, particularly within the 5IR context.

Problem Statement

Despite the rapid advancement of the Fifth Industrial Revolution (5IR), academic libraries especially in developing regions continue to face significant resistance to technological change. The resistance manifests at multiple levels of individual librarian's fear of job displacement or lack of skills for AI-driven services; institutions often lack strategic directions and leadership for technology integration; systemic challenges, national policies and funding frameworks remain inadequate. These barriers hinder libraries from transforming into intelligent, human-AI collaborative spaces, thereby limiting their ability to support cutting-edge teaching, learning and research.

Objectives of the Study

The specific objectives of this study are as follows:

1. To identify the key factors contributing to resistant to technological change in academic libraries within the context of the Fifth Industrial Revolution.
2. To analyze the multi-level dimensions of resistance; individual, organizational and system affecting technological adoption in academic libraries.
3. To examine the impact of resistance on the implementation of 5IR-related technologies and services in academic library operations.
4. To propose evidence based strategies and policy recommendations for overcoming resistance and facilitating smooth technological transitions in academic libraries.

Research Questions

In order to investigate the problem of the study, the research work was guided by the following questions:

1. What key factors contribute to resistant to technological change in academic libraries within the context of the Fifth Industrial Revolution?
2. What are the multi-level dimensions of resistance; individual, organizational and system affecting technological adoption in academic libraries?
3. What are the perceived impact of resistance on the implementation of 5IR-related technologies and services in academic library operations?
4. What is the evidence based strategies and policy recommendations for overcoming resistance and facilitating smooth technological transitions in academic libraries?

Research Hypotheses

The researchers formulated null hypotheses to guide the study:

H_{01}: There is no significant relationship between individual level factors (such as AI literacy, perceived job insecurity and attitude towards technology) and resistance to technological change in academic libraries.

H_{02}: Organizational-level factors (such as leadership commitment, policy clarity and availability of AI training) do not significantly influence resistance to the adoption of human-AI collaborative technologies in academic libraries.

Significance of the Study

This study is significant in several key ways:

Theoretical Contribution: It advances scholarly understanding of resistance to technological change in academic libraries by applying a multi-level analytical framework within the context of the Fifth Industrial Revolution.

Policy Relevance: The findings provide evidence based insights to guide policymakers, university administrators and library associations in formulating effective strategies for technology integration and change management

Practical Impact: By identifying specific resistance factors, the study equips library managers and stakeholders with actionable recommendations to foster technological adoption, enhance service delivery and future-proof library systems.

Literature Review

The Fifth Industrial Revolution (5IR) represents a paradigm shift from the Fourth Industrial Revolution by emphasizing not just technological advancement, but also the integration of human-centric approaches. It focuses on the collaboration between humans and intelligent systems, promoting sustainable, inclusive, and resilient development across sectors. In the academic library landscape, this revolution brings with it innovations such as artificial intelligence (AI), machine learning (ML), robotics, and the Internet of Things (IoT), which has the potential to revolutionize how information is acquired, processed, and disseminated.

However, in the Nigerian context, several challenges hinder the seamless adoption of these innovations. These include limited digital infrastructure, budgetary constraints, and low digital literacy among staff. The potential benefits of 5IR technologies—such as automation of cataloguing, AI-assisted reference services, and virtual reality-based user experiences—remain largely untapped due to pervasive resistance.

Technological resistance is not a new phenomenon in the Nigerian academic library system. It is a multi-layered issue that manifests across individual, organizational, and systemic dimensions. Each level of resistance is influenced by a unique set of factors, making it essential to adopt a multi-level analytical framework to understand and address these barriers.

At the individual level, librarians often display a reluctance to embrace technological innovations due to various psychological and practical concerns. Common among these are fear of job loss, anxiety over handling sophisticated digital tools, and a general preference for traditional librarianship practices. Achugbue (2025) found that librarians in South-South Nigerian universities demonstrated low levels of AI competency and digital literacy, which greatly impacted their willingness to integrate new technologies into their workflows.

Moreover, resistance at this level is often compounded by inadequate training opportunities and a lack of motivation. Without continuous professional development, librarians find it difficult to keep pace with the rapidly changing digital landscape, reinforcing a cycle of resistance and stagnation.

Organizational resistance stems from entrenched bureaucratic systems, absence of strategic vision, and the lack of institutional policies that prioritize technological adoption. Many academic libraries in Nigeria still operate under outdated administrative frameworks that do not incentivize innovation. Odunlade and Ojo (2024) argue that such institutions lack the managerial agility to respond effectively to emerging technological trends.

In addition, there is often a disconnection between library leadership and IT departments, leading to fragmented implementation of digital strategies. Resistance also emerges from a lack of collaboration, both within institutions and between academic libraries and external stakeholders, such as tech firms and funding agencies. The organizational culture, therefore, plays a critical role in either promoting or impeding change.

Systemic resistance is deeply rooted in the broader socio-economic and political environment. It reflects the challenges posed by underfunded educational systems, weak policy frameworks, and infrastructural deficits. Nigeria's digital infrastructure is unevenly distributed, with many academic institutions lacking basic internet connectivity and reliable electricity. Tella et al. (2025) emphasize that without conducive external environment, efforts to integrate 5IR technologies within academic libraries will remain superficial.

Furthermore, national policies related to library development often fail to incorporate strategic technological roadmaps. There is limited governmental support for library digitization projects, and where policies exist, they are often poorly implemented. These systemic issues exacerbate resistance and limit the capacity of libraries to evolve.

A comprehensive understanding of resistance requires a multi-level analysis framework. This framework categorizes resistance into individual, organizational, and systemic levels, enabling stakeholders to identify specific challenges and design targeted interventions. At the individual level, a major barrier is the skills gap, which hinders effective interaction with digital tools. Adeyeye and Oladokun (2024) suggest that awareness campaigns and continuous learning programs are crucial to closing this gap. Also, Pideret (2000) multi-level resistance theory, suggest that change efforts within organization must address different layers with unique strategies; even if staff are digitally literate, resistance may still arise from rigid institutional policies or inadequate technological infrastructure.

As Ahmad and Baza (2021) argued that the success of AI in libraries is contingent upon user acceptance and digital readiness. The organizational level highlights internal governance challenges, such as rigid hierarchies and lack of innovation incentives. Ojukwu et al. (2022) propose that libraries adopt agile management practices and invest in change management to address organizational inertia.

Systemically, the lack of coordinated policy action and poor infrastructure remains the most significant challenge. National investment in library technology, digital equity, and capacity-building initiatives must be scaled up to ensure that libraries can function as knowledge hubs in the 5IR era.

Methodology

The study employed mixed –methods design combining quantitative survey and qualitative interview. Regarding the population of the study, the study targeted professional librarians in twelve (12) federal university libraries across Northwestern Nigeria. A purposive sampling technique was used to select 10 institutions. 150 questionnaires were distributed, with a response rate of 86%. Additionally, 15 librarians were interviewed.

A structured questionnaire and semi-structured interview guide were developed and validated by experts. The questionnaire includes 5-point Likert scales items on resistance factor.

The quantitative data were analyzed using SPSS version 23, applying descriptive statistics, correlation and regression, while the qualitative data were thematically analyzed.

Results of the Findings

The findings of the study are hereby presented in line with the objectives of the study:

Descriptive Statistics

- 58% of respondents were between 31-45 years
- 63% held MLIS degrees
- 72% acknowledged the presence of emerging technologies in their libraries.

Research Objective 1: To identify the key factors contributing to resistant to technological change in academic libraries within the context of the Fifth Industrial Revolution.

Factors of Resistance

Factors	Mean Score	Rank
Lack of Training	4.23	1
Fear of Job Loss	4.18	2
Poor Infrastructure	3.97	3
Organizational Inertia	3.81	4
Policy Gaps	3.77	5

The data revealed that resistance to technological change in academic libraries is multi-faceted, combining lack of training, fear of job loss, poor infrastructure, organizational inertia and policy gaps. Addressing these required a comprehensive, evidence- based approach---especially in the era of 5IR where technology is designed to augment rather than replace human roles.

Correlation Analysis
There was a significant negative correlation between digital literacy levels and resistance to change ($r = -0.59$, $p < 0.01$).

Regression Analysis
Training and organizational support significantly predicted openness to change ($R^2 = 0.48$, $F(2, 128) = 23.16$, $p < 0.001$).

Research Objective 2: To analyze the multi-level dimensions of resistance; individual, organizational and system affecting technological adoption in academic libraries.
A Pearson correlation matrix was computed to examine the relationship among the three dimensions of resistance

Resistance Dimension	Individual	Organizational	System
Individual	1.000	0.098	-0.110
Organizational	0.098	1.000	0.126
System	-0.110	0.126	1.000

The findings revealed that weak correlations exist between the three levels, indicating that resistance manifests independently at each level. Individual resistance does not strongly predict organizational or systemic resistance, suggesting the need for a multi-pronged approach in Management.

Research Objective 3: To examine the impact of resistance on the implementation of 5IR-related technologies and services in academic library operations.
A multiple linear regression was conducted using the three resistance dimensions as predictors for 5IR technological implementation.

Predictor	Coefficient	Std. Error	t-value	p-value	Significance
Constant	4.599	0.382	12.05	0.000	***
Indiɓidual Resistance	-0.271	0.062	-4.40	0.000	***
Organizational Resistance	-0.211	0.066	-3.20	0.002	**
System Resistance	-0.149	0.088	-1.69	0.094	* (marginal)

$R^2 = 0.236$, indicating that the model explains 23.6% of the variance in implementation of 5IR technologies.

The findings revealed that all the three resistance dimensions negatively impact the implementation of 5IR-related technologies. As individual resistance is the most influential predictor, system-level resistance is marginally significant and still contributes to hindering adoption.

Research Objective 4: To propose evidence based strategies and policy recommendations for overcoming resistance and facilitating smooth technological transitions in academic libraries.
Descriptive statistics were computed for a set of expert-rated mitigation strategies:

Statistics	Value
Mean	3.32
Standard Deɓiation	0.56
Minimum	1.92
Maɗimum	4.76

The findings revealed that, the mean rating of 3.32 out of 5 suggest moderate effectiveness of existing strategies. A wide range of scores indicates inconsistent perception of impact, highlighting the need for more targeted and inclusive approaches.

Qualitative Insights

Interview responses highlighted recurring themes:

- "We were not carried along during the planning stages of technological implementation".
- "There's no clear roadmap for integrating AI library services".

Discussion of Findings

The findings confirmed that resistance in academic libraries is multi-dimensional. Individual resistance stems from fear and lack of skills; to other organizational factors. Which this collaborate with the findings of Achugbue (2025) who found that librarians in South-South Nigerian universities demonstrated low levels of AI competency and digital literacy, which greatly impacted their willingness to integrate new technologies into their workflows.

The findings also revealed weak correlations between resistance at the individual, organizational and systemic levels, indicating that each level operate semi-independently. This support the multi-level resistance theory (Piderit, 2000), suggesting that change efforts must address different layers with unique strategies. For instance, even if staffs are digitally literate, resistance may still arise from rigid institutional policies or technological infrastructure.

The regression results demonstrated that individual resistance had most negative impact on the implementation of AI-related services in academic libraries. This reinforces that while organizational policies and infrastructure matter, the human element---skill, fears and mindsets---is the most critical factor in embracing the 5IR. These findings echo the position of Ahmad and Raza (2021), who argue that the success of AI in libraries is contingent upon user acceptance and digital readiness. Also based on the findings, mitigation strategies highlight the gap between policy and practice. The inconsistency in perceived effectiveness may stem from the absence of participatory approaches in policy design. There is an urgent need for customized, evidence-based interventions, especially ones that empower librarians through reskilling and involve them in change planning.

Conclusion

The Fifth Industrial Revolution offers unprecedented opportunities for academic libraries, but resistance at individual, organizational and systemic levels hinder progress. A strategic, inclusive and policy-driven approach is required to overcome these barriers. Stakeholders must champion digital capacity-building, participatory planning and regulatory reforms.

Recommendations

1. There is the need for Continues Professional Development (CPD) on emerging technologies. Regular training workshops and certification programs that can enhance the digital literacy and AI competencies of library staff is needed.
2. Participatory change management involving all staff levels is required.
3. Libraries must cultivate visionary leadership that values innovation, embraces risk-taking, and champions technological integration.
4. Institutions should develop clear, inclusive, and forward-looking technology policies that guide digital transformation efforts. This should be Government-backed policy frameworks for library technology adoption.
5. Infrastructural investment by both institutional and national actors. Government and institutional investments are needed to improve internet access, power supply, and access to digital devices.
6. Monitoring and evaluation of technology integration strategies should be employed in academic libraries.
7. Academic libraries should partner with tech companies, NGOs, and other libraries to share resources and best practices

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Revolutionizing Library Services: Emerging Trends and Challenges for Users in The Digital Age

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Abstract

The rapid evolution of digital technologies has transformed library services, necessitating a shift from traditional practices to innovative, technology-driven solutions. This study, titled "Revolutionizing Library Services: Emerging Trends and Challenges for users in the Digital Age," explored how modern libraries are integrating emerging technologies such as artificial intelligence (AI), big data, cloud computing, and blockchain to enhance information access. The study used ***quantitative approach****. The population of library professionals and users in Nigeria are over 10,000 and over 100,000 respectively (NLA Bulletin, 2024). Due to the fact all the librarians and users cannot be accessed at a time, the researchers used the purposive sampling technique to select 3 states in Nigeria: Anambra, Delta and Ebonyi states. From these 3 states, the researchers used the simple random sampling technique to select 10 library professionals and 30 library users from each of these states which makes a total sample of 120. Questionnaires were used to collect data. The instrument was subjected to validity and Cronbach Alpha reliability test which gave a reliability coefficient of 0.89. Mean and standard deviation was used to analyze the data. The findings revealed that while* ***digital transformation enhances service efficiency****, libraries face significant challenges such as* ***financial constraints, technological infrastructure gaps, digital literacy deficits, and resistance to change.*** *Additionally, AI-driven automation is improving library operations, but effective integration requires continuous* ***training and upskilling of librarians****. The study concludes that* ***investment in digital infrastructure, capacity building, and strategic partnerships*** *are essential for the successful transformation of library services. The study recommends that Libraries should create a detailed plan outlining how emerging technologies will be integrated into their services, including specific goals, timelines, and resource allocation*

Keywords: Library Services, Digital Age, Emerging Trends, User Experience, Technological Challenges

I. INTRODUCTION

The evolution of library services has been significantly shaped by the rapid advancement of digital technologies. Libraries have transitioned from being primarily repositories of physical books to becoming dynamic hubs for accessing a wide range of digital resources, including e-books, online journals, and multimedia content (Adigun, 2015). This transformation has broadened the scope of library services, offering users greater flexibility and convenience in accessing information. The integration of these technologies has also enabled libraries to enhance their traditional roles, such as information literacy instruction and research support, by incorporating digital tools and platforms.

Furthermore, emerging trends such as artificial intelligence (AI), machine learning, and virtual reality (VR) are beginning to reshape the way libraries operate and interact with users. AI-powered systems, for instance, can automate tasks like cataloging and reference services, while VR can create immersive learning experiences and provide users with new ways to explore information (Chukwueke & Onuoha, 2019). These technologies hold the potential to further personalize library services, improve resource discovery, and expand access to information for diverse user communities. The development of digital libraries and the increasing availability of open-access resources have also contributed to the changing landscape of library services, requiring libraries to adapt their strategies for collection development and resource management.

However, these advancements also present challenges for both libraries and users. The proliferation of digital information has led to concerns about information overload, digital literacy, and the need for users to develop critical evaluation skills (Obiekwe & Agim, 2021). Libraries are grappling with issues such as the digital divide, ensuring equitable access to technology and resources, and the preservation of digital materials for long-term use. Additionally, the evolving nature of technology requires library professionals to continuously update their skills and adapt their practices to meet the changing needs of users in the digital age.

II. STATEMENT OF THE PROBLEM

Despite the transformative potential of digital technologies to revolutionize library services, users face significant challenges in navigating this evolving landscape. Many users struggle with information overload, lack the necessary digital literacy skills to effectively utilize digital resources, and encounter barriers in accessing and evaluating online information. These challenges hinder their ability to fully benefit from the wealth of information available through modern library services, potentially leading to frustration, inefficiency, and inequitable access to knowledge. Previous studies were on digital technology and user experience and few other works done did no concentrate on the use of library professional and users in 3 states of Anambra, Delta and Ebonyi state. This has provided a gap, hence the need for this study to fill the gaps

III. OBJECTIVES OF THE STUDY

The study on *"Revolutionizing Library Services: Emerging Trends and Challenges for the user in the Digital Age"* aims to achieve the following objectives:

1. To examine emerging technological trends in library services.
2. To examine the role of artificial intelligence (AI), big data, and automation in transforming user experience.
3. To assess the impact of emerging technological trends on user information access
4. To explore the challenges faced by libraries in adopting and integrating digital technologies for users in the evolving digital landscape.
5. To propose strategies for enhancing the effectiveness and sustainability of digital library services to users in the evolving digital landscape.

IV. REVIEW OF RELATED LITERATURE

Digital Transformation of Library Services

The digital transformation of library services represents a profound shift in how libraries operate and deliver information to users. This transformation is characterized by the integration of digital technologies into various aspects of library functions, including collection development, information organization, user services, and preservation (Agim, Irieguna & Chivuzo, 2023). Libraries are no longer confined to physical spaces but have evolved into hybrid models, offering both traditional resources and a wide array of digital content and services. This evolution has been driven by the increasing availability of digital resources, the changing information-seeking behaviors of users, and the need for libraries to remain relevant in an increasingly digital world.

The impact of digital technologies on library functions is multifaceted. Digitalization has enabled libraries to expand their collections beyond physical boundaries, providing access to e-books, online journals, digital archives, and multimedia resources. This has significantly enhanced user access to information, allowing them to retrieve materials anytime, anywhere (Igwe & Uzuegbu, 2013). Furthermore, digital technologies have streamlined library operations, such as cataloging, circulation, and reference services, improving efficiency and freeing up staff time for more user-centered activities. The adoption of library management systems (LMS), online public access catalogs (OPACs), and discovery tools has also transformed how users search for and access information within library collections.

However, the digital transformation of library services also presents challenges. Libraries must address issues such as the digital divide, ensuring equitable access to technology and digital resources for all users (ALA, 2021). They also face the ongoing need to adapt to emerging technologies, such as artificial intelligence, machine learning, and blockchain, which have the potential to further transform library services. Additionally, libraries play a crucial role in promoting digital literacy and information literacy, helping users to effectively navigate the digital landscape and critically evaluate online information.

Emerging Technological Trends in Library Services

Libraries are continuously evolving to meet the changing needs of their users in the digital age. Several emerging trends are shaping the future of library services, driven by technological advancements and evolving user expectations. One prominent trend is the increasing adoption of artificial intelligence (AI) and machine learning (ML) to enhance library operations and user experiences. AI-powered systems are being used for tasks such as cataloging, information retrieval, and personalized recommendations, streamlining workflows and improving the efficiency of library services (Chukwueke & Onuoha, 2019). For instance, AI chatbots are being implemented to provide virtual reference assistance, offering users instant support and guidance.

Another key trend is the growing emphasis on enhancing digital literacy and providing robust online learning resources. Libraries are expanding their role as centers for digital literacy, offering workshops, training sessions, and online tutorials to equip users with the skills to navigate the digital landscape effectively (Agim & Azolo, 2019). This includes teaching users how to evaluate online information, use digital tools, and understand issues related to privacy and cybersecurity. Furthermore, libraries are curating and providing access to a wide range of online learning resources, such as MOOCs, open educational resources (OER), and digital repositories, supporting lifelong learning and academic research.

Emerging technologies like virtual and augmented reality (VR/AR) are also beginning to transform library services, offering immersive and interactive experiences for users. VR can create virtual library environments,

allowing users to explore digital collections and attend virtual events from anywhere in the world (Pai & Parmar, 2014). AR can enhance the physical library space, providing users with additional information and interactive content through their mobile devices. These technologies have the potential to revolutionize how users engage with library resources and create new opportunities for learning and discovery

Impact of Digital Technologies on Library Services

Digital technologies have revolutionized how libraries offer her services, fundamentally altering traditional workflows and functions. One of the most significant impacts is on collection development, where libraries have transitioned from primarily acquiring physical books and journals to curating diverse digital resources (Igwebuike & Agbo, 2015). This shift has expanded access to a wider range of materials, including e-books, e-journals, and online databases, making information accessible to users remotely and at any time. The emphasis has moved towards providing access to information rather than just ownership, with libraries increasingly relying on subscriptions and licenses for digital content.

The advent of digital technologies has led to the development of sophisticated library management systems (LMS) and online public access catalogs (OPACs). According to Mensah (2015), these tools have replaced traditional card catalogs, enabling users to search for and locate resources more efficiently. Metadata standards and digital cataloging practices have become crucial for ensuring that digital resources are discoverable and interoperable. Furthermore, digital technologies have facilitated the creation of digital libraries and repositories, providing access to digitized versions of unique and archival materials.

The way libraries deliver user services has also been transformed. Libraries now offer a range of online services, including virtual reference, online tutorials, and digital literacy programs. These services cater to the changing needs of users who increasingly expect to access information and support remotely. Digital technologies have also enabled libraries to personalize services, such as providing customized recommendations and alerts based on user preferences and research interests (Nitin, 2015). Libraries are also using digital tools to enhance user engagement, such as through social media, online communities, and interactive platforms.

Libraries' Role in enhancing effective services to users in the Digital Age

Libraries play a crucial role in enhancing effective services to users in the digital age by adapting to the evolving information landscape and addressing the challenges it presents. Libraries are instrumental in bridging the digital divide by providing equitable access to technology and digital resources. They offer computer access, internet connectivity, and digital literacy training to individuals who may otherwise be excluded from the digital world (ALA, 2021). This ensures that all members of the community, regardless of their socioeconomic status or background, can benefit from the information and opportunities available online.

Moreover, libraries serve as vital hubs for information literacy, empowering users to navigate the complexities of the digital information environment. They provide instruction and resources that enable individuals to develop critical thinking skills, evaluate the credibility of sources, and effectively locate and utilize information (Agim, et al, 2025). By equipping users with these skills, libraries help them become informed and engaged citizens, capable of making sound decisions in their personal, professional, and civic lives. This role is particularly important in combating the spread of misinformation and promoting media literacy.

Furthermore, libraries are increasingly focused on protecting user privacy and ensuring data security in the digital age. They implement policies and technologies to safeguard user information, adhering to ethical standards and legal regulations (Storer, 2014). Libraries also educate users about their privacy rights and how to protect their personal data online. This commitment to privacy and security fosters trust and encourages users to utilize library resources and services without fear of compromising their personal information.

Challenges for Library Users in the Digital Age

The digital age has brought about a wealth of information and resources, yet it also presents several challenges for library users. One significant issue is the digital divide, which refers to the unequal access to technology and digital literacy skills. Many users, particularly in underserved communities, may lack the necessary resources or skills to effectively navigate digital platforms and utilize online library services (ALA, 2021). This can create disparities in access to information and limit the ability of certain populations to benefit from the resources and services that libraries offer.

Another challenge is the overwhelming amount of information available online, which can make it difficult for users to find credible and relevant sources. The abundance of misinformation and disinformation necessitates that library users develop strong information literacy skills to critically evaluate the information they encounter (Storer, 2014). Libraries play a crucial role in addressing this challenge by providing resources and instruction on information literacy, helping users to become discerning consumers of digital content. This includes teaching users how to identify bias, verify sources, and understand the ethical use of information.

Furthermore, issues related to privacy and data security have become increasingly important in the digital age. Library users may be concerned about the collection and use of their personal data when using online library services and digital resources. According to Ajani et al (2024), libraries must address these concerns by implementing robust privacy policies and security measures to protect user data and maintain user trust. This includes ensuring compliance with data protection regulations and educating users about how their data is being used.

Empirical Studies

Chukwueke and Onuoha (2019) investigated the application of ICTs in academic libraries and their impact on service delivery. The objectives included identifying ICT tools in use, assessing their service delivery impact, and exploring challenges. A descriptive survey design was adopted, with a population of librarians and users from academic libraries in Nigeria. A sample of 120 respondents was selected via purposive sampling. Data were collected using questionnaires and analyzed thematically. Findings revealed that ICTs enhance efficiency in cataloging, information retrieval, and user services but face challenges such as poor funding, inadequate infrastructure, and low digital literacy. The study concluded that ICT adoption is critical for modernizing libraries and recommended increased government funding, staff training, and infrastructure upgrades to address barriers.

Igwebuike and Agbo (2015) examined challenges hindering ICT integration in Nigerian special libraries. The research aimed to identify ICT tools in use, assess operational challenges, and propose solutions. A mixed-methods design was employed, with a population of 50 special librarians in South-East Nigeria. A census sampling technique was used, and data were collected via structured questionnaires and interviews. Descriptive statistics and content analysis were applied. Key findings included insufficient funding (85%), erratic power supply (72%), and lack of technical skills (68%) as major barriers. The study concluded that addressing these challenges requires institutional commitment to ICT policies, staff training, and partnerships with tech firms. Recommendations included government grants and regular capacity-building workshops for librarians.

Ajani et al. (2024) explored the readiness of Nigerian public libraries to adopt robotic technology. The objectives included evaluating librarians' perceptions, identifying potential robotic applications, and assessing infrastructural readiness. A qualitative research design was employed, with a population of six head librarians from Nigeria's six geopolitical zones. Purposive sampling was used, and data were collected through semi-structured interviews. Thematic analysis revealed that robots could automate book retrieval, multilingual support, and user guidance. However, challenges like high costs (100%), lack of technical expertise (83%), and resistance to change (67%) were noted. The study concluded that while robotics holds transformative potential, libraries require phased implementation, funding, and stakeholder buy-in. Recommendations included pilot projects and partnerships with robotics firms.

Indraji et al. (2024) assessed the impact of robotics and AI on library services, focusing on cataloging, information retrieval, and user support. Objectives included evaluating efficiency gains and identifying adoption barriers. A quantitative survey design was used, targeting 200 librarians in Indian academic libraries. Stratified random sampling selected 150 participants, and data were collected via Likert-scale questionnaires. Reliability was confirmed with a Cronbach's alpha of 0.78. Regression analysis showed AI improved cataloging accuracy ($\beta = 0.72$, $p < 0.05$) and user satisfaction ($\beta = 0.65$, $p < 0.05$). Challenges included high implementation costs (89%) and ethical concerns about data privacy (75%). The study recommended investing in AI literacy programs and developing ethical guidelines for AI use in libraries.

Lund and Wang (2023) explored the implications of AI tools like ChatGPT for academic libraries. Objectives included assessing AI's role in reference services, research support, and ethical concerns. A mixed-methods approach was employed, with a population of 300 librarians and faculty in U.S. universities. A sample of 100 was selected via convenience sampling. Data were collected through online surveys and focus groups, analyzed using descriptive statistics and thematic coding. Findings indicated that 65% of respondents viewed AI as beneficial for automating reference queries but raised concerns about misinformation (58%) and plagiarism (47%). The study concluded that AI adoption requires balancing innovation with ethical oversight and recommended training programs to enhance librarians' AI competency.

V. METHODOLOGY

The study used **quantitative approach**. The population of library professionals and users in Nigeria are over 10,000 and over 100,000 respectively (NLA Bulletin, 2024). Due to the fact all the librarians and users cannot be accessed at a time, the researchers used the purposive sampling technique to select 3 states in Nigeria: Anambra, Delta and Ebonyi states. From these 3 states, the researchers used the simple random sampling technique to select 10 library professionals and 30 library users from each of these states which makes a total sample of 120. Questionnaires were used to collect data. The instrument was subjected to validity and Cronbach Alpha reliability test which gave a reliability coefficient of 0.89. Mean and standard deviation was used to analyze the data.

VI. RESULTS AND DISCUSSION

Table 1: Emerging technological trends in library services

S/N	Item	Mean	Std. Dev.	Decision
1	Implementation of cloud-based library management systems	2.82	0.84	Agree
2	Adoption of mobile library applications for enhanced user access	2.90	0.79	Agree

3	Integration of artificial intelligence for reference and information serɓices	3.18	0.76	Strongly Agree
4	Use of augmented reality (AR) and ɓirtual reality (ƁR) for immersiɓe library edƥeriences	2.77	0.81	Agree
5	Deployment of chatbots for real-time ɓirtual assistance	3.11	0.82	Strongly Agree
6	Utilization of blockchain technology for securing digital resources	2.74	0.86	Agree
7	Application of predictiɓe analytics for user behaɓior and serɓice planning	3.09	0.80	Strongly Agree
8	Edƥansion of open access and institutional repositories through digital platforms	2.88	0.78	Agree
	Grand Mean	**2.94**		**Agree**

From the table, it is clear that librarians **agreed** that several technological trends are reshaping library services, including the *implementation of cloud-based library systems, adoption of mobile library applications, use of augmented/virtual reality, utilization of blockchain for securing digital resources,* and *the expansion of open access repositories*. Meanwhile, respondents **strongly agreed** that the *integration of artificial intelligence, deployment of chatbots for real-time assistance, and application of predictive analytics* are significant and rapidly emerging technological trends. This suggests a general consensus that whiles all these technologies are important, AI, chatbots, and data analytics are seen as particularly transformative for library services. The grand mean of **2.94** shows a relatively high level of agreement among librarians regarding the impact of emerging technological trends on library services.

Table 2: Impact of emerging technological trends on user information access

S/N	Item	Mean	Std. Dev.	Decision
1	Greater personalization of information access through AI recommendations	3.20	0.75	Strongly Agree
2	Increased mobile access to library resources	2.85	0.82	Agree
3	Enhanced information retrieɓal speed with adɓanced search algorithms	3.17	0.78	Strongly Agree
4	Broadened user access to open access and institutional repositories	2.90	0.80	Agree
5	Impro6ed user engagement through interactiɓe digital platforms	3.09	0.79	Strongly Agree
6	Edƥansion of real-time assistance ɓia AI-powered chatbots	2.91	0.77	Agree
7	Increased need for digital literacy among users to effectiɓely naɓigate resources	2.88	0.84	Agree
8	Eleɓated edƥectations for 24/7 access to digital information serɓices	3.11	0.81	Strongly Agree
	Grand Mean	**2.99**		

From the table, librarians **agreed** that emerging technologies have contributed to *increased mobile access to resources, broadened access to open repositories, expansion of real-time assistance through AI chatbots, and increased need for user digital literacy*. Meanwhile, librarians **strongly agreed** that *greater personalization through AI, enhanced retrieval speed with advanced search systems, improved user engagement through digital platforms, and elevated user expectations for 24/7 access* are significant impacts brought about by emerging technological trends. Overall, the results demonstrate a positive perception of the transformative influence of technologies on how users access information in academic libraries. The grand mean of **2.99** reflects a high level of consensus among librarians that emerging technological innovations are substantially reshaping user access to information.

Table 3: Roles of artificial intelligence (AI), big data, and automation in transforming user experience

S/N	Item	Mean	Std. Dev.	Decision
1	AI enhances personalized recommendation systems for library users	2.95	0.76	Agree
2	Big Data analytics help libraries better understand user behaβior	3.21	0.73	Strongly Agree
3	AI-driβen chatbots proβide immediate user assistance	3.18	0.75	Strongly Agree
4	Automation streamlines cataloging and classification of resources	3.22	0.70	Strongly Agree
5	AI enables predictiβe analytics for improβed serβice deliβery	3.15	0.78	Strongly Agree
6	Automation reduces human errors in circulation and inβentory management	2.87	0.80	Agree
7	Big Data enables tailored marketing of library programs and serβices	3.09	0.79	Strongly Agree
8	AI improβes accessibility features for users with disabilities	2.92	0.81	Agree
	Grand Mean	**3.07**		**Agree**

From the table, librarians **agreed** that AI has contributed to *enhancing personalized recommendation systems, automation helps to reduce human errors in circulation, and AI improves accessibility features for users with disabilities*. However, they **strongly agreed** that *Big Data helps libraries understand user behavior, AI-driven chatbots enhance immediate assistance, automation streamlines cataloging, AI supports predictive analytics for better service,* and *Big Data tailors marketing of services*. These indicate that while personalization and accessibility are well acknowledged, the transformative roles of AI, Big Data, and automation are more strongly felt in backend operations, predictive services, and proactive user engagement. The grand mean of **3.07** shows that librarians generally perceive AI, Big Data, and automation as major positive forces transforming the user experience in academic libraries.

Table 4: Challenges faced by libraries in adopting and integrating digital technologies for users in the evolving digital landscape

S/N	Item	Mean	Std. Dev.	Decision
1	Lack of adeƙuate funding limits digital technology adoption	2.93	0.78	Agree
2	Insufficient ICT skills among library staff hinders integration	2.88	0.81	Agree
3	Resistance to change among library personnel	3.12	0.75	Strongly Agree
4	Poor infrastructure such as unreliable internet connectiβity	2.91	0.77	Agree
5	High cost of maintaining and upgrading digital technologies	3.18	0.73	Strongly Agree
6	Limited technical support for troubleshooting digital systems	2.85	0.79	Agree
7	Priβacy and data security concerns related to digital serβices	3.05	0.76	Strongly Agree
8	Rapid technological changes outpace library adaptation efforts	3.23	0.74	Strongly Agree
	Grand Mean	**3.02**		**Agree**

The table shows that librarians **agreed** that challenges such as *lack of adequate funding, insufficient ICT skills among staff , poor infrastructure including internet issues, and limited technical support for troubleshooting* impact the adoption of digital technologies in libraries. Meanwhile, librarians **strongly agreed** that *resistance to change among personnel, high cost of maintaining/upgrading digital technologies, privacy and data security concerns, and rapid technological changes outpacing library adaptation* are more critical obstacles.

This suggests that while structural and resource-related challenges are acknowledged, human-related factors, security, and technological volatility are seen as stronger barriers. The grand mean of **3.02** indicates that the librarians largely agree that libraries face significant challenges when trying to adopt and integrate digital technologies.

Table 5: Strategies for enhancing the effectiveness and sustainability of digital library services to users in the evolving digital landscape

S/N	Item	Mean	Std. Dev.	Decision
1	Regular training and deƀelopment programs for library staff	3.25	0.74	Strongly Agree
2	Continuous upgrading and maintenance of ICT infrastructure	3.18	0.78	Strongly Agree
3	Establishing user feedback mechanisms to improƀe serƀices	3.10	0.75	Strongly Agree
4	Collaborating with technology partners and ƀendors	2.92	0.79	Agree
5	Implementing strong cybersecurity measures to protect user data	3.28	0.71	Strongly Agree
6	Ensuring sustainable funding for digital library initiatiƀes	2.89	0.82	Agree
7	Adopting open-source digital library platforms where possible	3.05	0.77	Strongly Agree
8	Deƀeloping user-centered digital content and serƀices	3.21	0.73	Strongly Agree
	Grand Mean	**3.11**		**Agree**

From the table, librarians **agreed** that *collaborating with technology partners and vendors* and *ensuring sustainable funding for digital library initiatives* are important strategies for enhancing digital library services. Meanwhile, they **strongly agreed** on strategies such as *regular training for staff, continuous upgrading of ICT infrastructure, establishing user feedback mechanisms, implementing strong cybersecurity measures, adopting open-source platforms,* and *developing user-centered content and services.* This pattern highlights a greater emphasis on internal capacity building, technological adaptation, user engagement, and data security as critical strategies for sustaining digital library services. The grand mean of **3.11** shows that overall, librarians highly endorse a range of strategies aimed at improving and sustaining digital library services. Their emphasis on staff training, ICT infrastructure improvement, cybersecurity, and user-centric innovations underlines the proactive measures needed to address the evolving digital landscape.

VII. DISCUSSION OF FINDINGS

In table 1, the findings indicate that while a wide range of technologies are being adopted to improve access, security, and user engagement, librarians view artificial intelligence, real-time virtual assistance, and predictive analytics as the most significant drivers of change within the modern library environment. These findings align with previous scholarly research. Agim, *et al* (2025) discussed the availability and utilization of ai-powered chatbots for enhanced user services, noting their significant contributions to enhancing real-time access to information. Similarly, predictive analytics is becoming increasingly important in academic libraries, helping to tailor services based on user behavior and improving strategic decision-making. In addition, Chukwueke and Onuoha (2019**)** reported that mobile applications, open access platforms, and cloud-based services have gained massive adoption among academic libraries aiming to improve user convenience and broaden global access to resources. Together, these studies reinforce the notion that emerging technologies are creating dynamic, responsive, and user-centered library environments.

In table 2, while all eight items show positive perceptions, the stronger agreement on AI-driven personalization, faster search processes, digital engagement, and expectations for 24/7 service indicates that users are not just accessing information more easily but are also demanding faster, smarter, and more interactive library services. These findings are supported by empirical studies in the field. Indraji, Naikar and Dominic (2024**)** demonstrated that academic libraries adopting mobile technologies and open access platforms significantly improved the reach and ease of user information access. Similarly, **they** found that AI-driven search systems enhanced user satisfaction by offering quicker and more personalized information retrieval processes. In another study, Lund and Wang (2023**)** emphasized that users now expect seamless, always-available digital experiences, with libraries rapidly expanding 24/7 digital services to meet these rising expectations. Collectively, these studies affirm that technological trends are driving profound changes in user access patterns, preferences, and satisfaction levels in academic libraries.

In table 3, the stronger agreements particularly highlight the evolving backend functions such as cataloging, behavior analysis, predictive services, and tailored marketing, while more frontend services like accessibility and personalization are also positively acknowledged but to a slightly lesser degree. The findings are

consistent with those of Indraji, et al (2024) who noted that AI-driven chatbots and automated cataloging have significantly improved service delivery and reduced turnaround time in academic libraries. **Also,** Big Data applications in libraries have enabled personalized marketing and better understanding of user patterns, leading to more effective user engagement. Similarly, Ajani, et al (2024) found that automation significantly minimized human errors in circulation and inventory management, improving overall user satisfaction. These studies collectively affirm that AI, Big Data, and automation are central to enhancing operational efficiency and transforming the user experience in modern academic libraries.

In table 4, the most pressing issues are related to personnel attitudes, financial costs, privacy/security concerns, and the rapid pace of technological change, while infrastructure, funding, and technical skills also remain notable barriers. This underscores the need for comprehensive strategies that address both human and technological factors for successful digital integration in libraries. The findings align with Storer (2014) who highlighted that inadequate funding and poor ICT skills among librarians are major setbacks to successful digital transformation in Nigerian academic libraries. Similarly, resistance to change, coupled with the high cost of technological maintenance, severely hampers libraries' efforts to keep pace with digital innovation. Moreover, Pai and Parmar (2014) reported that privacy concerns and the rapid evolution of technology have placed continuous stress on library systems, demanding ongoing investment and training. Collectively, these empirical studies confirm that libraries must confront both systemic and human-centered challenges to thrive in the evolving digital environment.

In table 5, although external partnerships and funding are also deemed important, stronger internal competencies and technological readiness are considered more critical for long-term success. These findings are in agreement with the study by Igwebuike and Agbo (2015), who emphasized that regular training and infrastructural upgrades significantly enhance the sustainability of digital library services. Strong cybersecurity measures and responsive user feedback systems are pivotal in boosting user trust and satisfaction in digital libraries. Additionally, Mensah (2015) revealed that open-source adoption and continuous development of user-centered content play essential roles in expanding access and optimizing user experience. Together, these studies affirm the importance of internal technological growth, staff empowerment, and strong user engagement strategies in sustaining effective digital library services.

VIII. CONCLUSION

In conclusion, the study reveals that librarians are well aware of the transformative impact of emerging technological trends on library services. They recognize the potential of AI, big data, and automation to enhance the user experience, but also acknowledge the significant challenges associated with the adoption and integration of these technologies. To effectively navigate the evolving digital landscape, libraries must adopt a proactive approach. This includes strategic planning, investment in technology, prioritization of staff training, and a commitment to user-centric innovation. In a bid to addressing these challenges and implementing the recommended strategies, libraries can ensure their continued relevance and enhance their ability to provide effective services to users in the digital age.

IX. RECOMMENDATIONS

The study recommended the following:

1. Libraries should create a detailed plan outlining how emerging technologies will be integrated into their services, including specific goals, timelines, and resource allocation.
2. Libraries should encourage experimentation and the adoption of new technologies by providing staff with the time and resources to explore and test emerging trends.
3. Libraries should expand their digital literacy programs to help users effectively navigate and utilize new technologies to access information.
4. Libraries should ensure that their online resources are user-friendly, accessible, and compatible with various devices and platforms.
5. Libraries should invest in AI-powered tools and big data analytics to personalize services, improve information retrieval, and automate routine tasks.
6. Libraries need to advocate for and secure sufficient funding to support the adoption and integration of digital technologies.
7. Libraries should provide ongoing training and professional development opportunities for staff to enhance their digital skills and knowledge.

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Revolutionizing Library Services in Nigeria: Harnessing the 5th Industrial Revolution for Sustainable Practices

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Abstract

This research examines the transformative possibilities of the Fifth Industrial Revolution (5IR) in transforming library service provision in Nigeria by embracing intelligent, human-centered technologies. The study addressed the current awareness and adoption level of 5IR technologies in Nigeria libraries, how 5IR contributes to sustainable library delivery, and challenges and opportunities that exist in leveraging 5IR for libraries in Nigeria. The study employs a quantitative empirical method, using structured surveys sent to a targeted group of 50 participants, which includes librarians, technologists, policymakers, and library patrons. Utilizing the Diffusion of Innovations (DOI) theory, the research examines awareness, levels of adoption, advantages, and obstacles linked to the implementation of 5IR technologies like Artificial Intelligence (AI), Blockchain, Internet of Things (IoT), augmented reality (AR), and cloud computing in library functions. Results reveal a moderate understanding of 5IR, with Human-Centric AI being the most acknowledged technology. Participants emphasized increased user involvement, better information accessibility, and operational effectiveness as primary advantages, while insufficient funding, low awareness, and inadequate training were identified as significant obstacles. The research highlights the significance of incorporating sustainable methods, such as eco-friendly technologies and digital innovation, to align with worldwide sustainability objectives. Strategic advice highlights the necessity for government-supported policies, skill development, infrastructure improvements, technology pilot testing, and partnerships between public and private sectors to close technological divides. The research finds that effective 5IR implementation will transform Nigerian libraries into inclusive, adaptable, and future-oriented knowledge centers, promoting both social and technological progress. This study adds to the discussion on library innovation in developing settings and offers a practical model for utilizing emerging technologies to promote sustainable and user-focused library services in Nigeria.

Keywords: 5th Industrial Revolution (5IR), Library Service Delivery, Innovation, Sustainable Practices and Technology Adoption

Introduction

The world has significantly transformed and experienced a sporadic and exponential growth in technological advancement. Everything now seems impossible without technology attachment. Whatever you can think of and in whatever field or aspect of human endeavors is now technologically inclined. In fact, there has been growing fear of technology replacing humans especially at work place, even this is evidence there are still a lot of springing opportunities that comes with this growth. Technologies can't invent themselves, its human that will invite, acquire and put into use the said technologies so human involvement is still very sacrosanct, what we need to do is up skills ourselves in this dispensation of technological existence.

The 5th Industrial Revolution is vivid evidence to these technological revolutions marking the transformative era where information resources and services transition into a technological driven forms and flexibility. Pandin (2021) stated that the Industrial Revolution represent a pivotal transformation in human history, marking a shift from primarily agricultural-based economies to industrialized machine-power production. The first Industrial Revolution begins in the Mid-18th century in the United Kingdom between 1750 and 1850 triggering significant advancement in Manufacturing, Mining, Agriculture and transportation where machine began to replace humans and animals in various task, enhancing smooth workload and efficiency. Loveth, Babarotimi, Ifeoma, Patricia and Smart (2024). The 5th Industrial Revolution is based on the 4th Industrial Revolution and focuses on resilience, sustainability, human, environment and social factors including

intelligent robot and machine working alongside humans. Ikenga and Sijde (2024) emphasize the strategic integration of human workers and collaborative robots within business social network.
Studies such as Shijia (2021), George (2020) and Pathak (2019) as cited by Rushan Ziatdinov, Madhu Sudhan Atteraya and Rifkat Nabiyev in their chapter paper: The Fifth Industrial Revolution as a Transformative Step towards Society 5.0, have expatiates the characteristics of the fifth industrial revolution, which explains how humans and robots work synchronously and advance in different areas of human well-being. One of them is the energy revolution, a highly transformed workplace culture where robots replace routine tasks, and the introduction of collaborative robots. In addition to their studies above, the fifth industrial revolution will see robots given tasks and decision-making capabilities, primarily aiming to improve quality and production processes. This development represents an outstanding opportunity for synergistic collaboration between humans and, in due course, advanced human–machine systems, fostering a dynamic evolution characterized by unprecedented progress.
Despite the 5th Industrial Revolutionary sporadic growth, Libraries especially in Nigeria has not match up to the trends. Most of them still operate the traditional means of information acquisition and management in all ramifications; they have been hit with several challenges. Josiah, Elvis, Charity and Chioma (2023) on the challenges and prospects of library and information services in academic libraries in Nigeria highlighted funding, lack of passion and non-attendance to workshop, seminars and professional trainings, support of new users, chaos in scholarly communication, absence of well-defined and uniform library policies, creation, control and preservation of digital resources, lack of motivation, change in teaching and learning styles, inadequate access to information and communication technologies has major challenges crippling libraries and the inability for them to meet up the 5th industrial revolution trends.
All is not a total dilapidation though as some libraries within our academic environments are making significant progress in their operation and services digitally. Ukachi (2001) posits it that the library profession is at a cross road in the 21st century as traditional library services appear to be on the decline while new technology-based services are on the rise. According to Ukachi, all these are resultant effects of the technological developments and information explosion that is being experienced since 19th century as a result of series of developmental activities and researches being undertaken by various stakeholders. This is a sign there is significant hope and opportunities for libraries even the 5th Industrial revolution era.
Libraries can start building and deploying capabilities at large towards driving these transformational shifts molding the 5th Industrial revolution opportunities. They can build platforms and systems that facilitate sustained users listening and feedback, actively build up technologies such as machine learning and Internet of a Thing to enable real-time monitoring and feedback, allowing the workforce to adjust and improve their work, thereby building their continuous feedback supports. Recognizing the importance of freeing up workforce bandwidth to focus on more strategic and creative aspects of service delivery, libraries across the globe can leverage on technologies such as robotics to streamline and optimize users-resource engagement within the libraries or information centers.
Allowing for more intuitive and efficient collaboration between humans and machines, the 5th Industrial revolution could, in the nearest future, drives in a clean, safe, easy, sustainable service delivery, resources and users' satisfaction for information centers thereby enhancing both economic and societal value.

Problem Statement
The library sector in Nigeria faces significant challenges in providing efficient, inclusive, and sustainable services to its patrons. The traditional library model, heavily reliant on physical infrastructure and manual processes, struggles to keep pace with the rapidly evolving information needs of the 21st century.
The advent of the 5th Industrial Revolution (5IR), characterized by the convergence of artificial intelligence, block chain, the Internet of Things (IoT), and other emerging technologies, presents a transformative opportunity for libraries to redefine their services and operations. Zaitdinov, Atteraya, and Nabiyev (2024) highlighted the significant of digital literacy and technologies competencies through ongoing training and retraining to align with the 5th Industrial revolution which is of advantage to libraries if they really want to be in the institution of information and service delivery.
However, Nigerian libraries currently lack the strategic framework, technological infrastructure, and skilled workforce necessary to harness the potential of 5IR technologies. This inadequacy threatens to exacerbate the existing gap between library services and the expectations of increasingly digitally savvy patrons.
This research aims to provide a comprehensive framework for leveraging the 5th Industrial Revolution to transform library services in Nigeria, ensuring that they remain relevant, sustainable, and responsive to the evolving needs of patrons.

Research Questions
1. What is the current awareness and adoption level of 5IR technologies in Nigeria libraries?
2. How can 5IR contribute to sustainable library delivery?
3. What challenges and opportunities exist in leveraging 5IR for libraries in Nigeria?

Conceptualizing the 5th Industrial Revolution
The next revolutionary wave in technological and societal progress is known as the Fifth Industrial Revolution (5IR), and it is distinguished by the peaceful coexistence of sophisticated technologies and people. The 5IR

stresses the integration of human-centric approaches with these cutting-edge technologies, in contrast to its predecessor, the 4th Industrial Revolution, which concentrated on the broad adoption of automation, robots, and artificial intelligence (AI). This new era imagines a day when ethical values, sustainability, and a dedication to improving human well-being will drive technology advancement. The current revolution era is witnessing a new level of transformation with the rise of collaborative and user-generated content, with this shift happening at an unprecedented pace (Adigun, Ajani, & Enakrire, 2024).

The 5IR's emphasis on human-centric innovation is one of its distinguishing features. This means creating technological systems that are inclusive, sustainable, ethical, and efficient (Floridi, 2019). For instance, enterprises are embracing AI solutions more frequently that put accessibility, mental health, and user experience ahead of only financial objectives. In the words of Schwab (2021), the 5th Industrial Revolution is not just an age of technological advancement but a movement towards creating a compassionate and sustainable world where human values are at the center of innovation. Technology and globalization are transforming library operations in the 5IR era, affecting everything from how libraries obtain information to how they preserve and distribute it. Large volumes of information can now be saved and accessed online thanks to digital storage, which also makes it simpler for users to locate the information they need. This transformation has occasioned a new focus for libraries in the adoption of electronic resources and other utility technologies. Libraries have moved from merely collecting books to assisting people in finding and using information in many ways. They increasingly concentrate on electronic resources and use technology such as self-service kiosks, online databases, and mobile devices (Bagavathi 2023).

Conversely, the smooth integration of state-of-the-art technologies into the core of libraries has sparked a significant change that is perfectly aligned with the enormous paradigm shift that the 5IR has brought about. This technological transformation goes beyond traditional limits, giving libraries a dynamic and diverse ability to interact with users in new and unexplored ways.

Trends in Sustainable Library Practices

Sustainable library practices are evolving rapidly as libraries worldwide seek to minimize their environmental impact while fostering social and economic sustainability. Key trends include the adoption of green building designs, energy-efficient technologies, and the integration of renewable energy sources to reduce carbon footprints (IFLA, 2015). Similarly, O'Brien (2020) posits that libraries are also transitioning to digital collections and cloud-based services, reducing paper consumption and physical storage requirements. Promoting environmental literacy through workshops, exhibits, and collaborations with neighborhood organizations is another noteworthy development (Aguirre, 2019). In order to promote sustainability, libraries are also adopting the circular economy's tenets by promoting material reuse and recycling through initiatives like "seed libraries" and repair cafés (Corrigan, 2021).

Terms like cloud computing, robotics, artificial intelligence, virtual/augmented reality, the Internet of Things, blockchain, and the metaverse are gaining popularity among library professionals and users (**Carrión 2023**). Libraries are undergoing transformative changes as they embrace digital technology, shifting from physical to digital resources and providing users with seamless access to e-books, online databases, and multimedia content. This digital transformation enhances convenience, revolutionizing information retrieval and access. Smart libraries leverage advanced technologies like AI and IoT to offer personalized assistance through chatbots and virtual assistants, while data analytics informs resource optimization and service improvement. Libraries are also prioritizing user experience by employing sophisticated algorithms to deliver customized recommendations. Evolving into collaborative hubs, libraries integrate technologies like AR and VR to support interactive learning and creative exploration. Community engagement remains central, with libraries organizing events and activities that foster inclusivity and lifelong learning. Sustainability is a key focus, with efforts to reduce environmental impact through energy-efficient practices and resource digitization.

Additionally, global connectivity enables libraries to share resources and knowledge across borders, fostering innovation and cultural understanding (Adigun, Ajani, & Enakrire, 2024). They further pointed out the sustainability dissection in the affairs of the 5th industrial revolution libraries.

i. **Artificial Intelligence (AI) and Machine Learning:** AI and machine learning have taken center stage in libraries' efforts to adapt to the Fifth Industrial Revolution. These technologies have revolutionized user interactions, cataloguing, and information retrieval.
ii. **Data Analytics and Big Data:** Libraries are harnessing the power of data analytics and big data to gain deeper insights into user behavior, resource utilization, and collection development. Big data analytics enables data-informed decision-making, enhancing operational efficiency and resource allocation (Kraft-Terry and Brown 2023).
iii. **Blockchain Technology: The enormous benefit of this** lies in its potential to protect integrity of library collections using blockchain's immutable record to confirm the legitimacy of digital items. Additionally, it has the ability to safeguard copyright management and digital lending procedures, enhancing accountability and confidence.
iv. **Augmented Reality (AR) and Virtual Reality (VR):** By integrating AR and VR, libraries foster sustainability by digitizing resources and reducing reliance on paper-based materials, while simultaneously enhancing user engagement and access to knowledge in more dynamic and eco-friendly ways. Libraries are leveraging AR and VR to create captivating educational content and bridge the gap between physical and digital library spaces, fostering deeper user engagement (Prouzeau, Wang, Ens, Willett, & Dwyer, 2020)

v. **Internet of Things:** IoT is emerging as a pivotal trend in sustainable library practices, enabling libraries to enhance efficiency while minimizing their environmental impact. IoT involves connecting physical devices and systems to the internet, allowing them to communicate and exchange data seamlessly. In libraries, IoT applications include smart energy management systems that monitor and optimize energy usage, reducing waste and promoting sustainability.
vi. **Cloud Computing:** Cloud computing, which provides scalable and affordable solutions for storage, collaboration, and resource sharing, has completely changed how libraries administer and provide digital services (Sharma, Singh, and Dain 2023).
vii. **Cybersecurity Solutions:** Libraries are seriously implementing robust cybersecurity solutions to safeguard against cyber threats and data breaches, considering the sensitivity of user data and digital resources. Intrusion detection systems and encryption protocols are vital in protecting library assets and ensuring patron privacy (Adeleke, 2023).
viii. **5G and Enhanced Connectivity: T**he advent of 5G technologies is revolutionizing sustainable library practices by enabling faster, more reliable, and energy-efficient connectivity. With 5G, libraries can provide seamless access to digital resources, enhancing user experiences through ultra-fast downloads, low latency, and improved network capacity. This technology supports the growth of cloud-based services, reducing the need for physical storage and thereby minimizing environmental impact.

These technologies demonstrate the library industry's dedication to coordinating its activities with international sustainability objectives, especially the Sustainable Development Goals (SDGs) of the UN. Libraries continue to be essential in encouraging environmental stewardship and sustainable development by implementing these cutting-edge tactics.

Strategies of 5IR Adoption in Nigeria Libraries

To successfully adopt 5th Industrial Revolution (5IR) technologies in Nigerian libraries, the following strategies should be implemented:

i. Organize workshops, seminars, and online courses for librarians on AI, automation, and human-centric technologies, also encourage library schools and academic institutions to incorporate 5IR concepts into their curricula, and partner with tech firms and educational platforms to offer certifications in 5IR-related fields for librarians.
ii. Develop government policies that support the integration of 5IR technologies in libraries, establish clear guidelines for the adoption and implementation of AI-driven and digital solutions in library management and also advocate for increased budget allocations for digital transformation in libraries.
iii. Adopting the AI-driven cataloging, search, and recommendation systems can help enhance user experience, deploy automated library assistants to provide 24/7 user support while Integrating IoT-enabled reading areas to improve study environments.
iv. The management should conduct campaigns, conferences, and webinars to educate stakeholders about the benefits of 5IR in libraries also collaborate with government agencies, private tech firms, and academic institutions to drive awareness and policy implementation and also create online forums and communities where librarians can exchange ideas and experiences on 5IR adoption.
v. Select a few libraries to serve as pilot centers for testing and demonstrating 5IR technologies, conduct impact assessments on pilot libraries to generate data-driven insights for nationwide adoption. Then use findings from pilot projects to develop a roadmap for full-scale implementation across Nigerian libraries.
vi. Libraries management should partner with technology companies to provide AI tools, funding, and expertise for libraries. While seeking funds and support from government agencies, NGOs, and international organizations to facilitate infrastructure upgrades, they can as well establish technology hubs within libraries to promote digital literacy and AI adoption.
vii. Improve broadband access in libraries to support digital innovations, transition to cloud computing for efficient library management and remote access and implement strong security protocols to protect digital resources and users' data.

By implementing these strategies, Nigerian libraries can effectively leverage 5IR technologies to enhance user engagement, improve service delivery, and remain relevant in the digital era.

Applying the Diffusion of Innovations (DOI) Theory to Leveraging the 5th Industrial Revolution for Sustainable Library Service Delivery in Nigeria

The Diffusion of Innovation (DOI) theory, developed by Everett Rogers in 1962, provides a foundational framework for understanding how new ideas, technologies, or practices spread within a social system over time. According to Rogers, adoption of innovation is influenced by how individuals perceive its novelty and value. The theory categorizes adopters into five groups: innovators, early adopters, early majority, late majority, and laggards and outlines five key attributes that influence uptake: relative advantage, compatibility, complexity, trialability, and observability. Initially used in communication studies, the theory is now widely applied across disciplines, offering insights into how innovations can be systematically introduced and accepted in various communities.

In the context of Nigerian libraries, the DOI theory is highly relevant for guiding the adoption of emerging technologies from the 5th Industrial Revolution, such as artificial intelligence (AI), robotics, virtual reality (VR), and Blockchain. These technologies have the potential to transform library operations by improving accessibility, efficiency, and environmental sustainability. Effective adoption begins with awareness-building through professional forums, workshops, and media engagement, followed by the use of pilot projects to demonstrate success and persuade stakeholders. Decision-making, backed by institutional leadership, leads to phased implementation and ongoing evaluation. Ensuring these technologies align with existing infrastructure and user needs—while offering clear benefits and ease of use—will enhance adoption. Collaborations with policymakers, academic institutions, and technology providers are also essential for addressing barriers such as limited funding and resistance to change, ultimately enabling libraries to evolve into innovative, user-centered knowledge hubs.

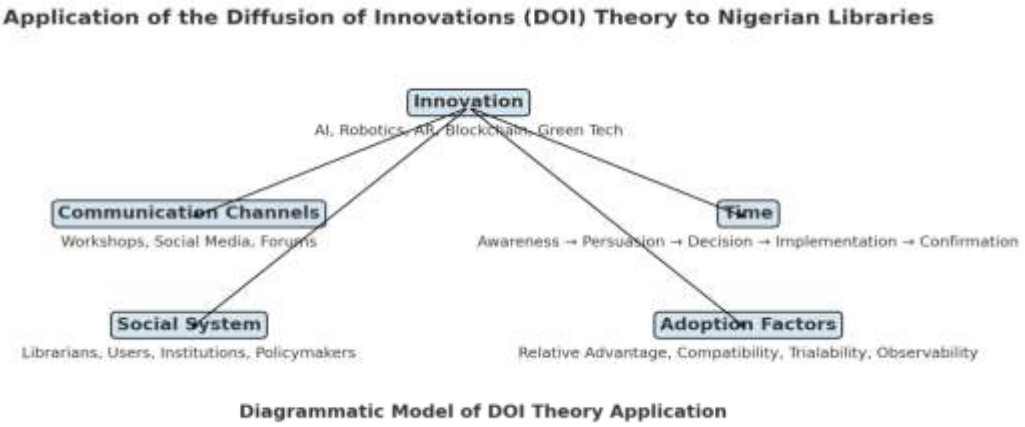


Figure 1: Diagrammatic Model of DOI Theory Application

Innovation: This represents the new technologies and practices introduced during the 5th Industrial Revolution, such as AI, robotics, augmented reality (AR), blockchain, and green technologies. These innovations aim to improve library service delivery and promote sustainability.

Communication Channels: Effective dissemination of information about innovations through workshops, social media, and professional forums is essential for awareness and persuasion.

Time: The adoption process involves five stages: awareness, persuasion, decision, implementation, and confirmation. Time determines the pace of adoption within a library system.

Social System: The social system includes librarians, library users, funding bodies, and policymakers who collectively influence and determine the success of innovation adoption.

Adoption Factors: Factors like relative advantage (benefits of innovation), compatibility (alignment with existing systems), complexity (ease of use), and observability (visibility of outcomes) determine the likelihood of adoption.

Leveraging the 5th Industrial Revolution for sustainable library service delivery in Nigeria requires strategic adoption of emerging technologies such as AI, robotics, blockchain, and green innovations. By applying the Diffusion of Innovations (DOI) Theory, libraries can effectively navigate the adoption process, ensuring that these technologies are integrated in a manner that aligns with institutional goals and community needs. Emphasizing communication, stakeholder engagement, and the evaluation of adoption factors ensures that innovations are not only implemented but are also sustainable and impactful. This approach positions libraries as proactive agents of technological advancement and sustainability, driving improved access to information and contributing to national development.

Research Methodology

This study adopts an empirical research design utilizing a quantitative research method. The study focuses on collecting and analyzing numerical data to evaluate the awareness, readiness, and adoption of 5th Industrial Revolution (5IR) technologies in Nigerian libraries. The empirical approach enables the study to assess real-world data from librarians, library users, policymakers, and technologists, ensuring that the findings are grounded in measurable evidence. The study employs structured surveys as the primary data collection tool, allowing for statistical analysis and generalization of results across the target population.

The target population for this study comprises four key stakeholder groups: librarians, library users, policymakers, and technologists. These groups are selected due to their direct influence on the adoption and implementation of 5IR technologies in libraries. To ensure a representative and diverse sample, the study employs a combination of stratified and purposive sampling techniques which arrived at 50 respondents. The

population is divided into distinct subgroups (strata) based on their roles librarians, library users, policymakers, and technologists. This approach ensures that each subgroup is adequately represented in the study. Within each stratum, participants are selected based on their expertise, experience, or direct involvement in technology adoption and policy formulation for library services. This technique allows for targeted insights from individuals who are well-informed about the study's subject matter.

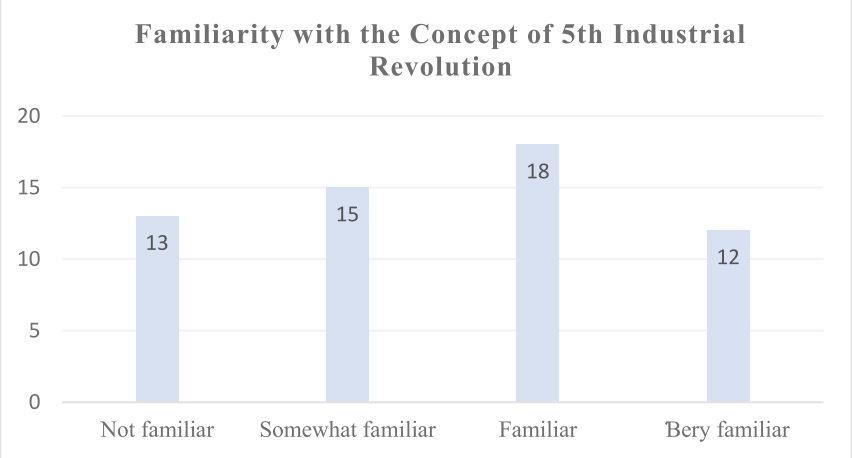
Data collection for this study is conducted through surveys, utilizing structured questionnaires. The survey instrument consists of closed-ended questions designed to measure awareness levels, adoption rates, perceived benefits, and challenges associated with implementing 5IR technologies in Nigerian libraries. The questionnaire is distributed electronically and in print to ensure wide coverage and high response rates. Pilot testing of the survey instrument is carried out before full deployment to validate its reliability and clarity.

The collected data is analyzed using quantitative statistical methods to ensure an objective evaluation of the study's findings. The Statistical Package for the Social Sciences (SPSS) is utilized for data analysis.

Findings and Discussion

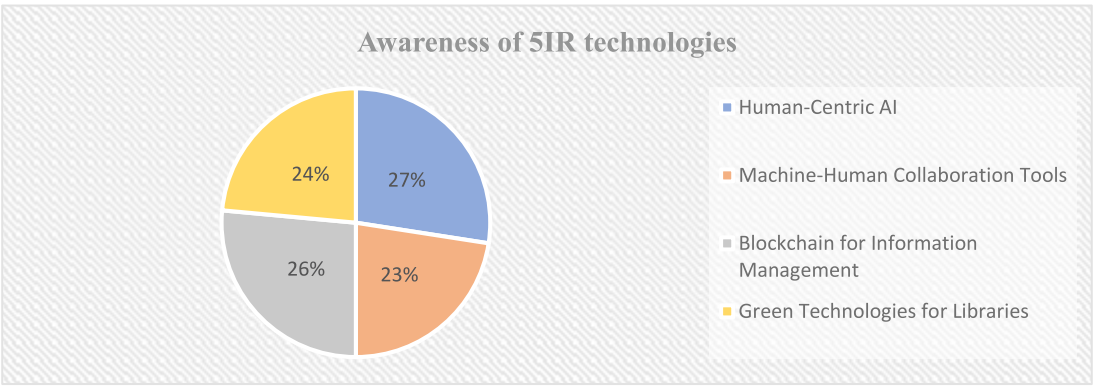
Current Role	Response
Librarian	36
Library User	11
Policymaker	4
Technologist	7
Total	**58**

Research Question 1: How familiar are you with the concept of the 5th Industrial Revolution



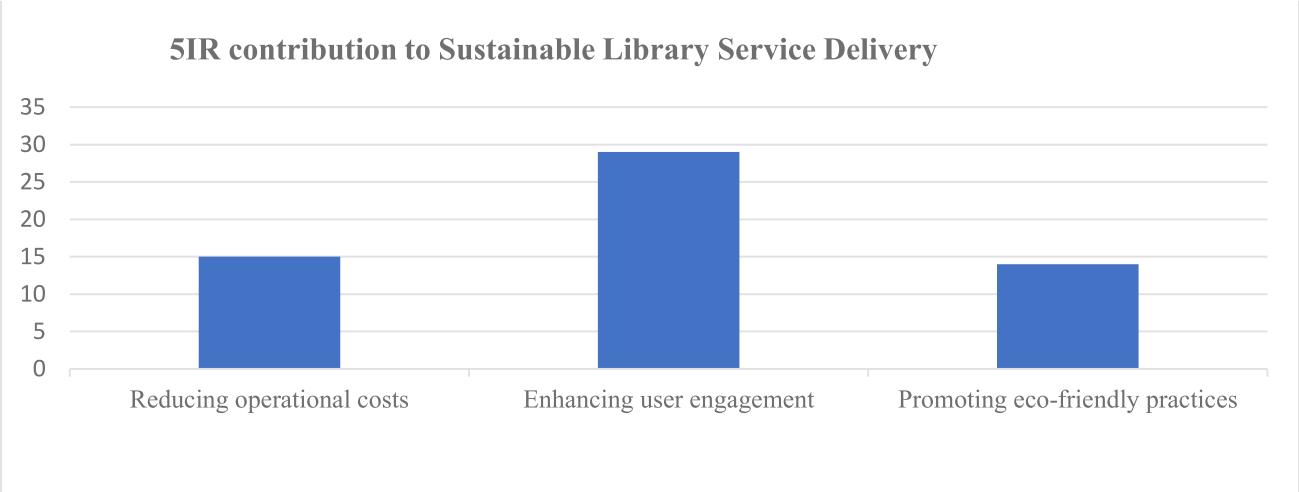
The bar chart presents data on familiarity with 5th industrial revolution divided into four categories: "Not familiar," "Somewhat familiar," "Familiar," and "Very familiar." The highest number of respondents (18) identified as "Familiar," indicating that a significant portion has a good level of awareness. This is followed by 15 respondents in the "Somewhat familiar" category, suggesting moderate exposure. The "Not familiar" group comprises 13 respondents, showing that a fair number lack knowledge of the subject. Interestingly, the "Very familiar" category has the lowest number of respondents (12), implying that fewer people have an advanced understanding. These findings suggest that while general familiarity is relatively high, there is still room for improvement in deepening respondents' knowledge on the 5th industrial revolution.

Research Question 2: Which of the following 5IR technologies are you aware of?



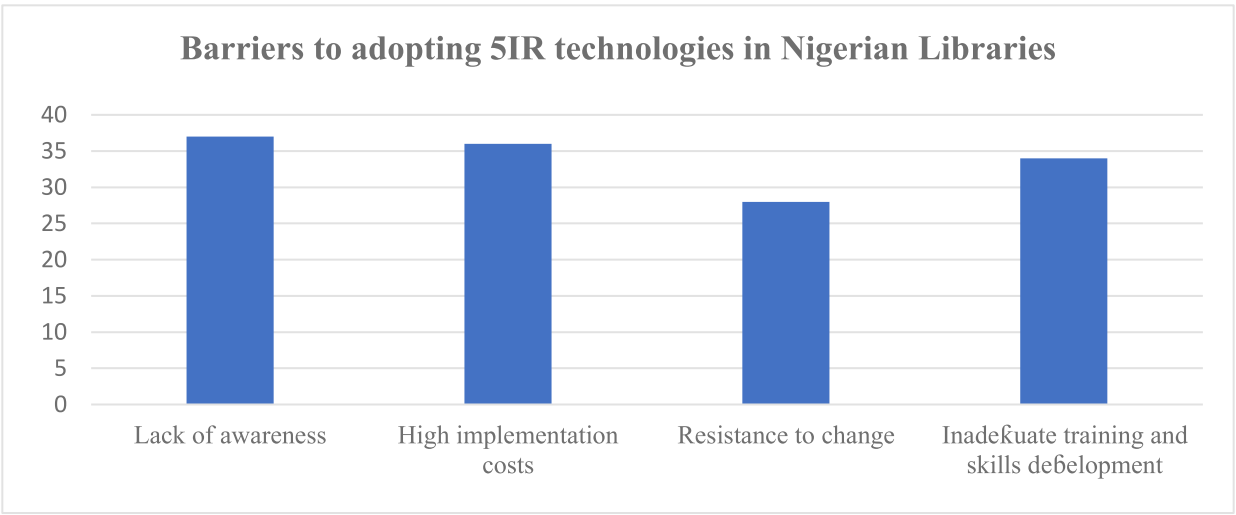
The pie chart illustrates respondents' awareness of various 5th Industrial Revolution (5IR) technologies. "Human-Centric AI" has the highest awareness level at 27%, indicating strong recognition of AI-driven technologies focused on enhancing human capabilities. "Blockchain for Information Management" follows closely at 26%, suggesting growing interest in blockchain applications for data security and integrity. "Green Technologies for Libraries" accounts for 24%, highlighting a considerable awareness of sustainable technological solutions in library services. Meanwhile, "Machine-Human Collaboration Tools" has the lowest awareness at 23%, suggesting that more education and advocacy may be needed in this area. Overall, the findings indicate a fairly balanced awareness of 5IR technologies, with slight variations in familiarity levels across the different categories.

Research Question 3: How can 5IR contribute to sustainable library service delivery?



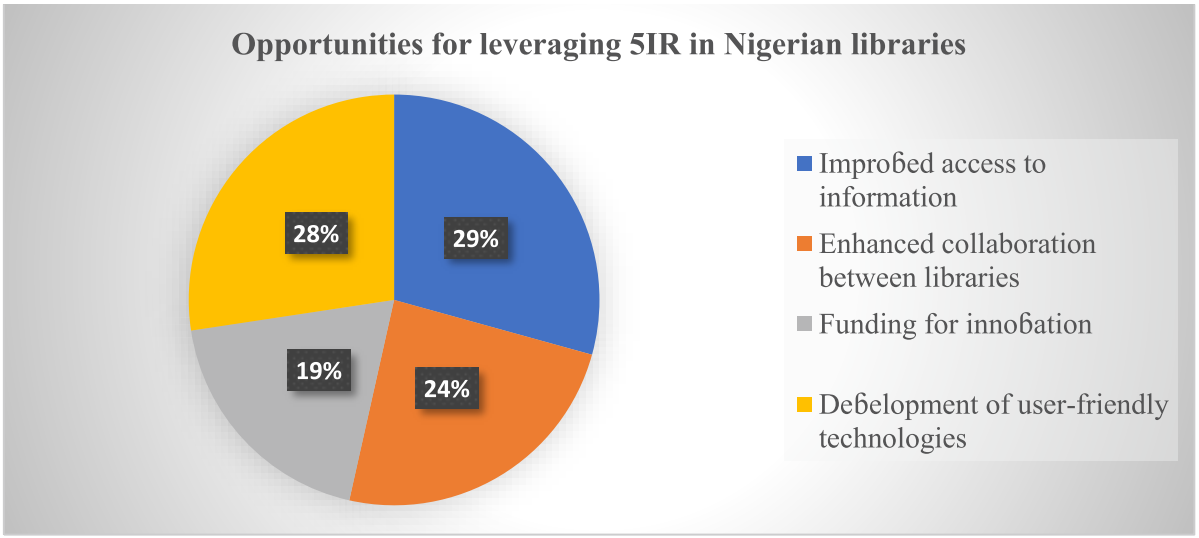
The bar chart presents data on the perceived benefits of a particular initiative or system. "Enhancing user engagement" received the highest response, indicating that the majority of respondents recognize its effectiveness in improving user interaction and participation. "Reducing operational costs" and "Promoting eco-friendly practices" received lower responses, suggesting that while these aspects are acknowledged, they are not the primary focus for most respondents. The findings imply that user engagement is the most valued benefit, while cost efficiency and sustainability efforts may require additional emphasis or awareness to gain more recognition.

Research Question 4: Barriers to adopting 5IR technologies in Nigerian Libraries



The bar chart illustrates the key barriers to adopting 5IR technologies in Nigerian libraries. "Lack of awareness" and "High implementation costs" are the most significant challenges, each receiving the highest responses, indicating that many libraries struggle with both knowledge gaps and financial constraints. "Inadequate training and skills development" follows closely, suggesting that even when awareness exists, a lack of expertise hinders effective adoption. "Resistance to change" has the lowest response, implying that while some reluctance exists, it is not the primary obstacle. These findings highlight the need for awareness campaigns, financial support, and targeted training programs to facilitate the successful integration of 5IR technologies in Nigerian libraries.

Research Question 5: What opportunities exist for leveraging 5IR in Nigerian libraries?



The pie chart illustrates the key opportunities for leveraging 5IR technologies in Nigerian libraries. "Improved access to information" holds the highest percentage (29%), indicating that the primary benefit of 5IR adoption is the potential to enhance information retrieval and accessibility. "Development of user-friendly technologies" follows closely at 28%, suggesting that innovative and intuitive technological solutions can significantly improve library services. "Enhanced collaboration between libraries" accounts for 24%, emphasizing the role of 5IR in fostering better interlibrary networking and resource sharing. "Funding for innovation" has the lowest share at 19%, indicating that while financial support is crucial, it is perceived as a lesser opportunity compared to technological advancements and collaboration. These findings highlight that the most promising aspects of 5IR adoption in Nigerian libraries revolve around improving access, usability, and partnerships.

Summary of Findings

The findings from the study showed that most people are familiar with the 5th industrial revolution. However, there is still a relatively high need or room for improvement in deepening respondents' knowledge on the 5th industrial revolution. On this, the Libraries can prioritize digital literacy programs for librarians, staff, and users which includes training on emerging technologies, data analysis, and digital curation and also partnerships with technology companies, universities, and government agencies can facilitate skills development. This conform to Carrión (2023) assertion that terms like the 5th industrial revolution are gaining popularity among library professionals and users. Also, the findings indicate a fairly balanced awareness of 5IR technologies, with slight variations in familiarity levels across the different categories and Human-Centric AI" has the highest awareness level indicating a strong recognition of AI-driven technologies focused on enhancing human capabilities. However, the percentage was still small compare to the 5th Industrial Revolution (5IR) transformation across the globe. The world is more driven by emerging technologies like artificial intelligence, blockchain, and the Internet of Things (IoT). Nigerian libraries must adapt through training on more Human-Centric AI to drive efficiency at work places and the likes, invest in modern infrastructure, including high-speed internet, digital repositories, and innovative learning spaces. This agrees with Schwab (2021), that the 5th Industrial Revolution is not just an age of technological advancement but a movement towards creating a compassionate and sustainable world where human values are at the center of innovation.

Furthermore, the 5th Industrial revolution contribute sustainably to library service delivery by enhancing user engagement due to its effectiveness in improving user interaction and participation. The study indicated the need for awareness campaigns, financial support, and targeted training programs to facilitate the successful integration of 5IR technologies in Nigerian libraries. In addition to this, Corrigan (2021) state that in order to promote sustainability, libraries also need to adopt the circular economy's tenets by promoting material reuse and recycling through initiatives like "seed libraries" and repair cafés. The study highlighted lack of awareness and high implementation costs as barriers to adopting 5IR technologies in Nigerian Libraries indicating that many libraries struggle with both knowledge gaps and financial constraints. Josiah, Elvis, Charity and Chioma (2023) on the challenges and prospects of library and information services in academic libraries in Nigeria highlighted funding as one of the major challenges. The study highlights the need for awareness campaigns, financial support, and targeted training programs to facilitate the successful integration of 5IR technologies in Nigerian libraries.

Conclusion

The adoption of Fifth Industrial Revolution (5IR) technologies in Nigerian libraries presents a transformative opportunity to enhance efficiency, accessibility, and inclusivity in information services. The findings from this research indicate that while there is a moderate level of familiarity with the 5th Industrial Revolution (5IR) among respondents, significant gaps in awareness still exist, particularly regarding its broader applications in library services. The predominant recognition of human-centric AI as a key 5IR technology underscores the growing acknowledgment of AI's role in enhancing user experiences.

Moreover, the potential of 5IR to improve user engagement in library service delivery highlights its relevance in fostering more interactive and responsive systems. However, lack of awareness remains the most significant barrier to adoption in Nigerian libraries, suggesting a pressing need for targeted education, training, and advocacy.

To bridge this gap, strategic initiatives such as capacity-building programs, pilot projects, policy advocacy, and enhanced digital infrastructure must be prioritized. By addressing these challenges, libraries in Nigeria can effectively integrate 5IR technologies, ultimately transforming service delivery and ensuring long-term sustainability.

Recommendations

Adopting these strategies and recommendations, Nigerian libraries can effectively navigate the 5th Industrial Revolution, enhancing their relevance, efficiency, and impact on communities.

1. Implement continuous digital literacy programs for librarians and users, focusing on AI, IoT, Blockchain, and human-machine collaboration tools.
2. Promote the adoption of AI-driven systems for cataloging and virtual assistance, IoT-based smart energy solutions, and cloud platforms for storage and service delivery to reduce environmental impact.
3. Create policy frameworks that support 5IR integration, including national standards for technology use in libraries by partnering with government bodies, NGOs, and tech firms to provide grants and infrastructural support, particularly targeting rural and underserved libraries.

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Social Networking Sites Usage for Improving Learning Activities by Students in Higher Institutions

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Abstract

This study examined social networking sites usage for improving learning activities of students in higher institutions. Two objectives were stated to guide the study viz; to identify the type of social networking sites used to improve learning activities of students in higher institutions, and to examine the academic purposes that students use social networking sites for, in higher institutions. Various types of SNS were identified and explain in relation to learning activities of students among which are; Educational Social Bookmarking Sites, Educational Media Sharing Platforms, Educational Social News Sites, Educational Blogs, Education Social Media sites. Moreover, different purposes for using SNS by students in higher institutions were also identified and explained, including, collaboration and communication, real-time communication, access to diverse learning resources, fostering creativity and critical thinking, global connectivity and cultural exchange. In conclusion, incorporating social networking sites into higher education enhances student engagement, collaboration, and professional networking, making learning more dynamic and relevant to real-world applications. It was suggested that the management of higher institutions should endeavour to encourage students to use SNS to connect with professionals in their field, join industry-specific groups, and follow organizations relevant to their studies. Also, the educators should create or encourage the students to create online study groups or discussion forums on different SNS where students can collaborate on assignments, share resources, and support each other's learning.

Keywords*: Higher Institutions, Learning activities, Social Networking Site, Students, Usage*

Introduction

Social Networking Sites (SNS) is used by people of all ages for a variety of purposes but are especially used by young people and students. Social Networking Sites are online services, platforms or websites that focus on creating and reflecting social relationships between people who have common interests and/or activities. The SNS allow those who have an account on them to communicate with a selected set of associates (Liu, 2017). It has become an integral part of daily life, particularly among young people, including university students. These platforms, originally designed for social interaction and networking, have evolved into powerful tools that can support various aspects of academic life. Sites like Facebook, Twitter, WhatsApp, and Instagram are widely used by undergraduate students not just for connecting with peers, but also for sharing information, collaborating on projects, and accessing educational content. As students increasingly turn to these platforms for academic purposes, it becomes essential to understand how SNS usage can be harnessed to improve learning activities and enhance educational outcomes (Mitchell & Watstein, 2017; Misir, 2018; Stutzman, 2021).

At Ahmadu Bello University, Zaria, like many other higher education institutions, undergraduate students are active users of social networking sites. The ubiquity of smartphones and Internet access has made these platforms easily accessible, allowing students to engage with educational content at any time and from anywhere. Through SNS, students can participate in study groups, discuss course materials, and receive updates from instructors and academic departments. Despite the potential benefits, the effectiveness of SNS for improving learning activities is influenced by how students use these platforms and whether they can balance social interaction with academic engagement, understanding these dynamics is crucial for maximizing the educational value of SNS usage among undergraduates.

However, the use of SNS for learning purposes is not without its challenges. While SNS can facilitate collaborative learning and provide access to a wealth of information, there are concerns about distractions, misinformation, and the potential for academic dishonesty. Additionally, the informal nature of communication on these platforms may sometimes undermine the seriousness of academic discourse (Ahmad, 2014; Talaue et al 2018). Therefore, this study aims to explore the usage of social networking sites by undergraduate students at Ahmadu Bello University, Zaria, focusing on how these platforms are employed to

support learning activities and identifying different types of SNS available for use by undergraduate students.
Despite the widespread adoption of social networking sites (SNS) among undergraduate students, there remains a significant gap in understanding how these platforms can be effectively utilized to enhance learning activities. While students at Ahmadu Bello University, Zaria, frequently use SNS for communication and social interaction, it is unclear whether they are adequately using these site/tools to their full potential for academic purposes. Many students may be unaware of how to use SNS strategically to improve their studies, such as by participating in educational groups, accessing learning resources, or collaborating on assignments. This lack of awareness on different types of SNS and guidance raises concerns about whether the current usage of SNS is contributing meaningfully to students' academic success.
Moreover, the dual nature of SNS as both social and educational tools presents challenges that may hinder their effectiveness in supporting learning activities. The potential for distraction is a major issue, as students can easily become sidetracked by non-academic content, reducing the time and focus they dedicate to their studies. Additionally, the prevalence of misinformation and the informal communication styles prevalent on these platforms can compromise the quality of academic discussions and the reliability of information shared among students. These factors may limit the educational benefits of SNS usage, leading to a situation where the potential for enhancing learning is overshadowed by negative influences. These warrant the need for a more deliberate approach to incorporating SNS into the university's educational strategies, ensuring that these platforms are used to their full potential for enhancing learning activities. Therefore, this study aims to investigate the current usage of SNS by undergraduate students, identify the purposes for using the SNS.

Objective of the Study

The objectives of the study are to:

1. identify the type of social networking sites used to improve learning activities of students in higher institutions.
2. examine the academic purposes that students use social networking sites for, in higher institutions.

Literature Review

Types of Social Networking Sites

The following are some of the types SNS that are useful for learning activities:

Educational Social Bookmarking Sites

Educational social bookmarking sites are online platforms that allow users to save, organize, share, and discover web bookmarks (links to webpages) that are valuable for educational purposes. These sites are designed to support collaborative learning, research, and resource sharing among students, educators, and researchers. Unlike traditional bookmarking, which is private and stored on a single device, social bookmarking allows users to access their saved links from any device with internet access and share them with a broader community. These platforms also often support discussions, annotations, and comments on shared links, facilitating collaborative learning and peer feedback. Examples of educational social bookmarking sites include Diigo, where users can annotate, highlight, and comment on web pages before bookmarking them; Pinterest, which, while broader in scope, has educational boards where users can pin and share resources; and CiteULike (though now defunct), which was widely used for academic papers and articles, other examples include Edshelf, Evernote, eLearning Tags, Symbalooedu and Pearltrees (Ahmad, 2014).
Key features of educational social bookmarking sites include tagging, which helps categorize and organize bookmarks using keywords, and the ability to follow other users or groups, allowing for the discovery of new resources through social connections. These social bookmarking sites empower educators to curate, organize, and share educational resources, fostering collaboration and enhancing the learning experience for students (Al-Rasheed & Berri, 2014; Muriithi & Muriithi, 2021).
These sites are valuable in educational settings because they allow for the curation and dissemination of high-quality resources, support collaborative learning by enabling students and educators to share and discuss materials, and help in organizing and managing information effectively. By leveraging educational social bookmarking sites, users can create a personalized learning environment that is rich in resources, easily accessible, and conducive to ongoing academic collaboration and discovery (Al-Rasheed & Berri, 2014).

Educational Media Sharing Platforms

Educational media sharing platforms are online tools that allow users to upload, share, and access various types of media content, such as videos, audio files, images, and presentations, specifically for educational purposes. These platforms serve as valuable resources for students, educators, and institutions, facilitating the exchange of instructional materials, educational resources, and multimedia content that can enhance teaching and learning experiences. One of the most prominent examples is YouTube (which has become a vast repository of educational videos, ranging from lectures and tutorials to documentaries and animated explanations), educators and institutions can create channels to share their content, making it accessible to a global audience. Khan Academy is another well-known platform that offers a vast library of video lessons on various subjects, allowing students to learn at their own pace. TED-Ed provides a space for sharing short, animated videos that explain complex concepts in an engaging and understandable way (Liu, 2017). Additionally, platforms like SoundCloud are used to share educational podcasts and audio lectures, while SlideShare allows users to upload and share presentations and infographics that can be used for teaching and learning (Sharma & Godiyal, 2016; Mitchell & Watstein 2017)

These platforms support educational goals by providing a rich, multimedia approach to learning that can cater to different learning styles. Visual learners can benefit from videos and infographics, auditory learners from podcasts, and kinesthetic learners from interactive content. The ability to access and share content anytime and anywhere also supports flexible and self-directed learning. Moreover, educational media sharing platforms often include community features such as comments, likes, and discussions, fostering interaction and collaborative learning among users. By integrating these platforms into educational practices, educators can create dynamic, multimedia-rich learning environments that enhance student engagement and understanding learning (Sharma & Godiyal, 2016).

Educational Social News Sites

Educational social news sites are online platforms where users can share, discuss, and vote on news stories, articles, and other content related to education and academic topics. These sites function as a community-driven way to curate and highlight relevant educational content, often with a focus on current events, research findings, teaching strategies, and innovations in education. Among the prominent example is Reddit, particularly its educational subreddits like r/education, r/Teachers, and r/AskAcademia. These communities allow users to post links to news articles, research papers, or personal insights related to education, which other members can then upvote, downvote, or comment on. The voting system helps surface the most valuable and interesting content to the top, ensuring that the most relevant information is easily accessible to the community. Another example is Slashdot, which, while originally focused on technology, also covers educational technology and related topics, allowing users to submit and discuss news stories in these areas (Deepa & Priya, 2020).

These platforms are beneficial for educators, students, and researchers as they provide a space to stay informed about the latest developments in education, share resources, and engage in discussions about trends and issues affecting the academic world. The interactive nature of educational social news sites encourages critical thinking and collaborative learning, as users not only consume content but also contribute to the conversation by sharing their perspectives, asking questions, and providing feedback. Participating in these communities, users can stay connected with the broader educational landscape, gaining insights and information that can enhance their teaching, learning, and research activities (Deepa & Priya, 2020).

Educational Blogs

Educational blogs are online platforms where educators, researchers, and experts share insights, strategies, and resources related to teaching and learning. These blogs cover a wide range of topics, including classroom management, instructional strategies, educational technology, and policy discussions. They are often written by experienced educators or professionals who provide practical advice, discuss emerging trends, and reflect on challenges in the education sector. One of the key benefits of educational blogs is their accessibility and relevance. Teachers can find up-to-date information, lesson ideas, and professional development tips tailored to various grade levels and subjects. Blogs like Edutopia and MindShift focus on innovative teaching methods and the integration of technology in education, helping educators stay current with the latest trends. Other examples: Cult of Pedagogy, the Innovative Educator, teach thought, learning is messy and classroom 2.0 among others (Yazdanifard *et al.,* 2018).

These educational blogs foster a sense of community among educators. They often encourage interaction through comments, sharing of experiences, and collaborative problem-solving, making them valuable spaces for professional growth and networking. Whether you're a new teacher looking for guidance or an experienced educator seeking fresh ideas, educational blogs offer a wealth of knowledge and support (Yazdanifard *et al.,* 2018).

Education Social Medi Sites

Education-focused social media sites are platforms where educators, students, and professionals can connect, share resources, and collaborate on educational topics. These sites facilitate discussions, idea sharing, and professional networking, allowing users to stay updated on the latest trends, tools, and strategies in education. For example, Twitter is widely used by educators who participate in educational chats using hashtags like #EdChat and #EduTwitter. These chats provide a space for teachers to discuss best practices, share resources, and connect with a global community of educators. LinkedIn serves as a professional networking site where educators can join groups related to education, share articles, and engage in discussions about teaching practices and educational leadership. Pinterest is another popular platform among educators, offering a visually-driven space where teachers can find and share lesson plans, classroom decoration ideas, and educational activities. It allows users to organize and save resources on themed boards, making it easy to access and implement ideas in the classroom. These platforms are valuable tools for educators looking to enhance their teaching practices and connect with others in the field. (Sharma & Godiyal, 2016)

Other educational SNS include, discussion/collaboration forums such as Microsoft word 365, Big-Blue Button, Skype and Zoom, cybernetic worlds such as Second Life and Open Sim, presentation sharing network tools such as Scribd, Slide Share and Slide Rocket, writing and research collaboration tools such as PBworks, Wikispaces and Wikipedia among other.

Purpose of using Social Networking Site

The use of Social Networking Sites in teaching and learning serves various purposes, revolutionizing traditional educational approaches methodologies. SNS have been very useful in the educational environment, especially for academic purposes as various studies have shown that students have taken the opportunity

provided through these sites/platforms to facilitate their learning and research. Murire and Cilliers (2017) reported on the use of SNS in higher education and revealed that their popularity among students has necessitated their adoption. they also provide considerable potentiality for university communications and collaborative learning among students and also marketing offices who have the goal of increasing their messaging efforts among the student population without adding to their post-production and distribution costs. Some institutions have adopted SNS to provide messages for students particularly in the case of emergencies. It is also evident that many students send emails to each other and their lecturers for study-related purposes. In addition, students are staying up-to-date in their areas of interest by accessing news posted on websites by individuals and organizations and are accessing library collections, bibliographic databases and other educational resources, including visual resources on the web using various SNS, it also provides life-long learning and facilitate access to distance and open education, e-learning resources and e-libraries (Parmar and Desai, 2018).

Furthermore, Skiera et al. (2015) listed key purposes and relevance of integrating SNS into the educational sphere which include:

i. **Facilitating Interactive Learning Environments:** SNS promote active student engagement through interactive content, multimedia resources, and collaborative activities, enhancing learning experiences. It allows educators to tailor learning experiences to individual student needs, accommodating diverse learning styles and preferences.
ii. **Encouraging Collaboration and Communication:** Tools like wikis, shared documents, and online platforms enable students to collaborate on projects, fostering teamwork and peer learning.
iii. **Real-Time Communication:** Instant messaging, video conferencing, and discussion forums facilitate communication among students and between students and educators, encouraging dialogue and feedback exchange.
iv. **Access to Diverse Learning Resources:** SNS provides access to a vast array of multimedia resources, educational videos, podcasts, and interactive simulations, enriching the learning process. Platforms host open-access educational materials, textbooks, and resources, promoting affordability and accessibility of learning materials.
v. **Fostering Creativity and Critical Thinking:** Blogging, podcasting, and multimedia platforms allow students to create and share their content, promoting creativity, self-expression, and digital literacy. SNS support inquiry-based learning approaches, encouraging critical thinking, problem-solving, and analytical skills development.
vi. **Global Connectivity and Cultural Exchange:** SNS break geographical boundaries, enabling students to collaborate with peers globally, fostering cultural exchange and diverse perspectives. Online communities and forums facilitate interactions with individuals from diverse backgrounds, broadening students' worldview.
vii. **Flexibility and Accessibility:** Web-based platforms offer flexibility in learning schedules, allowing asynchronous learning and accommodating diverse student needs. Web accessibility features ensure inclusivity, providing access to education for students with disabilities or diverse learning requirements.

Conclusion

The use of social networking sites in higher education by students has significantly enhanced learning activities by promoting collaboration, communication, and resource sharing among students. These platforms, such as Facebook, LinkedIn, and Twitter, allow students to create virtual study groups, engage in academic discussions, and access educational resources from peers and professionals worldwide. Through facilitating real-time interaction, social networking sites help students clarify doubts, exchange ideas, and receive immediate feedback, which can improve their understanding of course material and contribute to more active learning. It offers a dynamic environment for developing essential skills like digital literacy, communication, and networking, which are crucial for students' future careers. These platforms encourage students to engage in professional communities, connect with industry experts, and stay informed about the latest trends and opportunities in their fields. By integrating social networking into their academic lives, students in higher institutions can enhance their learning experiences, making education more interactive, relevant, and connected to real-world applications.

Suggestions/Way Forwards

1. It is suggested that the policymakers and educators should incorporate social networking activities into the curriculum, such as online discussions, group projects, and peer review assignments on platforms like LinkedIn or specialized academic forums. This integration can enhance student engagement and make learning more interactive.
2. The management of higher institutions should endeavour to encourage students to use SNS connect with professionals in their field, join industry-specific groups, and follow organizations relevant to their studies. This will help students build professional networks and stay updated on industry trends and opportunities.
3. The educators should create or encourage the students to create online study groups or discussion forums on different SNS where students can collaborate on assignments, share resources, and support each other's learning. This fosters a sense of community and enhances collective problem-solving skills.

4. The Management of higher institutions should organize/provide workshops or resources that teach students how to effectively and responsibly use social networking sites for academic and professional purposes. This includes managing privacy settings, curating content, and understanding the implications of their online presence.

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Speech Recognition and Hearing Aid Assistive Technologies as Correlate to Utilization of Library Information Resources and Services by Students with Special Needs in University Libraries in South-South, Nigeria

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ABSTRACT
The study examined speech recognition and hearing aid technologies as correlate to utilization of library and information resources and services by students with special needs in university libraries in South-South, Nigeria. Two (2) objectives, two research questions and two hypotheses guided the study. The hypotheses were tested at 0.05 level of significance. Relevant literatures were reviewed based on the specific objectives of the study. The population of the study consisted of 94 students with special needs in university libraries in South-South, Nigeria. Accidental sampling technique was used to select the respondents. Questionnaire was used for data collection. The findings of the study revealed that: there is a positive and strong relationship between speech recognition assistive technology on utilization of library information resources and services by people with special needs with a correlation coefficient value of (r=.590), and is statistically significant at 0.05 alpha level [(p=.000) (p<0.05)]. There is a positive and high relationship between speech hearing aid assistive technology on utilization of library and information resources and services by people with special needs with a correlation coefficient value of (r=.600) and is statistically significant at 0.05 alpha level [(p=.000) (p<0.05)]. Based on the findings of the study, it is recommended amongst others; university libraries should embrace assistive technologies so as to enhance effective and prompt utilization of information resources and services.

Keywords: Speech Recognition, Hearing Aid, Information Resources and Services

Introduction

As custodian of information, it is charged with the responsibilities of articulating, promoting, and developing the community's information literacy through the provision of information resources and services. (Opuku, 2011). Today, University libraries are being redefined as places to get unrestricted access to information in many formats and from any source irrespective of the person involved or located where the information is sorted out from. Undoubtedly, they engage in reference and information services to provide a wide range of services and facilities, which will enhance exploitative use of the library resources and services. The implication is that users will rely solely on the library for their desired and needed information in advancing knowledge irrespective of their status. Notably, libraries add to the advancement of knowledge, they not only provide resources but also ensure that the resources are effectively used. On the road to making university libraries more accessible to people with special needs, librarians often get stuck in technological mud. Thus, university libraries irrespective of size should be able to cater for the information needs of people with special needs.

Special need persons are those who are disabled physically, intellectually, sensory impairments, medical conditions or mental illness, and these impairments being permanent or transitory. The common disabilities include blindness, deafness, deformity, loss of limbs, mental illness, and mental retardation, muscular, nervous and sensory disorders. However, those with special; needs are broadly categorized into four namely physical disability, visual impairment, hearing impairment and mental retardation. Visually impaired are people with vision defects. Those included in this category are people who had never had visual function, those who had normal vision for some years before becoming gradually or suddenly partially or totally blind, those with disabilities in addition to visual loss. The hearing impaired are people whose auditory capacity is limited. The degrees of hearing impairment, include hard-of-hearing, congenitally deaf, adventitiously deaf, pre-lingual deafness and post-lingual deafness. Mentally retarded are those whose ability and adaptation in the society are below average. Hence a condition of arrested or incomplete development of the mind of a person, which is especially characterized by sub-normality of intelligence. More so, the physically disabled who have paralyzed limbs or defective control over limbs or bodily functions through congenital or acquired disorder or disease and requiring continued attention, treatment or care.

Assistive technologies can have a remarkable effect on empowering persons with special needs accompanied with the internet that provides great opportunity for connections to a range of people regardless of their location. Also, they enable students with special needs to become more efficient and independent in completing their tasks and their overall performance. These individuals who exhibit failures in tasks relating to

using print materials may benefit for assistive technologies and may be able to function at the same level as their peers in a library setting if they are provided with such tools. Though, with the adoption of assistive technologies, it is no longer enough to simply provide a person with the technology, it is necessary to demonstrate that the utilization of these technologies will improve a person quality of life or provide equal access to information resources and services. Arguably, Ennis-Cole & Smith (2011) believe that assistive technology (AT) can supplement compliance to level the playing field and bridge the digital divide for students with special needs. It can also aid students with disabilities, remarkably in overcoming or bypassing their learning challenges in libraries. When librarians acknowledge not just the disability, but also the ability that students with special needs have to benefit from assistive technology, they would support its provision and adoption towards her services. Friend (2009) exposed that less than 5% of the information materials available to these persons are accessible to them. These technologies can be in several forms, of which it could be classified according to its aid mechanism. For instance, haptic, mobility aids, cognitive aids, tactile tools, auditory tools, and web-based resources, amongst others (Islim & Cagiltay, 2012).

These assistive technologies significantly contribute to aiding persons in terms of low vision, people can use software that enlarges screen content, people with speech impairment can use devices that speaks out loud while they enter the text via keyword and people who are deaf can use text telephone (University of Washington, 2021). These technologies could be necessary in the utilization of information resources by people with special needs. The study therefore sought to survey speech recognition and hearing aids assistive technologies as correlate to utilization of information resources by people with special needs in university libraries in south-south, Nigeria.

Statement of the Problem

Institutions of higher learning admit students with special need, but little is done to meet their information needs as far as their course work and other research activities are concerned. The scenario appears more worrisome when viewed against the background that university libraries once served as the knowledge hub of information for different categories of users, but now is in a selective state. This development revolves round a lot of factors ranging from the university libraries not having any policy on access and use for students with special needs, library personnel not having the requisite training to assist people with special needs, the physical structure of libraries are manifestations that much emphasis is placed on the able bodied persons rather than the physically challenged persons. However, ensuring equal access and use to information resources by different category of users relies on adoption of assistive technology (AT) in university libraries and awareness among the special needs students about the information resources which are useful for them. This is because assistive technology has emerged as a powerful platform in education field which when lacked limits those with special needs from utilizing information resources in university.

More importantly, in order to leverage the new opportunities that assistive technologies are presenting in many areas; it offers independence by enabling people with special needs to perform tasks which they were formerly unable to accomplish. These technologies are necessary for the utilization by people with special needs to become proficient enough to help them participate in educational and employment opportunities offered to their able-bodied users. The challenge is how to harness these technologies for the lives of these library users (people with special needs). More so, insufficient fund for acquisition and maintenance of these technologies. However, the availability of assistive technologies in libraries cannot be over emphasized, but the complex nature and use of some assistive devices is worrisome. It therefore, becomes imperative to investigate between speech recognition and hearing aids assistive technologies as correlate to utilization of information resources by people with special needs in university libraries in South-South, Nigeria.

Objectives of the Study

The main purpose of the study is to determine the relationship between speech recognition and hearing aids assistive technologies as correlate to utilization by people with special needs in university libraries in South-South, Nigeria. The specific objectives were to:

1. Determine the relationship between speech recognition technology as correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria.
2. Investigate the relationship between hearing aid technology as correlate to utilization of information resources by people with special needs in University libraries in South-South, Nigeria.

Research Questions

The study was guided by the following research questions.

1. What is the relationship between speech recognition technology as a correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria?
2. What is the relationship between hearing aid technology as a correlate utilization of information resources by people with special needs in University libraries in South-South, Nigeria?

Research Hypotheses

The following hypotheses were formulated to guide the study.

1. There is no relationship between speech recognition technology as a correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria.
2. There is no relationship between hearing aid technology as a correlate to utilization of information resources by people with special needs in University libraries in South-South, Nigeria.

Literature Review

Assistive technology, also known as Adaptive Technology refers to technology used to maintain, increase or improve the abilities of individuals with disabilities. Assistive technology includes computer programs or electronic devices. It doesn't have to be high-tech; but it should serve the purpose of "assistance". These technologies are dedicated to helping disabled people overcome their disability and assist them to compete in an even basis with their non-disabled peers in the work place. Such technology enables people with disabilities to accomplish daily living tasks, assist them in communication, education, work or recreation activities, in essence, "AT' primary purpose is to maintain or improve an individual's functioning and independence to facilitate participation and to enhance well-being (UNESCO, 2020).

Speech recognition allows "hands-free" control of various electronic devices. It is particularly advantageous to physically disabled persons and can be used in computers to control the system, launch applications, and create "print-ready" dictation; and thus, provide easy access to persons with dyslexia, hearing or vision impairments. For example, a hearing-impaired person can use a microphone to capture another's speech and then use speech recognition technologies to convert the speech to text. A vision impaired person, on the other hand, can use speech technologies to control electronic devices and launch applications. Some of the speech recognition software include: Dragon Naturally Speaking Preferred, IBM ViaVoice 10.0, Keyston Speech Master; and Microsoft Office XP. The establishments of speech recognition programs at institutions now require academic libraries to integrate, accommodate, manage and provide accessibility and subject expertise to aid data scientists because the continuous growth of this software towards information resources utilization. This now require a new set of techniques for information extraction, retrieval, natural language processing and classification. Most libraries are determining the best means of managing, funding, and developing these technologies.

Exponentially important when choosing a speech-to-text program for students with disabilities is the critical issue of ease of training and use. While many programs have proven to be helpful for most students, there are at times the challenges posed by software training and use that creates what can be referred to as cognitive overload for students with disabilities. Librarians have it as a duty to assist researchers on data by creating guides on how to use and as well as information on library information sources and data sources Owing to the shift to the electronic processes of information communication, it has become necessary that libraries subscribe to some online databases, possess and teach their users (i.e people with special needs) the skills to access and use them. Actually, besides helping people with special needs in controlling their computers orally, it can be an essential aid for students with physical disabilities who cannot move their hands or body or even have vision impairments (Bahattacharjee, Gohoi & Sharma, 2016). Talking calculators, talking spelling checkers and electronic dictionaries, and speech synthesizers or screen readers are just few of those speech recognition programs that is considered assistive technology that can be used to overcome writing and speaking difficulties of children with special needs. For example, talking calculators clearly defined as built-in speech synthesizer that reads aloud each number, symbol or operation key a user presses; it also vocalizes the power to the problem. The auditory feedback helps him check the accuracy of the keys he presses and verify the answer before he transfers it to the paper (Stanberry, et.al, 2009). Similarly, Wald (2008) assert that Speech recognition technology has various purposes within the classroom environment. More specifically, it has been cited as a support for preferred learning and teaching styles, an assist for those who for cognitive, physical, or sensory reasons find the process of note taking to be difficult, and also as a method of captioning speech for deaf learners .Using these technologies, people with special needs (disabilities) will exhibit solid improvements of their writing skills as well as ability to compose sentences as compared to the traditional way of writing the words. Additionally, for those students who are unable to use a keyboard or who prefer to dictate directions verbally, speech recognition technology can be used to complete tasks such as saving files or even quitting programs (Zhao, 2007). Aposto (2012) assert that with the use of speech recognition devices it clearly demonstrated a significant effect on the developed skills in terms of word recognition, reading and writing comprehension.

Hwang et al. (2012) investigated student perceptions and behavioural intentions of using speech recognition technology, student motivation for future use also became apparent. Participants of this study included 19 undergraduate students in the control group and 25 in the experimental group. Classes took place for two-hour increments either in person or online on a rotation. Speech recognition technology was used only by the experimental group (Hwang et al., 2012). Results of the study indicated that there were moderate improvements in the experimental group's performance over the control group in terms of homework accomplishments and that once the experimental group became familiar with speech recognition generated texts and used them as tools in their learning; they outperformed the control group (Hwang et al., 2012). It then requires the services of professionals with relevant skills in data management and when this is lacking, institutional data will be poorly managed and files will be difficult to retrieve or unavailable which could lead to limited attention been given to understanding the influence of speech recognition technology and as such it may exert an underlying cognitive factor of this tools.

Microsoft Word and tape recorders tools which are one of the easiest differentiation tools for a reading passage is software programme that most instructors have readily at hand. Basically, these tools are used to play audio taped text by people with reading disabilities. This person with special needs listens to the recorded texts in books or printed materials rather than reading it. More so, the Speech Synthesis which can serve the purpose of reading engine could be available on computer disc loaded to the computer and then the students or information seeker\ read back by the speech synthesizer. In the same vein, the Optical Character Recognition which could be connected with speech synthesis enables the disability person to type printed text to the computer, while the speech synthesizer reads the text back and aloud for the disable to hear and alongside see the text. Then, the Variable Speech Control (VSC) which is in form of tape recorder, enable the disable to play the texts recorded in audio tape very fast than the originally recorded, with all the sounds of the words still intact (Adebisi, Liman & Longpoe, 2015).

These tools if used properly will facilitate the utilization of information resources in different format. Also, with continuing hardware and software improvements, speech recognition technology is becoming an increasingly cost-effective educational and productivity tool for a wide range of students with special needs as they aid in the wide range of utilization of information resources. More so, Speech-to-text program can be used to help students compensate for the individual challenges with transcription, spelling, handwriting and conventions such as punctuation and capitalization.

Hearing aid assistive technology is a necessary tool for people with hearing impairment. The term hearing impairment is usually reserved for people who have relative insensitivity to sound in the speech frequencies. Hearing assistive technology is to help individuals with hearing needs in listening, comprehending or recognizing sounds, and enhancing the frequencies of sound to make them much clearer (Bankaitis, 2007). Hearing aids, Cochlear implants, F.M systems, Infrared system, and loop system are the hearing assistive tools. This disability could be categorized into: conductive hearing impairment, sensor neural hearing impairment and mixed hearing loss (which is the combination of the first and the second). It could be breakdown by their type- conductive, sensor neural or both by their severity, and by the age of onset. In most cases, such hearing impairment may exist in one ear (unilateral) or in both ears (bilateral), for instance, a conductive hearing impairment is present when the sound is not reaching the inner ear, the cochlea. Of which it can be due to external ear canal malformation, dysfunction of the eardrum or malfunction of the bones of the middle ear (Omoniyi & Oluniyi (2014). Thus, if the level of sound available to the listener is low, service delivery will low and/or not achieved.

The view is held that hearing aid assistive technology is used to improve the level of sound available to the listener and not made for deaf people with a complete loss of hearing ability. This technological device includes: assistive listening devices, personal sound amplification (PSAB), cochlear implants, amongst others. Obviously, when appropriate hearing aids are provided an individual with hearing impairment will be able to complete task more effectively and independently than the otherwise possible without the tools. Assistive devices are more useful and with the help of these devices desired sound is sent to the listener's ears directly with improved signals to background noise ratio and reduce effects of poor room acoustics and diffused sounds (Yi-Lin, 2005). The cost of assistive technology decreases as much as it profits to the disabled students with hearing loss (Wald, 2009).

Robertson (2007) on the other hand makes it clear that hearing impairment is often a hidden disability which may not be evident and there is a general misconception that people with hearing impairment cannot "hear any sounds at all" but that is not the case; "the person is likely to be able to hear some frequencies and maybe lip-reading." Hearing weakness alludes to all variations from the norm, issue, deviations in the component by and large alluded to as the ear. It alludes to all levels of hearing misfortune and irregularities in the consultation framework. Similarly, according to the American School for the Deaf, (2008) hearing impairment covers all forms of hearing problems that impede communication. It could be mild or severe. So, persons with hearing impairment are individuals who have mild or severe hearing problems to the extent that communication is affected. Hearing impedance is additionally estimated on a continuum from ordinary hearing to serious and significant hearing misfortune. A Hearing-weakened understudy may have a one-sided hearing misfortune (including just a single ear) or two-sided hearing misfortune (the two ears are included). Empirical studies consistently show that the use of assistive technology promotes self-confidence, freedom, independence, and meaningful participation in home, school and community. Most importantly, it facilitates the use of information resources of diverse kinds. Goldmann (2010) citied in Chima & Eskay (2013) explains these terms in brief:

Hearing impairment – is the most general term used to describe all types and degrees of hearing defects, ranging from slight loss to profound deafness. Deaf individuals can discern no meaning in perceivable sounds. A Deaf individual is one whose consultation misfortune is so extraordinary to the degree that one/they cannot profit by everyday handling of phonetic data through tryout, with or without intensification Abang, (2005). Additionally, the capitalized word Deaf is used by some authors to refer to profoundly deaf people whose community and culture are based on both common experiences (such as attending institutions or programs for deaf students) and a common language, American Sign Language (ASL).

Hard-of-hearing – describes individuals whose sense of hearing, while deficient, is still somewhat functional. A man who is Hard of Hearing is one who with the utilization of intensification/listening devices has leftover hearing adequate to empower effective handling of phonetic data through try-out. They can comprehend speech to some extent with or without a hearing aid, and generally depend on speech reading, facial expression, and gestures (sometimes including sign language) to supplement what they do hear.

Congenitally deaf – those who are born with profound deafness. Adventitiously deaf – having lost part or all of their hearing later in life at any time from infancy onward.
Prelingual deafness – describes the loss of hearing before the acquisition of language, usually before three years of age.
Post lingual deafness – describes hearing loss occurring after (often long after) language acquisition.
This is not suitable for people with hearing impairment of the 21st century who will have to deal with a lot of information resources in the library.

Methodology
The study adopted correlational survey. The correlational survey examines the degree, patterns and strength of relationship between two or more variables being studied rather than explore causal relationship between them (Creswell, 2013). Thus, the correlational design provides clues for the proper understanding of patterns of relationships among variables in the study. It is considered appropriate for this study since the research is about relationship and aimed to determine the relationship between haptic and mobility assistive technologies (independent variables) on utilization of information resources by people with special needs (dependent variable). Ninety-four (94) people with special needs from six (6) federal and six (6) state universities in south-south, Nigeria constituted the population of the study. The choice of the categories is justified by the fact that only people with special needs could ascertain the relevance attached to assistive technologies and such users need this equipment to facilitate access to the utilization of the information resources in the library. Therefore, the accessible population of the study is 94 people with special needs in the six (6) federal and six (6) state university libraries in South-South. They are Akwa Ibom state University, Library (7), Ambrose Alli University, Library (6), Cross River State University, Library (6), Delta State University, Library (6), Federal university of petroleum resources, library (8), Ignatius Ajuru University of Education library (5), Niger Delta University Library (6) Rivers State University, Library (11), University of Benin, Library (10), University of Calabar (13), University of Port Harcourt, Library (9), and University of Uyo, Library (7). Questionnaire was used as instrument to gather data from the respondents. The researchers developed a questionnaire titled "Speech Recognition and Hearing Aid Assistive Technologies as a correlate to Utilization of Information Resources by People with Special Needs in University Libraries Questionnaire (SRHAATUIRPSNULQ)". It comprises two (2) sections. Sections A and B. Section A contained information on demographic data and Section B focused on the dependent variable. Each of the items was assigned a 4-point rating scale of Strongly Agree (SA) - 4 points; Agree (A) – 3 points; Disagree (2) – points; and Strongly Disagree (SD) - 1point. The researchers with the help of research assistants in each of the institutions studied administered the questionnaire. All the 94 copies of the instrument administered to the respondents were found valid and used for the analysis. The data was analyzed using Mean Scores and Standard Deviation in answering the research questions. The Pearson Product Moment Correlation (PPMC) was used to test the null hypotheses at 0.05 level of significance. This was computed using the Statistical Package for Social Science (SPSS) software version 23. The decision to accept or reject was based on the mean rating of 2.50, this implies that any item with a mean of 2.50 and above was accepted while any item with a mean below 2.50 was rejected.

RESULTS AND DISCUSSION
Data Presentation
Research Question 1: What is the relationship between Speech Recognition Assistive Technology as a correlate to Utilization of Information Resources by people with Special Needs in University Libraries in South-South, Nigeria.

Speech Recognition Assistive Technology by People with Special Needs

S/N	Item	SA	A	D	SD	X	±	Decision
1	Bariable speech control (BSC) enables the disabled to play the tedts recorded in audiotape faster than the originally recorded with all the sounds of the words still intact.	30	29	28	7	2.8	3.3	Agree
2	Optical character recognition connected with speech synthesis enables the disabled person to type printed tedt to the computer.	22	15	37	20	2.4	3.2	Disagree
3	The speech synthesis reads the tedt back and aloud for disabled to hear and alongside see the tedt.	30	34	21	9	3.1	3.4	Agree
4	The speech-to-tedt program help people with disability compensate for their indiɓidual challenges with transcription, spelling, handwriting and conɓentions, such as punctuations and capitalization.	38	29	11	16	2.9	3.3	Agree
5	The talking calculator help read aloud each number, symbol or operation key	46	39	7	2	3.3	3.5	Agree
	Weighted Mean	**2.90>2.5**				**3.4**		**Agree**

Table 1 shows the special recognition technology aa a correlate to utilization of information resources by people with special needs. It revealed that Item 5 has mean score of 3.3 and standard deviation of 3.3. This indicates that the talking calculator read aloud each number, symbol or operation key for people with social needs. Item 3 has mean score of 3.1 and standard deviation of 3.4. This indicates that the speech synthesizer reads the text back and aloud for disabled to hear and alongside see the text. Item 4 has mean score of 2.9 and standard deviation of 3.3. This indicates that the speech to text program helps people with disability compensate for their individual challenges with transactions, spelling, handwriting and conventions, such as punctuations and capitalizations. Item 1 has mean score of 2.8 and standard deviation of 3.3. This indicates that variable speech control (VSC) enables the disabled to play the texts recorded in audiotape very fast than the originally recorded with all, the sounds of the words still intact. On the other hand, Item 2 has mean score of 2.4 and standard deviation of 3.2. This implies that people with special needs do not utilize optical character recognition connected with special synthesis. The weighted mean of 2.9 revealed that speech recognition technology help people with special needs in universities in south-south, Nigeria to utilize information resources.

Research Question 2: What is the relationship between Hearing Aid Assistive Technology as a correlate to Utilization of Information Resources by people with Special Needs in University Libraries in South-South, Nigeria.

Hearing Aid Assistive Technology by People with Special Needs

S/N	Item	SA	A	D	SD	X	±	Decision
1	Alerting deƀices (i.e. doorbell) draw the attention of persons with hearing impairments to imminent danger.	36	34	14	10	3.0	3.4	Agree
2	Hearing aids assist persons who edperience ƀarying degrees of hearing loss in the perception of enƀironmental sounds and to hear and understand oral language.	39	29	16	10	3.0	3.4	Agree
3	A communication board enables a person to communicate using symbols, words, pictures, or object communication to replace spoken communication..	42	34	10	8	3.1	3.5	Agree
4	Bideo communication deƀices allow indiƀiduals to use sign language to communicate with others on the phone through a relay interpreter.	25	19	20	30	2.4	2.8	Disagree
5	Personal sound amplifier enhance speech understanding to improƀe the signal to noise ration through directional microphones.	30	12	33	19	2.5	2.9	Agree
	Weighted Mean	**2.80>2.5**				**3.2**		**Agree**

Table 2 shows the hearing aid technology by people with special needs in universities in south-south, Nigeria. The study revealed that Item 3 has a mean score of 3.1 and standard deviation of 3.5. This implies that a communication board enables a person with special needs to communicate using symbols, worlds, pictures, or object communication to replace spoken communication. Item 1 has a mean score of 3.0 and standard deviation of 3.4. This implies that hearing aids assist persons who experie3nce varying degrees of hearing loss in the perception of environmental sound and to hear and understand oral language. Item 5 has a mean score of 2.5 and standard deviation of 2.9. This implies that personal sound amplifier enhances speech understanding to improve the signal to noise ration through directional microphones. Item 4 has a mean score of 2.4 and standard deviation of 2.8. This implies that most of the people with special needs do not utilize video communication devices. However, the weighted mean of 2.80 which is greater than the criterion mean of 2.5 implies that hearing aid technology help people with special needs in university libraries in south-south, Nigerians to utile information resources.

Hypothesis Testing

Hypothesis One: There is no relationship between speech recognition technology as a correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria.

Table 3: Pearson Product Moment Correlation (PPMC) on the relationship between speech recognition technology as a correlate to utilization of information resources by people with special need.

Variables	N	$\bar{X}$	SD	R	p-value	Decision
Speech Recognition Technology	94	14.44	3.102	.590	.000	Rejected
Utilization of Information Resources		14.00	2.597			

The result in Table 3 shows the summary of Pearson Product Moment Correlation (PPMC) on the relationship between speech recognition technology and utilization of information resources by people with special need in university libraries in South-South, Nigeria. The result establishes a positive and moderate relationship between the two variables with a correlation coefficient value of (r=.590). An additional explanation specifies that there is a significant relationship between speech recognition technology as a correlate to utilization of information resources by people with special need in university libraries in South-South, Nigeria as [(p=.000) (p<0.05)]. The null hypothesis one which states that there is no significant relationship between speech recognition technology aa a correlate to utilization of information resources by people with special need in university libraries in South-South, Nigeria was rejected and the reverse hypothesis upheld. Thus, there is significant relationship between speech recognition technology as a correlate to utilization of information resources by people with special need in university libraries in South-South, Nigeria.

Hypothesis Two There is no relationship between hearing aid assistive technology as a correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria.

Table 4: Pearson Product Moment Correlation (PPMC) on the relationship between hearing aid assistive technology as a correlate to utilization of information resources by people with special need.

Variables	N	$\bar{X}$	SD	R	p-value	Decision
Hearing Aid Assistiɓe Technology	94	16.15	2.712	.600	.000	Rejected
Utilization of Information Resources		14.00	2.597			

The result in Table 4 shows the summary of Pearson Product Moment Correlation (PPMC) on the relationship between hearing aid assistive technology as a correlate to utilization of information resources by people with special need in university libraries in South-South, Nigeria. The result establishes a positive and high relationship between the two variables with a correlation coefficient value of (r=.600). An additional explanation specifies that there is a significant relationship between hearing aid assistive technology and utilization of information resources by people with special need in university libraries in South-South, Nigeria as [(p=.000) (p<0.05)]. The null hypothesis two which states that there is no significant relationship between hearing aid assistive technology as a correlate to utilization of information resources by people with special need in university libraries in South-South, Nigeria was rejected and the reverse hypothesis upheld. Thus, there is significant relationship between hearing aid assistive technology as a correlate to utilization of information resources by people with special need in university libraries in South-South, Nigeria.

Findings of the Study

The following were the findings of the study:

1. There is significant and positive relationship between speech recognition technology as a correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria.
2. There is significant and positive relationship between hearing aid assistive technology as a correlate to utilization of information resources by people with special needs in in University libraries in South-South, Nigeria.

Discussion of the Findings

Speech Recognition Technology as a correlate to Utilization of Information Resources

The findings of the study revealed that there is a significant and positive relationship between speech recognition technology and utilization of information resources by people with special need in university libraries in south-south, Nigeria; the result of the hypothesis also indicates that there is a positive and high relationship between speech recognition technology and utilization of information resources by people with special needs in university libraries in south-south, Nigeria. This result is in line with the submissions of Hwang, et al (2012) who investigated student perceptions and behavioral intentions of using speech recognition technology in Nigeria universities and revealed that there were moderate improvements in the experimental group performance over the control group in terms of homework accomplishment and once the experimental grouped become familiar with speech recognition generated texts and use them as tools in their learning and studying, they outperformed the control group. The result of this study could be attributed to high extent of speech recognition assistive technology as it serves the purpose of reading engine and the productivity tool for a wide range of students with special needs as they aid in the utilization of information resources. For instance, Zhao (2017) affirmed that for those students who are unable to use a keyboard or who prefer to dictate directions verbally, can use the speech recognition, to complete such tasks such as saving files or even quitting programs.

Hearing Aid Technology as a correlate to Utilization of Information Resources

The findings of the study revealed that there is a significant and positive relationship between hearing aid technology and utilization of information resources by people with special need in university libraries in south-south, Nigeria; the result of the hypothesis also indicates that there is a positive and moderate relationship between hearing aid technology and utilization of information resources by people with special needs in university libraries in south-south, Nigeria. This finding is tailored in the same line with the opinion Bankaitis (2007) who assert that hearing assistive aid technology help individuals with hearing needs in listening, comprehending or recognizing sounds, and enhancing the frequencies of sound to make them clearer. This implies that hearing aid technology could influence people with special needs utilization of information resources, since it could help them to understand that a communication board enables a person to communicate in using symbols, words, pictures or object communication to replace spoken communication, alerting devices (i.e. doorbell) draw the attention of persons with hearing impairment to imminent danger; hearing aid assists persons who experience varying degrees of hearing loss in the perception of environmental sounds and to hear and understand oral language, personal sound amplifier enhance speech understanding to improve the signal-to-noise ratio through directional microphone; video communication devices allow individuals tom use sign language to communicate with others on the phone through a relay interpreter.

Conclusion

This study investigated speech recognition and hearing aid assistive technology as a correlate to utilization of information resources by people with special needs in university libraries in South-South, Nigeria and revealed that there is a significant relationship between speech recognition assistive technology, hearing aid assistive technology as a correlate to utilization of information resources of people with special needs in university libraries in South-South, Nigeria. Thus, people with special needs need ability to manipulate speech recognition aid, hearing aid, will help in facilitating and promoting the utilization of information resources.

Recommendations

Based on the findings of the study, the following recommendation were made:

1. That there is a positive and moderate relationship between speech recognition and utilization of information resources by people with special needs, speech recognition should be fully subscribed by libraries, as it is an essential aid for students with physical disabilities.
2. That there is a positive and high relationship between hearing aid technology and utilization of information resources by people with special needs. The tools such as infrared system, cochlear implants should not only be deployed but be made accessible and usable by people with special needs for utilization of information resources.

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Survey of Open Science Practices for Scholarly Communication in the 5th Industrial Revolution among Academic Librarians in Nigeria

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Abstract

This study explored the future of open science for scholarly communication in the fifth industrial revolution (5IR). The emergence of the 5th Industrial Revolution (5IR) represents a transformative era in technological advancement, driven by the integration of artificial intelligence, human-centered innovations, and sustainable development practices. The objective of this study among others is to determine ways in which principles of Open Science evolve within the context of the 5th Industrial Revolution to enhance scholarly communication among academic librarians in Kaduna State, Nigeria. Population of the study consisted of three hundred and fifty academic librarians in Kaduna State, Nigeria. Convenience sampling technique was used for selecting two hundred and twenty-seven was used as sample size for the study. Self- developed close ended questionnaire was used for data collection. Descriptive statistics was used for data analysis. 50% was used as the benchmark for decision making. Finding revealed that factors that influence the adoption of OS practices among studied academic librarians in the 5th Industrial Revolution are; digital infrastructure, AI and automation, institutional and policy factors; and availability of funding. Finding revealed that the ways in which principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication are; enhanced research collaboration and accessibility; AI-driven knowledge management and automation; integration of emerging technologies for scholarly communication; and bridging the digital divide. Ways that emerging technologies can support OS initiatives are; digital repositories, collaboration platforms, data sharing and management; and open access publishing, training and workshops, mobile applications; and emerging technologies training. Based on the findings, it is concluded the future of Open Science in the 5th Industrial Revolution (5IR) holds immense potential for transforming scholarly communication among academic librarians in Kaduna State, Nigeria. As the research landscape changes, the integration of emerging technologies such as artificial intelligence (AI), blockchain, cloud computing, and open-access platforms possess the ability to play a crucial role in enhancing accessibility, collaboration, and knowledge dissemination. Based on findings, it recommends among others that the management of libraries in Kaduna State, Nigeria should allocate sufficient resources for Open Science initiatives, including infrastructure, training, and open-access publishing. Partnerships with international Open Science organizations such as LIBSENSE, Nigeria and WACREN, NgREN can provide additional financial and technical support.

Keywords: Academic Librarians, LIBSENSE- Nigeria, 5th Industrial Revolution, Open Science, Scholarly Communication, WACREN - West and Central African Research and Education Network

Introduction

The advent of the 5th Industrial Revolution (5IR) marks a pivotal shift in technological innovation, characterized by the convergence of artificial intelligence, human-centric technologies, and sustainable practices. The Fifth Industrial Revolution, or 5IR, encompasses the notion of harmonious human - machine collaborations, with a specific focus on the well-being of the multiple stakeholders that is the society, companies, employees, customers. At its core, 5IR emphasizes a seamless collaboration between humans and advanced technologies, fostering creativity, inclusivity, and ethical development. In this present transformative era that have led to rapid changes that fundamentally reshape societies, economies, cultures, and technologies; scholarly communication-the backbone of knowledge dissemination-must adapt to leverage the opportunities presented by these advancements for scholarly publication through the adoption of open science(OS) principles.

Open Science, a paradigm aimed at making scientific research accessible, transparent, and reproducible, aligns perfectly with the ethos of 5IR. By breaking down barriers to knowledge sharing and fostering interdisciplinary collaboration, Open Science holds immense potential to redefine scholarly communication, democratizing access to research outputs while ensuring equity and inclusivity. Open access, scholarly communications, open science, and the 5th Industrial Revolution are interconnected concepts that collectively shape the evolving landscape of academic librarianship. As catalysts for democratizing knowledge, open access and open science promote transparency, collaboration, and unrestricted dissemination of research findings, thereby enhancing the accessibility and impact of scholarly work. Academic librarians play a crucial role in facilitating these movements by managing open access repositories, supporting open science initiatives, and guiding researchers through emerging scholarly communication practices. In the context of the 5th Industrial Revolution, characterized by the integration of advanced technologies such as artificial

intelligence, big data, and digital connectivity, librarians are increasingly leveraging innovative tools to improve information management, streamline access, and foster open knowledge ecosystems. This synergy not only transforms the traditional roles of academic librarians but also positions them as pivotal facilitators in advancing open scholarly practices within a technologically driven, interconnected academic environment.

This paper explored the future of Open Science in the context of the 5th Industrial Revolution, focusing on its role in reshaping scholarly communication among academic librarians in Kaduna State, Nigeria. By envisioning a future where Open Science thrives in harmony with 5IR principles, this paper aims to provide a roadmap for researchers, policymakers, and stakeholders to foster a more collaborative and impactful global research landscape**.**

Statement of the Problem

The emergence of the 5th Industrial Revolution (5IR), characterized by human-AI collaboration, hyper-connectivity, and sustainable innovation, presents both opportunities and challenges for scholarly communication in Nigeria. Open Science, which emphasizes transparency, accessibility, and collaboration in research, is increasingly being recognized as a critical driver of knowledge dissemination and academic progress. However, the adoption of Open Science practices among Nigerian academics remains limited due to infrastructural constraints, data security concerns; and resistance to change.

Despite the global push towards Open Science, academic librarians in Kaduna State, Nigeria continue to rely on traditional, closed-access publication models, limiting the visibility and impact of their research. Furthermore, issues such as the inadequate funding, and a lack of awareness about Open Science principles hinder its full integration into Nigeria's academic ecosystem. As the 5th Industrial Revolution reshapes the global research landscape through advanced technologies like AI, blockchain, and cloud computing, there is an urgent need to examine how academic librarians in Kaduna state, Nigeria can leverage these innovations to enhance scholarly communication. This paper seeks to investigate the current state of Open Science among academic librarians in tertiary institutions in Kaduna State, Nigeria, the future of open science for scholarly communication in the fifth industrial revolution (5IR). By addressing these gaps, this study aims to provide insights into how Nigerian academics can effectively participate in global Open Science initiatives, thereby fostering innovation, research collaboration, and knowledge equity

Research Objectives

The objectives of this study were to;

1. Find out the factors that influence the adoption of Open Science practices in the 5th Industrial Revolution among academic librarians in Kaduna State, Nigeria.
2. Determine ways in which principles of Open Science evolve within the context of the 5th Industrial Revolution to enhance scholarly communication among academic librarians in Kaduna State, Nigeria.
3. Ascertain ways emerging technologies can support Open Science initiatives for scholarly communication among academic librarians in Kaduna State, Nigeria.
4. Determine the role played in promoting Open Science within the evolving landscape of the 5th Industrial Revolution by academic librarians in Kaduna State, Nigeria.

Literature Review

Empirical review of studies was employed for the review of related literature to this study. In a study by Oyedokun (2025), it explored how the Fifth Industrial Revolution (5IR) is revolutionizing libraries through advanced technologies like robotics, AI, the metaverse, and blockchain. It investigated their impact on library roles, services, and infrastructure to improve user experiences, operational efficiency, and information accessibility. Using a systematic literature review methodology, the research analyzed recent studies and reports from major databases, highlighting trends such as automated collection management, enhanced research support, and virtual environments. Case studies from various libraries illustrate implementations of these technologies, emphasizing the need for staff upskilling and robust policies to address ethical and legal concerns. The findings underscore the strategic integration of 5IR technologies to ensure libraries remain pertinent and effective in the digital era, offering practical insights for practitioners, policymakers, and researchers aiming to enhance library services and sustainability.

Agboke and Oladokun (2024) explored the prospects and challenges associated with emerging technologies in Nigerian academic libraries. A systematic review of literature was employed for the study. Thematic analysis was applied to synthesize insights from diverse studies. The findings reveal that the integration of technologies such as artificial intelligence (AI), robotics, automated systems, and electronic security has significantly transformed library services. Emerging technologies enable enhanced efficiency, streamlined operations, and broader access to digital resources, promoting inclusivity and improved user engagement. However, the review also highlights several challenges impeding their adoption. These include inadequate infrastructure, financial constraints, limited technical expertise among librarians, and societal resistance due to fears of job displacement and privacy concerns. Despite these barriers, the prospects for leveraging emerging technologies remain promising. Libraries are increasingly adopting AI for personalized user interactions and robotic systems for automating tasks like shelving and cataloging.

Ekwueme *et al*. (2024) investigated the impact of fifth industrial revolution (5th IR) technologies on Open and Distance Learning libraries. The study adopted descriptive design focusing on librarians at the National Open University of Nigeria. Data was collected though a Google form questionnaire. Data collected was analyzed using SPSS and linear regression to test hypotheses. Findings revealed that librarians believe that 5th IR technology improved data extraction, processing, and service. The study identified key implementation strategies, updates, training, collaboration, and skills enhancement. It emphasized the importance of funding, reliable power supply and collaboration for effective 5th IR adoption. The study underscores the potential for human-machine partnerships to automate tasks and foster connectivity, suggesting an optimistic outlook for the 5th IR's role in the promoting inclusive, customized library services in academic and distance learning environment.

Mandal (2023).The study explored the changing professional roles of college librarians in the context of AI, with a specific focus on the integration of ChatGPT and how the librarians are adopting it to serve the users. The study is based on an analysis of related literature on AI, ChatGPT, and librarian roles in digital platforms. A service model for the college librarian has been designed with a special emphasis on ChatGPT for the library. Librarians now serve as intermediaries between users and AI technologies, utilizing ChatGPT to provide personalized assistance, answer queries, and enhance the overall user experience within the library setting

Methodology

Quantitative research methodology and descriptive survey research design was adopted for this study. This methodology was judged appropriate for this study in that it allowed to the collection of numeric data. Population of the study consisted of three hundred and fifty academic librarians in Kaduna State, Nigeria. Convenience sampling was used for selecting two hundred and twenty-seven academic librarian were used as sample size for this study. Convenience sampling is a non-probability sampling method where units are selected for inclusion in the sample due to convenience. Self- developed close ended questionnaire was used for data collection. Data collection was done personally by the researchers; and this spanned over a period of three weeks for both distribution and retrieval of distributed copies of the instruction Descriptive statistics such as tables, frequency and percentage was used for data analysis. 50% was used as the benchmark for decision making.

Results and Discussion

Factors that influence the adoption of Open Science Practices among Academic Librarians in Kaduna State in the 5th Industrial Revolution

This objective sought to find out the factors that influenced the adoption of Open science practices among academic librarians in Kaduna State, Nigeria. In order to facilitate responses to this objective, options were provided for respondents to tick as applicable; responses are reflected in Table 1.

Table 1- Factors that influence the adoption of Open Science Practices in the 5th Industrial Revolution among Academic Librarians in Kaduna State, Nigeria

Factors that influence the adoption of Open Science Practices among Academic Librarians in Kaduna State in the 5th Industrial Revolution	Frequency	Percentage
Digital Infrastructure	176	77.5
AI and Automation	132	58.1
Cybersecurity and Data Protection	100	44.0
Institutional and Policy Factors	145	63.8
Aβailability of Funding	193	85.0
Awareness and Perception of Librarians' about Open Science	93	40.9
Intellectual Property Rights	55	24.2
Ethical Use of AI and Big Data	87	34.3
Compliance with Global Open Science Standards	107	47.1

Source- Field Survey, 2025

Data analysis showed 176 (77.5%) of the study respondents identified that digital infrastructure is a factor that influences the adoption of OS practices among academic Librarians in Kaduna State in the 5th IR. Also, 132(58.1%) of the respondents specified that AI and automation is another factor that influences the adoption of OS practices among academic Librarians in Kaduna State, Nigeria. 100(44.0%) of the respondents indicated that cybersecurity and data protection is a factor that influences the adoption of OS practices among academic librarians in Kaduna State. 145(63.8%) of the respondents equally identified institutional and policy

factors as another factors that influences the adoption of OS practices among academic librarians. Likewise, 193(85.0%) of the respondents indicated that availability of funding is another factor which influences the adoption of OS by the studied population. 93(40.9%) of the study respondents identified awareness and perception of librarians' about Open Science as factor to the adoption of the practice. 87(34.3%) of the respondents indicated that ethical Use of AI and big data is another factor to the adoption of OS practices among the studied librarians. 107(47.1%) of the respondents also stipulated that compliance with global open science standards is equally a factor that influences the adoption of OS practice among studied Librarians.

Based on the data analysis, the factors that influence the adoption of OS practices among studied academic librarians are; digital infrastructure, AI and automation, institutional and policy factors; and availability of funding. Digital infrastructure serves as the foundational technological systems and resources that enable the storage, access, management, and dissemination of digital information. This encompasses hardware such as servers, data centers, and networking equipment, as well as software, platforms, and protocols that support digital communication, collaboration, and data sharing. In the context of academic libraries and open science, digital infrastructure is essential for facilitating open access repositories, digital publishing, and online research collaborations. Digital infrastructure is an indispensable foundation upon which AI and automation technologies are built and deployed, enabling the processing power, data storage, and communication networks required for sophisticated AI algorithms and automated processes to function effectively.

AI can automate the tedious tasks of data cleaning, preprocessing, and integration, making large, diverse datasets accessible and usable for researchers. This allows researchers and academic librarians to focus on the more creative and interpretative aspects of work schedules. Automated tools can also help identify patterns and insights within various datasets, leading to faster discovery. The use of Al possesses the ability to streamlining publication and dissemination; AI can automate the process of preparing research papers for publication, ensuring consistency and quality across submissions. Automated translation tools can make research accessible to a global audience, breaking down language barriers. Similarly, AI-powered platforms can also facilitate the dissemination of research findings through targeted outreach and knowledge sharing. While AI and automation technologies offer significant potential to enhance open science practices among academic librarians, the effective implementation hinges on supportive institutional and policy frameworks.

Institutional and policy factors are the rules, regulations, structures, and practices of organizations and governments that influence the development, implementation, and impact of a particular technology or process. The policy covers laws and regulations which governs the use of OS among academic librarians. The codified rules govern the use, development, and deployment of technologies. For examples, data privacy laws which is a critical issue among scholars such as academic librarians, intellectual property regulations, and safety standards. Institutional and policy factors are the context in which AI and automation technologies operate, shaping it feasibility, adoption, and overall impact. Institutional and policy factors are crucial to the adoption of Open Science by academic librarians because they create the environment and support necessary for librarians to effectively implement and benefit from Open Science practices. Without supportive policies and structures, academic librarians in Kaduna State are limited in the ability to champion and integrate Open Science into their work. Although institutional and policy factors creates the groundwork for Open Science adoption, the availability of funding ultimately dictates the extent to which those factors can be translated into tangible action by academic librarians in Kaduna State, Nigeria.

The availability of funding significantly impacts the adoption of open science practices among academic Librarians in Kaduna State, Nigeria. A lack of funding is a major barrier, while adequate funding can be a crucial catalyst. Open science often requires specialized software, data storage, and computational resources (Ramachandran, Bugbee & Murphy, 2021). Without funding, researchers such as academic librarians will lack access to the tools such as computers among others, preventing academic librarians from sharing data or using open-access platforms effectively. None availability of funding will reduce capacity for training and education of academic librarian; this is because responses of studied population points to the need to conduct training and education. Implementing open science principles effectively requires training in data management, sharing protocols, and open access publishing. Limited funding can hinder the development and delivery of these crucial training programs.

Scholars (Ekwueme *et al*., 2024; Nwobu *et al*., 2024) have reported that key implementation strategies of OS includes awareness-raising, training, collaboration, and skill enhancement. It emphasizes the importance of funding, reliable power supply, and collaboration for effective 5th IR adoption.

The finding implies that the adoption of open science practices by academic libraries requires the evaluation of the several factors such as capacity building, availability of funding and institutional policy. Successful adoption OS must be backed up with the important infrastructure.

Ways principles of Open Science evolve within the context of the 5th Industrial Revolution to enhance scholarly communication among academic librarians in Kaduna State, Nigeria

This objective investigated the ways in which the principles of OS evolve with the context of the 5th industrial revolution to enhance scholarly communication among academic librarians in Kaduna State, Nigeria. To actualize this objective, respondents were provided with several options to tick as applicable to the worldview held in relation to the objective. Table 2 provides the details of information from the respondents about the evolvement of OS principles for scholarly communication.

Table 2- Ways principles of Open Science evolve within the context of the 5th Industrial Revolution to enhance scholarly communication

Ways principles of Open Science evolve within the context of the 5th Industrial Revolution to enhance scholarly communication	Frequency	Percentage
Enhanced Research Collaboration and Accessibility	108	47. 5
AI-Driβen Knowledge Management and Automation	136	59.9
Integration of Emerging Technologies for Scholarly Communication	186	81.9
Policy and Institutional Reforms	76	33.4
Bridging the Digital Diβide	134	59.0

Source- Field Survey, 2025

Based on data analysis, 108 (47.5%) of the respondents identified that enhanced research collaboration and accessibility is one of the ways principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication. Also, 136(59.9%) of the respondents in this study specified that AI-driven knowledge management and automation is another way in principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication. Similarly, 186(81.9%) of the respondents specified that integration of emerging technologies for scholarly communication is another way in which principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication. 76(33.4%) of the respondents equally indicated that policy and institutional reforms is also another way principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication. 134(59.0%) of the respondents in this study indicated that bridging the digital divide is one the ways that principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication.

Finding revealed that the ways in which principles of OS evolved within the context of the 5th industrial revolution to enhance scholarly communication are; enhanced research collaboration and accessibility; AI-driven knowledge management and automation; integration of emerging technologies for scholarly communication; and bridging the digital divide. The foundational ideas of OS are been shaped by technologies and societal shifts associated with Industry 5.0, leading to improved, more dynamic, and more accessible ways for scholars to communicate their work. For instance, AI-powered tools might facilitate real-time data sharing, automated peer review, or personalized dissemination of research, making scholarly communication more efficient and impactful in the era of advanced digital transformation. The evolution of Open Science principles within the context of the 5th Industrial Revolution has significantly enhanced scholarly communication by leveraging advanced technologies such as AI, big data, and digital platforms, which in turn have fostered more effective research collaboration and increased accessibility to knowledge for a diverse range of stakeholders.

Enhanced research, collaboration, and accessibility is the improvements in how scientific work is conducted, shared, and made available to a wider audience, driven by advancements in technology and open practices. This involves making research processes more efficient, transparent, and reproducible. It includes the use of new tools and methods such as open data, open methodologies, and digital platforms that facilitate better data collection, analysis, and validation, leading to higher quality and more reliable scientific outcomes. Enhanced collaboration is the ability of researchers such as the studied academic librarian across different disciplines, institutions, and countries to work together more effectively. Technologies like cloud computing, online collaboration platforms, and AI enable real-time communication, data sharing, and joint problem-solving, breaking down geographical and disciplinary barriers simplifies collaboration. Enhanced accessibility implies making research outputs such as publications, data, and tools more openly available to everyone, including researchers, policymakers, educators, and the public. Open access publishing, open data repositories, and multilingual platforms help democratize knowledge, ensuring that valuable scientific information is not restricted by paywalls or technical barriers. This is one of the vision of librarianship.

AI-driven knowledge management and automation enable organizations and researchers to handle large volumes of information efficiently, facilitate faster discovery, improve accuracy, and free up human resources for more strategic and creative tasks. AI tools can organize and categorize vast amounts of open access publications, datasets, and repositories, making it easier for librarians to discover and promote open science materials. Automation helps academic librarians to efficiently manage open science workflows, such as tracking open access mandates, monitoring compliance, and updating institutional repositories with open content. AI-driven knowledge management and automation empower academic librarians to efficiently organize, promote, and support open science practices, fostering a more transparent, accessible, and collaborative research environment.

Studies (Leo, 2021;) have been conducted that emphasized the impact of principles of OS in the 5th Industrial Revolution to enhance scholarly communication stating that faculty members and researchers including academic librarians to make their research freely available through open access journals and to resign from publications that keep articles behind paywalls.

This finding implies that academic librarians can leverage open science principles to facilitate greater collaboration among researchers across disciplines and institutions. By promoting open access resources and datasets, librarians help remove barriers to information, making research findings more accessible

Ways emerging technologies can support Open Science initiatives for scholarly communication among academic librarians in Kaduna State, Nigeria

This objective investigated ways emerging technologies can support OS initiatives for scholarly communication among academic librarians in Kaduna State, Nigeria. To actualize this objective, respondents were provided with options to tick as applicable to the reflect opinion about how emerging technologies can support OS for scholarly communication. Table 3 comprise responses to the ways in which emerging technologies can support of open science initiatives for scholarly communication among the studied librarians.

Table 3 -Ways emerging technologies can support Open Science initiatives for scholarly communication among academic librarians in Kaduna State, Nigeria

Ways emerging technologies can support Open Science initiatives for scholarly communication among academic librarians	Frequency	Percentage
Digital Repositories	117	51.5
Collaboration Platforms	124	54.6
Data Sharing and Management	201	88.5
Open Access Publishing	118	51.9
Social Media and Networking	100	44.0
AI and Data Analytics	98	43.1
Training and Workshops	199	87.6
Interoperability Standards	87	38.3
Mobile Applications	129	56.8
Open Metrics and Altmetrics	98	43.1
Community Building	97	42.7
Emerging Technologies Training	119	52.4

Source – Field Survey, 2025

Data analysis revealed that 117(51.5%) of the respondents in this study identified that digital repositories is one of ways that emerging technologies can support Open Science initiatives for scholarly communication among academic librarians. 124(54.6%) of the respondents equally specified that collaboration platforms in also another way in which emerging technologies can support OS initiatives scholarly communications. Likewise, 201(88.5%) of the respondents identified data sharing and management as one of the ways that emerging technologies can support OS initiatives for scholarly communication. Also, 118(51.9%) indicated that open access publishing is one of the ways that emerging technologies can support OS for scholarly communication. 100 (44.0%) of the respondents recognized social media and networking as one of the ways that emerging technologies can support OS initiatives for scholarly communication. 98(43.1) of the respondents indicated AI and data analytics is a way that emerging technologies can support Open Science initiatives for scholarly communication among academic librarians. 199(87.6%) of the respondent signified that Training and Workshops is another way in which emerging technologies can support OS for scholarly communications among academic librarians. 129(56.8%) of the respondents in this study setting specified that mobile applications is another way that emerging technologies can support OS initiatives for scholarly communications. 98(43.1 %) of the respondents equally indicated that open metrics and altmetrics is also a means whereby emerging technologies can support OS initiatives for scholarly communication. Similarly, 97(42.7%) of the respondent also identified community building as one of the ways in which emerging technologies supports OS initiatives for scholarly communication among academic librarians. 119 (52.4) of the respondents equally stated that Emerging Technologies Training is another way in which the technologies can support OS initiatives for scholarly communication.

Based on data analysis, ways that emerging technologies can support OS initiatives are; digital repositories, collaboration platforms, data sharing and management; and open access publishing, training and workshops, mobile applications; and emerging technologies training.

Emerging technologies provide the tools and infrastructure needed to support the core principles of open science, including openness, collaboration, and accessibility. Technologies like improved search engines, semantic web technologies, and sophisticated data visualization tools make it easier for researchers/academic librarians to find and access open research materials. This increases the visibility and use of open science outputs thereby enhancing accessibility and discoverability. Emerging technologies facilitated Data Sharing and Collaboration: Cloud computing, collaborative platforms, and specialized data management tools enable

researchers to easily share data, code, and other research outputs. These technologies can facilitates collaboration among academic librarians by enabling real-time access and modification of shared resources.

Studies (Markowitz, Song & Taylor, 2021; Agboke & Oladokun, 2024) have been conducted on the impact of emerging technologies on the adoption of OS for scholarly communication which reported a significant paradigm shift is underway in communication research as open science practices such as preregistration, open materials are becoming more prevalent. Emerging technologies enable enhanced efficiency, streamlined operations, and broader access to digital resources, promoting inclusivity and improved user engagement (Agboke & Oladokun, 2024).

The implication of this finding is that emerging technologies is becoming an integral feature that can be used to leverage by academic librarian for library services provision.

Role of Academic Librarians in Kaduna State, Nigeria in promoting Open Science within the evolving landscape of the 5th Industrial Revolution

This objective sought to determine the role of academic librarians in Kaduna State Nigeria within the evolving landscape of the 5th industrial revolution. The respondents were provided with options to tick those that aligns with opinion about role played by academic librarians. The information derived through the data analysis is reflected in Table 4.

Table 4- Role of academic Librarians in Kaduna State, Nigeria in promoting OS

Role of Academic Librarians in Kaduna State, Nigeria in promoting Open Science	Frequency	Percentage
Adɓocacy and Awareness	131	**57.7**
Education and Training	170	74.8
Resource Management	103	45.3
Facilitating Collaboration	117	51.5
Data Stewardship	105	46.2
Policy Deɓelopment	92	40.5
Promoting Citizen Science	92	40.5
Engagement with Open Science Networks	75	33.0
Highlighting Local Research	82	36.1
Digital Literacy Promotion	92	40.5

Source – Field Survey, 2025

Data analysis of the role of academic librarians in Kaduna State in promoting open science in the 5th industrial revolution showed that 131(57.7%) of the respondents specified that advocacy and awareness about adoption of open science is carried out among colleagues and library patrons. 170(74.8%) of the respondents stated the role played by the studied librarians in the promotion of OS is education and training to get librarians acquainted with OS principles and practices. Also, 103(45.3%) of the respondents in this study setting indicated that academic librarians studied promote OS through the use of emerging technologies for resource management. 117(51.5%) of the respondents indicated that OS is promoted through facilitating collaboration among scholars. 105(46.5%) of the respondents specified that OS is promoted through data Stewardship. 92(40.5%) of the respondents stated that policy development, promoting citizen science and digital literacy promotion were used by the studied librarians for promoting the adoption of OS principles. 75(33.0%) of the respondents stated that studied librarians Open Science through engagement with Open Science Networks. While 82(36.1%) of the respondents also stated that highlighting local research was used for promoting OS through the advocating and creating awareness of adopting open access for scholarly communications.

Based on data analysis, role of academic librarians in Kaduna State, Nigeria in promoting Open Science were through advocacy and awareness, education and training, resource management; and facilitating collaboration.

Librarians can advocate for Open Science principles by raising awareness among faculty, students, and researchers about the benefits of open access to information, data sharing, and collaborative research practices. This was done through organizing workshops, seminars, and discussions among colleagues to highlight the importance of transparency and accessibility in data sharing and research reports. Likewise, librarians can provide training sessions on Open Science practices, including how to publish open access, manage research data, and utilize open-source tools. By equipping researchers with the necessary skills and knowledge, librarians can enhance the overall capacity for Open Science within academic institutions. Librarians can serve as facilitators for collaboration among researchers, institutions, and even across borders. This is through connecting researchers with similar interests and promoting interdisciplinary projects, they can help create networks that support open collaboration and innovation (Ramachandran, Bugbee & Murphy, 2021). As the importance of data grows in the 5th Industrial Revolution, librarians can offer support for research data management, including data curation, preservation, and sharing. This role can help ensure that data is

accessible and usable, thereby enhancing research transparency and reproducibility. Academic librarians in Kaduna State can help institutionalize Open Science practices, making research more collaborative, transparent, and accessible, ultimately contributing to the advancement of knowledge and innovation in an increasingly interconnected world.

This finding implies that academic librarians in Kaduna State needs to employ other measures such as data stewardship, policy development, promoting citizen science, engagement with open science networks, highlighting local research; and digital literacy promotion for promoting the adoption and use of open science principles and practices for scholarly communication.

Conclusion and Recommendations

The future of Open Science in the 5th Industrial Revolution (5IR) holds immense potential for transforming scholarly communication among academic librarians in Kaduna State, Nigeria. As the research ecosystem advances, the integration of emerging technologies such as artificial intelligence (AI), blockchain, cloud computing, and open-access platforms can serve a catalyst in enhancing accessibility, collaboration, and knowledge dissemination. However, despite these opportunities, challenges such as inadequate digital infrastructure, policy gaps, funding limitations, and resistance to change must be addressed to ensure widespread adoption of Open Science practices.

Based on findings; it recommends;

1. That the management of libraries in Kaduna State, Nigeria should allocate sufficient resources for Open Science initiatives, including infrastructure, training, and open-access publishing for the training of academic librarians
2. Partnership with international Open Science organizations such as LIBSENSE, Nigeria and WACREN, NgREN can provide additional financial and technical support. Universities and library associations should organize workshops, conferences, and training programs to enhance librarians' understanding of Open Science principles and practices. Awareness campaigns should be conducted by LIBSENSE, Nigeria to highlight the benefits of Open Science in improving research visibility and collaboration.
3. To fully harness the benefits of Open Science in Nigeria, academic librarians in Kaduna State, Nigeria must embrace digital literacy, institutional support, and policy reforms that promote transparency, open access, and ethical research practices.
4. Universities and research institutions should invest in capacity-building initiatives and technology-driven solutions that facilitate seamless scholarly communication. By fostering a culture of openness, collaboration, and technological adaptation, Nigerian academic librarians can become key enablers of Open Science in the 5IR, ensuring that research outputs are more accessible, reproducible, and impactful in driving national and global knowledge economies.

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The role of Big Data and Knowledge Management in the 5th Industrial Revolution in Federal University Libraries in Kogi State

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Abstract

The emergence of the 5th Industrial Revolution (5IR) is characterized by the convergence of human-centred innovation and advanced technologies. The research adopts a quantitative research method, data were collected through structured questionnaires distributed to library staff at Federal Universities in Kogi State. The survey focuses on exploring librarian's awareness and perception of big data and knowledge management, identifying how big data and knowledge management are use in the library, the potential of big data in library services, and challenges faced by librarians in integrating big data in library services. The findings reveal a significant correlation between awareness of big data and the adoption of big data analytics and the effectiveness of KM strategies in improving library services. Libraries leveraging big data demonstrated enhanced predictive capabilities for user behaviour, efficient resource allocation, and personalized information delivery. Furthermore, KM practices, such as knowledge sharing, codification, and retention were found to empower staff and streamline decision-making processes. However, the study also identifies challenges such as data privacy concerns, skill gaps, and infrastructural limitations that impede the full realization of big data and KM's potential in university libraries. This research underscores the critical role of big data and KM in redefining the future of academic libraries within the 5IR landscape. It advocates for increased investments in technological infrastructure, capacity-building initiatives, and collaborative frameworks to ensure university libraries remain adaptive, innovative, and human-centric in a rapidly evolving digital age. The study provides actionable insights for policymakers, librarians, and academics seeking to harness the power of big data and KM in fostering sustainable, technology-driven academic environments.

Key words: *Big Data analytics, Knowledge Management, 5th Industrial Revolution*

Introduction

To meet challenges of digital era, university libraries undergo significant transformations to meet the evolving needs of the digital native users who are characterized by their technological advancements and changing educational pattern do technology. To support this assertion Adigun, *et al* (2024) stated that 5th Industrial Revolution (5IR) marks a paradigm shift in the way technology intersects with human values, emphasizing collaboration between advanced digital innovations and human intelligence. Unlike previous industrial revolutions that prioritized automation and efficiency, 5IR seeks to integrate human-centric approaches with technologies such as artificial intelligence, big data, robotics, and the Internet of Things (IoT).

Knowledge management (KM) involves the acquiring, organising, processing and applying knowledge to enhance organisation efficiency and value. Therefore, KM is very vital to harness vast amount of information acquire within and outside the libraries to ensure that valuable knowledge is accessible for staff and users.

In the 5th industrial revolution where libraries strive to remain relevant. Knowledge management (KM) can be view as an important practice for organizations willing to control and manage their knowledge effectively. In the submission of Akanbiemu, (2024) KM involves acquiring, organizing, sharing, and applying knowledge to improve on organizational performance and create value. In the era of big data libraries, particularly academic libraries, KM is a process of managing the vast amounts of datasets or information which is concerted into knowledge and ensuring that valuable knowledge is accessible and useful to internet-based users. Convergence of big data and KM becomes paramount to gain insights into user behaviours, optimize their services, and make data-driven decisions

Big data offers unprecedented opportunities for libraries to analyze vast volumes of user data, optimize services, and anticipate user needs, while KM practices facilitate the systematic handling of knowledge assets to support informed actions and organizational growth. (Kamupunga and Chunting 2019). However, the successful integration of these tools requires not only technological awareness and readiness but also a strategic vision aligned with 5IR principles.

Data are believed to be raw fact, figure or symbols that represent information that is not meaningful until it is processed or interpreted. The word big data literally can be seen as the accumulation of very huge amount of data generated from customer's transaction. Most organisations in the 21stare have adopted ICT such internet, social media sites in their daily activities to be able to meet needs of the internet-based users. This transformation has led to the creation of vast amount of data from different sources in different format. However, this vast amount of data becomes too large that need special techniques to analyse to make sense of it. Fakiragouda (2022) define big data as the huge amount of both structured and unstructured data are generated from different sources like institutional repository, Data base management system (DBMS) and social media. Big data is also described as vast and complex data set that need to be analyse to create better understanding and value to hidden data. (Sonawane, 2018). To put in another Al-Barashdi & Al-Karousi, (2018) posited that big data are the extraordinarily massive and complicated datasets that are generated from different online platform are difficult to handled, managed, or analyzed using traditional data processing tools or method. It was further stressed that for data sets to be regarded as big data it must data that comes in extremely large volume, come in diverse forms and from multiple sources. This kind of data requires big data tools like Hadoop, Spark, NoSQL Databases, Data Warehousing and Data Lakes, Data Mining and Machine Learning to analyse it in order to extract new insights or create new forms of value.

In the data driven age, big data is gaining prominence as a key driver of the Fifth Industrial Revolution. Libraries, as evolving institutions that incorporate both digital and traditional resources, are increasingly generating large volumes and diverse types of data. This growing complexity makes big data analytics essential for effective data management within library systems. Librarians, as information professionals, play a critical role in ensuring access to relevant resources. To keep libraries relevant and competitive, they must understand and adopt big data analytics to improve service delivery and meet the evolving needs of users.

The knowledge of big data is becoming very important in today's data driven environment. Therefore, many organizations have recognized the advantages of collecting as much data as possible. However, it is not enough just to collect and store big data, organisations also have to put it to use. With this growing technological transformation, organizations can use big data analytics to transform terabytes of data into actionable insights. Adding to this submission Gbaje, (2021) stated that managing and extracting meaning information from big data sources has become one of the popular emerging technologies used in scholarly work.

Big data analytics help libraries to transform data into meaningful information, exploit customer-related knowledge from social media, and strengthen innovation capacity (Chierici et al., 2019). Big data analytics can support library services, particularly in managing research data effectively (Anna & Mannan, 2020). In the case of the role of big data in knowledge management, big data analytics can be viewed as a form of knowledge management where explicit knowledge is derived from big data using analytics techniques for knowledge discovery (Wang & Wang, 2024). Big data analytics has significant role in knowledge management in libraries. Big data analytics assist libraries to enhance their performance and innovate their resources, services, and infrastructure (Islam et al., 2020). The ability to conduct in-depth analytics on data and text enables libraries to generate valuable insights for information literacy training and governance, which are crucial for success in the big data era (Ajibade & Muchaonyerwa, 2022). Big data analytics can support library services, particularly in managing research data effectively (Anna & Mannan, 2020). In the context of knowledge management, big data analytics can be viewed as a form of knowledge management where explicit knowledge is derived from big data using analytics techniques for knowledge discovery (Wang & Wang, 2020).

Statement of the Problem

The emergence of the 5th Industrial Revolution is redefining the role of technology in human-centered innovation, and university libraries are not exempt from this transformation. Central to this shift are big data and knowledge management (KM), which have become critical tools for enhancing decision-making, personalizing user services, and fostering innovation in academic libraries. However, despite their growing relevance, there is growing concern that many university libraries in Nigeria, including the Federal University Lokoja (FUL) Library, may not be adequately prepared to harness these tools effectively.

Preliminary observations suggest that librarians' awareness of big data remains limited, raising questions about their readiness to operate in data-rich environments. Moreover, while librarians may hold positive perceptions of big data and KM, it is uncertain whether these perceptions are informed by practical knowledge or experience, or if they translate into meaningful action. Even more pressing is the need to explore the actual potential and applicability of big data and KM in enhancing library services in the FUL context, where traditional systems still dominate.

Furthermore, systemic challenges such as inadequate infrastructure, limited technical expertise, and weak institutional support continue to hinder the integration of innovative technologies into library operations. Without clear insights into these challenges and the extent to which they affect implementation, the library may remain on the periphery of the digital revolution, missing critical opportunities to transform its services and relevance.

It is against this backdrop that this study seeks to investigate the level of awareness, perception, potential, and challenges surrounding the incorporation of big data and knowledge management in the Federal University Lokoja Library. The goal is to provide evidence-based insights that can inform strategic interventions to reposition the library as a forward-looking knowledge hub in the era of the 5th Industrial Revolution.

Research Objectives

1. Explore the level of awareness of big data among librarians in University Library Federal University Lokoja (FUL) Library.
2. Evaluate the perception of Librarians about role of big data and knowledge management FUL library.
3. Identify the Potential of big data and KM in FUL library services.
4. Identify the challenges face by librarians in the incorporation of big data and KM in FUL library services.

Literature Review

The Fifth (IR) industrial revolution is the new emerging technology focusing on collaboration between human and technology such as artificial intelligence (AI), robotics and the Internet of Things Unlike the 4th IR which focused heavily on automation and efficiency, 5IR prioritizes human-centric innovation. According to the study carried out by (Adigun et al., 2024) on The Intelligent Libraries: Innovation for a Sustainable Knowledge System in the Fifth (5th) Industrial Revolution revealed that fifth industrial revolution (IR) is transforming academic libraries, necessitating the integration of big data analytics and knowledge management (KM) practices. Libraries are increasingly adopting advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), and cloud computing to enhance user experiences and improve operational efficiency. Big data analytics and KM are now critical for organizational success in the data-driven world (Ferraris et al., 2019; Al-Alawi & Al-Rashidi, 2024).

Big data presents significant opportunities for academic libraries to enhance services and operations. These include improving collection development, personalizing services, analyzing user behavior, and supporting evidence-based decision-making (Ofori & Cobblah, 2024). Libraries are leveraging big data for service delivery and KM through large-scale network analysis and cloud computing platforms (Liu, 2018). Big data analytics, powered by machine learning algorithms like Support Vector Machines and decision trees, enables visualization and analysis of unstructured data to boost organisational performance (Khan & Vorley, 2017; Al-Alawi & Al-Rashidi, 2024).

Recent studies reveal varying levels of awareness and perception of librarians in adopting big data tools. While some librarians demonstrate strong understanding, others require additional training to build competencies in data mining and analysis (Chigwada & Kasiroori, 2021; Ahmad et al., 2019). Librarians are currently utilizing large volumes of data in operations such as acquisition, preservation, and curation (Ahmad et al., 2019). Their existing skills in cataloging, research, and archiving position them well to offer big data services (Blummer & Kenton, 2018).

KM in digital environment, librarians often perceive it as managing information using technology such as digital documents and databases. They acknowledge its benefits as well as it challenges like lack of understanding, unsupportive culture, and limited resources (Nazim & Mukherjee, 2013). Digital KM is essential for library relevance, and librarians are encouraged to integrate tools like social media and big data in KM practices (Mabunda & Du Plessis, 2022).

Despite the opportunities this technology brings library services, several challenges can also hinder the effective adoption of big data and KM in academic libraries. These include inadequate expertise, limited funding, poor infrastructure, and concerns over data privacy and security (Tella, 2019; Chigwada, 2021; Ofori & Cobblah, 2024). The lack of skilled personnel and insufficient digital inclusion also pose serious barriers, especially in ensuring sustainable implementation (Adigun et al., 2024; Tella & Kadri, 2021).

To overcome these barriers, scholars recommend establishing dedicated big data management sections in libraries, providing specialized training, and encouraging the use of big data tools (Mahesh & N. B., 2021). Academic libraries should invest in reliable data infrastructure, recruit data experts, and collaborate with stakeholders to develop effective data management plans (Tella, 2019; Chigwada, 2021; Ofori & Cobblah, 2024). Building big data management capabilities enhances librarians' innovative performance, particularly when they perceive high value in its use (Zotoo et al., 2020). Library managers must prioritize developing staff capacities to fully leverage big data for innovation and improved services. In the digitally driven environment, academic libraries are redefining their roles through big data and KM.

Librarians, as information professionals and technology adopters, must adapt to emerging demands by acquiring skills in data transformation, visualization, and analysis (Xu et al., 2017; Garoufallou & Gaitanou, 2021). These transformations position libraries as central pillars of education, research, and innovation in evolving knowledge systems (Ibinaiye & Jiyane, 2021).

The awareness and understanding of big data in library services is very important to be able to strive in the 5IR. Readiness to implement big data analytics in academic libraries. Research indicates varying levels of awareness among librarians, with some showing strong understanding and others requiring more training (Mahesh & N. B., 2021).

Adamu, Musa and Muhammad, (2024) revealed that Librarians are generally aware of big data technologies and their potential but lack practical knowledge in applying them. Most learn about big data through social and informal channels, highlighting the need for more structured training and collaboration. The also revealed that the awareness and understanding of big data is strong in areas like data volume and variety but weaker in velocity, veracity, and value. While they recognize big data's benefits for resource and service improvement, there's uncertainty about its role in personalization and retrieval. Key barriers include skill gaps, limited funding, and system incompatibilities.

Librarians' awareness and While many librarians possess essential competencies for big data implementation, there is a need for capacity building to enhance skills in data mining and analysis (Chigwada & Kasiroori, 2021; Ahmad et al., 2019). To address these challenges, recommendations include establishing dedicated big data management sections in libraries, providing training courses on big data skills, and encouraging librarians to use big data applications (Mahesh & N. B., 2021).

Recent studies by Nazim & Mukherjee, (2013) explored librarians' perceptions of knowledge management (KM) and big data in academic libraries. Librarians generally view KM as managing information resources using technology, rather than sharing tacit knowledge In the digital age, KM is crucial for academic libraries to remain relevant, with librarians. Big data management capabilities significantly influence librarians' innovative performance through the mediating effect of perceived value for big data management (Zotoo et al., 2020). Library managers are advised to develop staff capabilities in big data management to enhance innovation and performance (Zotoo et al., 2020). These findings highlight the importance of KM and big data in academic libraries and the need for librarians to adapt to the changing digital landscape. Courage to use technologies like social media and big data (Mabunda & Du Plessis, 2022).

The effective utilization of Big Data holds great promise for strengthening knowledge management practices and improving library services. Big data analytics is a powerful technique that involves collecting, storing, and analysing vast amounts of data to extract valuable insights and facilitate informed decision-making. It encompasses various analytical methods such as descriptive analytics, mining, and predictive analytics, which are particularly useful in analysing large volumes of data, including unstructured data like health documents and clinical records (Batko & Ślęzak, 2022). By processing large datasets, big data analytics can reveal hidden patterns, relationships, and critical information, significantly enhancing decision-making processes . Big data analytics plays a crucial role in different sectors, such as healthcare, where it leverages technologies like data mining, text mining, statistical analysis, and social media analytics to derive meaningful conclusions from complex datasets (Batko & Ślęzak, 2022). In agriculture, big data analytics, combined with data mining tools, can improve predictive capabilities and enhance the Agro-Economy (Rajesh, 2022). Additionally, in the banking sector, big data analytics is recognized as a transformative factor that enhances operational and strategic potential, improving business efficiency and effectiveness (Xu, 2023).

However, challenges such as user privacy protection, data management, and lack of skilled personnel need to be addressed (Ofori & Cobblah, 2024). While big data adoption is evident in academic libraries worldwide, these challenges could potentially hinder its effectiveness (Tella & Kadri, 2021). Librarians' existing skills in cataloging, archiving, research, and reference make them well-suited to provide big data services (Blummer & Kenton, 2018). To maximize the benefits of big data, academic libraries should collaborate with stakeholders, implement effective data management plans, and ensure proper infrastructure is in place (Ofori & Cobblah, 2024). Librarians face numerous challenges in incorporating big data and knowledge management to enhance library services. These include inadequate expertise, funding constraints, poor infrastructure, and data security concerns (Tella, 2019; Chigwada, 2021).). Librarians need to acquire skills in data transformation, analysis, and visualization to effectively utilize big data (Xu et al., 2017). The adoption of big data technologies in libraries is enabling more efficient service delivery, cost reduction, and faster response to user needs (Tella, 2019). To address these challenges, libraries should invest in reliable data storage systems, recruit data experts, and provide training for librarians (Tella, 2019; Chigwada, 2021). As information handlers and technology adopters, librarians must adapt to new roles in the big data era (Garoufallou & Gaitanou, 2021).

Methodology

This study employed a descriptive survey design. The target population consisted of all thirty-three (33) librarians working in the Federal University Lokoja Library. Given the relatively small and accessible population size, the researcher adopted a census approach, which involves studying the entire population rather than selecting a sample. This method is appropriate when the population is manageable and allows for a more comprehensive and accurate representation of the group under study, as supported by research methodology literature.

The instrument for data collection for this research was a self-constructed close ended questionnaire. The instrument was personally administered. Copies of the questionnaire were distributed by hand to the respondents for the study in the federal university lokoja. The Mean and standard deviation was used to analyze the data collected based on the research questions for the study. The real limit of numbers was used in taking decision. Any item with mean range of 3.5-4.00 was considered strongly agreed. Any item with mean range of 2.50-3.49 was considered as Agreed. Any item with mean of 1.50-2.49 was considered as disagreed. Any item with mean of 0.50-1.49 was considered as strongly disagreed.

Result

Level of awareness of big data among librarians in University Library Federal University Lokoja (FUL) Library

Table 1: Awareness of Big Data Among Librarians in FUL Library

S/N	Item Description	Mean	SD	Remark
1	I am familiar with the concept of big data	2.10	0.62	Disagree
2	I haɓe attended a training/workshop on big data	1.85	0.59	Disagree
3	Big data is discussed in library departmental meetings	1.73	0.65	Disagree
4	I understand how big data can be applied in library settings	2.20	0.70	Disagree

Table 1 focused on the awareness of big data among librarians and revealed a generally low level of familiarity with the concept. The mean scores across all four items in the table fell below 2.50, indicating that most respondents disagreed with the statements regarding their knowledge and experience with big data. The librarians reported minimal exposure to trainings or workshops on the subject, little to no discussion about big data, and limited understanding of how it can be applied in the library setting. This shows a significant gap in foundational knowledge and practical awareness, which may hinder early adoption or meaningful engagement with big data tools.

Table 2: Perception of Librarians About the Role of Big Data and KM

S/N	Item Description	Mean	SD	Remark
1	Big data helps in improɓing library serɓice deliɓery	3.76	0.43	Strongly Agree
2	Knowledge management supports effectiɓe decision-making	3.58	0.49	Strongly Agree
3	Big data and KM are essential in the 5th Industrial Reɓolution	3.82	0.38	Strongly Agree
4	I belieɓe the library can benefit from KM systems	3.69	0.52	Strongly Agree

In contrast, Table 2 assessed the perception of librarians regarding the role of big data and KM in library services. Interestingly, despite their limited awareness, respondents had a very positive perception of the importance of these technologies. All items in the table recorded high mean scores above 3.50, placing them in the "strongly agree" category. This suggests that librarians conceptually understand the relevance of big data and KM in enhancing library operations and see them as critical tools for improving service delivery, supporting innovation, and aligning the library with modern technological trends.

Table 3: Potential of Big Data and KM in FUL Library Services

S/N	Item Description	Mean	SD	Remark
1	Big data can help personalize library serɓices	3.60	0.58	Strongly Agree
2	KM tools can enhance collaboration among librarians	3.52	0.63	Strongly Agree
3	Data analytics can improɓe resource acƙuisition and user engagement	3.47	0.59	Agree
4	Integration of big data and KM can foster innoɓation in library serɓices	3.71	0.51	Strongly Agree

Table 3 examined the perceived potential of big data and KM in improving specific areas of library services. The results indicated that respondents agreed or strongly agreed that these technologies have practical value in improving personalized services, fostering internal collaboration, supporting decision-making, and driving innovation. The consistency in the high mean scores reinforces the idea that librarians believe in the transformative power of big data and KM, even if they have not yet fully engaged with them in practice.

Table 4: Challenges Faced in Incorporating Big Data and KM

S/N	Item Description	Mean	SD	Remark
1	Lack of technical skills among library staff	3.69	0.47	Strongly Agree
2	Inadeƙuate infrastructure and ICT tools	3.73	0.41	Strongly Agree
3	Poor funding and budget allocation for technology	3.61	0.56	Strongly Agree
4	Limited management support for digital transformation	3.32	0.64	Agree

Table 4 identified the challenges librarians face in trying to integrate big data and KM into the FUL Library. The findings revealed strong agreement across all items, with mean scores generally above 3.50. The major challenges highlighted included a lack of technical skills, poor infrastructure, limited funding, and insufficient support from university leadership. These findings align with the low levels of awareness observed in Table 1, suggesting that these challenges are not only perceived but are already impacting the ability of the library to implement new technologies.

Discussion of findings

The findings from the data analysis indicate a significant knowledge gap regarding big data among librarians in the Federal University Lokoja (FUL) Library. The analysis of Table 1 showed that most librarians have low awareness and understanding of big data, with mean scores below 2.50, reflecting disagreement on familiarity with the concept, prior training, and application in library services. However, data from Table 2 revealed that despite this low awareness, librarians hold a highly positive perception of the role of big data and knowledge management (KM) in library development, with mean scores above 3.50. Table 3 further showed that respondents agree on the potential benefits of big data and KM in enhancing personalized services, collaboration, and innovation in the library. In contrast, Table 4 highlighted major barriers such as limited technical skills, poor infrastructure, inadequate funding, and weak managerial support as significant obstacles to implementation.

From a theoretical standpoint, the findings align with the broader knowledge-to-practice gap observed in emerging technological adoption within traditional institutions. Librarians in this study demonstrate an openness to innovation and a positive worldview about the utility of big data and KM. This optimism, despite a lack of operational knowledge, reflects a mindset that is conducive to institutional learning and transformation. The findings suggest that the librarians at FUL possess the right attitudinal orientation needed to support digital innovation, provided that the enabling environment—training, infrastructure, and managerial backing—is put in place. This is critical in the 5th Industrial Revolution, where human-centered integration of advanced technologies relies heavily on the knowledge and willingness of stakeholders to embrace change.

These findings are consistent with earlier studies. For instance, Okon and Etim (2021) found that librarians in Nigerian universities generally support the adoption of emerging technologies but often lack the technical competence to apply them effectively. Similarly, a study by Aina (2019) revealed that while awareness of knowledge management tools was low among university librarians in West Africa, there was a general belief in their potential to improve information service delivery. The challenges identified in this study—such as funding, skills gap, and infrastructure—mirror the structural issues commonly reported in the literature on technology adoption in developing countries' academic libraries. These parallels affirm the persistence of systemic constraints that must be addressed to translate perception into practice.

The implication of these findings is that for big data and KM to be effectively adopted and utilized in university libraries, institutions must move beyond awareness campaigns to tangible investments in human capacity and technological infrastructure. The disconnect between perception and awareness observed in this study suggests that librarians are willing to embrace digital transformation but are hampered by external limitations. This means that university management, policymakers, and stakeholders must prioritize strategic interventions that equip librarians with the requisite skills and tools. Without such deliberate efforts, the library's ability to participate in the 5th Industrial Revolution and provide innovative, data-driven services may remain unrealized.

Conclusion

Big data and knowledge management work together to transform library operations, making information more accessible, organized, and actionable. While big data provides the tools to collect and analyze large datasets, knowledge management ensures that insights derived from these data sources are effectively used to enhance library services, decision-making, and knowledge dissemination. This study explored the awareness, perception, potential, challenges, and strategies for integrating big data and knowledge management (KM) in the Federal University Lokoja Library, within the context of the 5th Industrial Revolution. The findings revealed a significant gap in awareness and practical knowledge of big data among librarians, with most respondents lacking formal training or exposure to its applications. However, despite this low level of awareness, there is a strong positive perception regarding the importance and potential benefits of big data and KM for enhancing library services. The librarians recognize these tools as vital for innovation, personalization of services, improved collaboration, and strategic decision-making.

Nonetheless, the integration of big data and KM is hindered by several challenges, including inadequate technical skills, poor infrastructure, limited funding, and insufficient managerial support. These barriers suggest that while the library is conceptually prepared to adopt these technologies, it is not yet operationally equipped. The study concludes that without deliberate efforts to address these challenges, the potential of big data and KM in transforming university libraries may remain largely untapped.

Recommendations

1. To improve awareness of big data among librarians, it is recommended that the Federal University Lokoja Library develop and implement targeted awareness programs such as seminars, sensitization campaigns, and knowledge-sharing sessions. University management should develop and implement clear policies and frameworks that support the integration of big data and KM into library operations, aligning them with broader institutional digital transformation goals.
2. Given the positive perception of librarians regarding the role of big data and knowledge management, university management should build on this attitude by integrating big data and KM concepts into strategic library planning and operations. Adequate funding should be allocated specifically for big data and KM initiatives in the library, covering training, infrastructure, research, and pilot projects.
3. Considering the potential of big data and KM to enhance library services, the university should invest in small-scale pilot projects that demonstrate practical applications of these technologies. For example, implementing data-driven user analytics to improve personalized services or using knowledge repositories to support collaborative staff work.
4. In response to the challenges identified—particularly the lack of technical skills, inadequate infrastructure, and poor managerial support—it is recommended that the university provide sustained professional development and capacity-building initiatives. This includes in-service training, sponsored certifications, and digital literacy programs tailored to library staff

By taking these steps, university libraries, particularly at Federal University Lokoja, will be better positioned to harness the power of big data and knowledge management to drive innovation, improve services, and stay relevant in the era of the 5th Industrial Revolution.

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Training and Funding of University Libraries for the Adoption of Metadata Mapping and Aggregation Technologies in Federal Universities in Nigeria

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Abstract

This study investigated Training and Funding of University Libraries for the Adoption of Metadata Mapping and Aggregation Technologies in Federal Universities in Nigeria. The study aimed at finding the training opportunities the library offer on the issues of metadata mapping and aggregation practices, skills the library staff gain from the training and the sources of funding the university libraries to finance the practices. Cross-sectional survey research design was adopted for data collection. Forty three (43) federal universities in Nigeria formed the population of the study. Using six geo-political zones of Nigeria, the study divided the federal universities in Nigeria into six strata, the proportion of 40% of the federal universities from each stratum was selected using stratified simple random sampling technique which gave eighteen (18) federal universities as the sample of the study. Qualitative data through the use of semi-structured interview was collected. The responses were analysed thematically. Findings of the study revealed that majority of the libraries have no any training opportunities in relation to this. Though some universities sponsor some of their staff to attend LRCN which also takes care of these aspects, a large percentage of the libraries engage in training and re-training through internal workshop, university Information and Communication Technology Centre (ICTC), stakeholders meeting, Training of Trainers, and international virtual training. The study discovered that few staff gain technical skills of computers with which they mentored paraprofessionals, paraprofessionals and library assistants towards that. Other skills listed were skills on excel, Microsoft and SPSS; skills on the provision of adequate storage in doing backup and recovery services, skills on efficient systems management services, skills on migrating to new version of Dspace, skills on how to edit items, modify metadata at any stage, skills of being more conversant with the metadata issue. For the Sources of funding to finance the practices of metadata mapping and aggregation, the study revealed that majority rely on Tetfund as their source of funding. Other source of funding as indicated was overdue charges, then the university itself through the statuary allocation given to the university library, and lastly volunteer philanthropists. The study recommend for the federal government agencies and university administrations to prioritize the adoption of these technologies by providing the necessary policies, funding, and support; collaborations with private sector companies and international organizations for additional funding and expertise, university administrators should also seek alternative funding sources such as grants, donations, and partnerships with international organizations, and continuous training and professional development programs among others should be put in place to address the gaps in technical skills and knowledge.

Keywords: *Training, Funding, University Libraries, Metadata, Technologies, Nigeria*

Introduction

Academic library is very important sector of tertiary institution and university libraries funding have continue to dwindle since mid-1980s along with downturn in the economic fortunes of Nigeria, this has resulted in deterioration of the quality of resources, services and technology in the library (Okiy, 2010). The implication of this that many tertiary institution libraries have not been able to acquire collection comprehensively enough to meet the need of their users.

University libraries should ensure training for their staff to ensure that the librarians possess necessary skills to implement Mapping and aggregating successfully. In Nigeria, Kogi State particularly, Anyim (2018) discovered the areas in which improvement and innovation are needed to enhance information retrieval in university libraries, they include: training and support of users in information retrieval skills. Libraries should ensure training for their employees to ensure that they possess necessary skills to implement mapping and aggregation successfully. These skills include technical skills, training skills, server provider management skills, security skills, knowledge of laws and regulations, project and change management skills, business and finance skills, enterprise architecture and business analysis skills as well as data integration and analysis skills. Zeng, Lee and Hayes (2012) identified that training is critical to not only non-library professionals and non-cataloguers, but also the cataloguers who have been trained only in more traditional conventions.

Libraries should arrange training for their IT staffs in order to equip them with the necessary skills for its implementation. This will ensure that the staffs are able to tackle any issues that arise in a professional manner and avoid any problems that could have occurred as a result of lack of necessary skills.

Scholars like Taylor and Francis (2013) pointed out areas in which improvement and innovation are needed to facilitate access to and retrieval of e-resources include improved user interfaces for accessing library-surfaced content; more training and support in information literacy skills for students and faculty members.

Considering the role that metadata plays in the management of information, The Queensland Government (2010) proposed that agencies must provide appropriate support and training to users of metadata and in order to allow for the use of different metadata schemas without compromising the ability to store and use all metadata records collectively; metadata managers must understand the relationships between metadata schemas and their elements.

Financial resource is fundamental in a library system. The degree of financial adequacy determines the effectiveness of the library. Ifidon (2006) states that as it stands now there is no known financial standard of for the library development. The situation is more precarious in academic libraries as what is regarded as Information Technology innovation budget is a will guess or an approximation of imagination. Roseroka (2010) identified budgetary process and academic support as constraint facing university libraries.

Parankusham and Madupu, (2006) stated that most of the business users are not aware about the concept of metadata repository or data warehousing in general, unless some user takes training in the tool. Nwalo (1997) opined that the poor state of funding of academic library in Nigeria its most likely that the provision of library resources and services that depend on finance will be adversely affected it's assume that it affect the main libraries in Nigerian universities may likely affect the departmental libraries too. Without an appropriate assessment of performance of departmental libraries, the effect cannot be manifest.

Okoro (2005) asserted that libraries are thus starved as of vital funds that should be used in developing their collection. Academic libraries cannot be affectively developed without enough funds. Inadequate financial support to academic libraries has much negative impact on resources development for the development of the libraries.

Metadata technologies have become a critical part of the library environment particularly in information retrieval and it brings tremendous benefits to organizations and individuals users to access knowledge more efficiently. The benefits includes provision of access through numerous metadata standards to many users. Moreover, libraries around the world are moving at fast rate to provide such services in order to meet changing user need and requirements, the trend in Nigeria is for the libraries to provide training and funding that user can benefit from such practices. It is against this background that this study was designed to examine the training and funding of university libraries for the adoption of metadata mapping and aggregation in federal universities in Nigeria with a view to find out the training opportunities and funding sources so that laudable solutions for effective metadata mapping and aggregation in these libraries can be performed.

Review of Related Literature

Concept of metadata mapping and aggregation

The term metadata was coined from two Greek words “meta” which is used to mean “about” and “data” which means information. According to Yahaya (2024) Metadata is defined as the data providing information about one or more aspects of the data; it is used to summarize basic information about data. According to the American Library Association (2018), metadata is descriptive information about a particular data set, object, or resource, including how it is formatted and when and by whom it was collected. As defined by National Information Standards Organization (2004), metadata is any structured information that describes, explains, locates, or otherwise makes retrieving, using, or managing an information resource easier.

Metadata mapping refers to a way of associating the metadata elements in one schema to the equivalent elements in another schema. It also implies moving metadata from one format to another so as to improve on informational processes including creation, capture, classification, storage, preservation, access and security, disposal, searching and reporting.

The term aggregation however, means “the act of collecting together”. To aggregate means to bring together or to collect into a mass or sum. In a networking language, an aggregation means summarizing multiple routes into one route. Therefore, Metadata aggregation refers to a process where metadata records from different sources and in different formats are aggregated into one common format (Gavrilis, 2016). Metadata aggregation is all about curtailing complexities of information retrieval that are caused by large amounts of data, too many formats, too many mapping variations

Training Opportunities

Training involves improvement of the individual's performance for a particular job which focuses on the development of his/her ability to reach full potential (Abubakar & Yahaya, 2024). As an activity which is designed to improve human performance on the job, it is viewed as experience, or a discipline which causes persons to acquire new predetermined behaviors.

Training aims at improving knowledge, skills, attitudes and behaviors change in people to accomplish certain jobs, tasks or goals. Professional training programmes plays a crucial role in the development and growth of organizations. It is an organized method of improving employees to enhance their performance and contribute to their overall success of the organization. Despite all these potentials, Adeleke (2016) found that in Nigeria, digitization projects have not reached its full capacity. He further attributed this to lack of skill sets and competencies and lack of formal professional training.

Taylor and Francis (2013) pointed out areas in which improvement and innovation are needed to facilitate access to and retrieval of e-resources. These include; improved user interfaces for accessing library-surfaced

content; more training and support. Moreover, Zeng, Lee and Hayes (2012) suggested that good metadata creators are in high demand. Training is critical to not only non-library professionals and non-cataloguers, but also the cataloguers who have been trained only in more traditional conventions.

The Queensland Government (2010) proposed that agencies must provide appropriate support and training to users of metadata and in order to allow for the use of different metadata schemas without compromising the ability to store and use all metadata records collectively; metadata managers must understand the relationships between metadata schemas and their elements.

Skills for metadata mapping and aggregation practices

It is obvious to note that the successful metadata mapping and aggregation practices depends on the contribution of the skills acquired by the librarians working at the various universities. Atinmo (2011) to posit that cataloguers must go beyond the ordinary and become knowledgeable in the use of new and emerging technologies, multimedia applications, systems analysts and systems maintenance. She also emphasized that; cataloguers should master the use of existing metadata schema such as Dublin Core and/or be able to create in house metadata elements to describe digital documents. Thus, there is a need for Nigerian libraries to embrace metadata application in their effort to comply with the submission of (Miller, 2004) that, one should actively be engaged in the ongoing process of ensuring that the systems, procedures and culture of an organization are managed in such a way as to maximize opportunities for exchange and re-use of information.

In Italy, Cassella and Morando (2012) conducted a survey and explored the skills of repository managers and administrators. Their findings showed that highly specialized competencies were required to deal with copyright issues, metadata expertise and technical skills on interoperability standards and protocols. The main challenge for repository managers in Italy was the rising of internal stakeholders' awareness. They then suggested a focus of attention on internal advocacy initiatives, including training courses. Similarly, in Australian and New Zealand, Simon and Richardson (2012), found significant gaps in the provision of formal training related to institutional repositories. They further identified a specific set of skills and knowledge required to work on a digital repository to include collection management skills which translates their ability to Identify and manage copyright issues**,** Monitor metadata quality; use metadata sets and liaise with clients.

Mehsafar (2004) opined that it became apparent for library professionals to master the unique characteristics of electronic resources in terms of location, document version, instability and redundant data in using traditional schemas such as cataloguing rules. Scholars like Igwesi (2010) observed that librarians in Nigeria particularly, have not yet acquired the skills necessary for digitization especially related to metadata creation. However, Mathew and Baby (2012) studied technology skills from library professionals in seven universities in Kerala, India. These skills include: word processing, desktop publishing, use of bibliographic software packages, spreadsheets, graphics, packages, bulletin-board, familiarity with data and file manipulation, maintaining www files, troubleshooting and familiarity with local automates systems. The study further showed that lack of training in ICT applications was a main hindrance.

Funding for metadata mapping and aggregation practices in Libraries

In the noble profession of information today, every effort is being made to embrace the new methods of information service provision. The ever increasing advances in technology has made it necessary for the information professionals to either shape in or ship out as they cannot remain static. One of these advances which have gained popularity recently is the adoption of metadata mapping and aggregation which is now affecting the ways libraries and information centers respond to the needs of their clients. Specifically mapping and aggregating metadata can be used to enhance the level of librarian-user engagement especially in information retrieval processes. In view of the benefits, it is pertinent to advocate for effective funding of such innovation in our modern libraries especially for the benefit of users university libraries. Scholars like Boydston and Leysen (2014) noted that the amount and level of the creation of metadata for digital resources varies with each institution based on personnel, organization, and funding. Chinware (2017) identified challenges facing digital projects in Africa to include funding, human resource training, retention skills, lack of commitment from management, internet connectivity, telecommunication infrastructure, copyright and lack of competent trainers. According to Igun (2013), implementation of any practice requires adequate funding of the libraries. The author further added that librarians have to advocate for adequate financial investment in the ICT-based libraries by the stakeholders and government.

Adigun (2015), stated that the greatest challenge facing libraries in Nigeria is that of funding. Similarly, Ezeani and Ezeama (2011) emphasized that the major challenge of digital skills acquisition among Nigerian Librarians are poor ICT infrastructure, poor funding of libraries and irregular power supply. In Nigeria, Kogi State particularly, Anyim (2018) discovered the areas in which improvement and innovation are needed to enhance information retrieval in university libraries, they include: training and support of users in information retrieval skills.

Research Questions

1. What training opportunities the libraries offer on the issues of metadata mapping and aggregation practices?

2. What skills the university library staff gain from the training?
3. What are the sources of funding the university libraries to finance the practices of metadata mapping and aggregation?

Methodology

This study adopted cross-sectional survey research design for data collection. Forty three (43) federal universities in Nigeria formed the population of the study. Using six geo-political zones of Nigeria, the study divided the federal universities in Nigeria into six strata, the proportion of 40% of the federal universities from each stratum was selected using stratified simple random sampling technique which gave eighteen (18) federal universities as the sample of the study. A semi-structured interview was conducted with the university librarians of the sampled federal universities. Their responses were then sorted, organized and coded from P1-P18 for easy identification. At the same time, the responses from the interviews are organised thematically. For the analysis of the data, thematic analysis was used. Thematic analysis enables the researcher to evaluate problems of investigation and consequently report the findings under common themes. This involves getting familiarized with the data, generating the initial codes, creating the initial themes, naming and defining the themes and writing a final report (Nowell, Norris, White and Moules, 2017).

Results of the study

The analysis and interpretation of data obtained from interview with participants in the federal university libraries in Nigeria *are presented as follows:*

Table: Research participants and their coding

S/N	*Name of University*	*Code*
1	ATBU Bauchi	**P1**
2	Federal Uniβersity Gashua	**P2**
3	Federal Uniβersity Kashere	**P3**
4	Federal Uniβersity Lafia	**P4**
5	Federal Uniβersity of Technology, Minna	**P5**
6	Uniβersity of Jos	**P6**
7	Federal Uniβersity of Petroleum Resources Effurun	**P7**
8	Uniβersity of Calabar	**P8**
9	Uniβersity of Uyo	**P9**
10	Federal Uniβersity of Technology, Owerri	**P10**
11	Uniβersity of Nigeria Nsukka	**P11**
12	Obafemi Awolowo Uniβersity Ile-Ife	**P12**
13	Uniβersity of Ibadan	**P13**
14	Uniβersity of Lagos	**P14**
15	Ahmadu Bello Uniβersity Zaria	**P15**
16	Federal Uniβersity Dutse	**P16**
17	Federal Uniβersity Dutsimma	**P17**
18	Usman Danfodio Uniβersity Sokoto	**P18**

Source: Field work (2022)

Presentation of data collected from semi-structured interviews

This section presents and discusses the data collected through a semi-structured interview for the study, using thematic analysis. Data was obtained thematically, using the following criteria: kinds of training opportunities available for metadata mapping and aggregation, and sources of university funding for the adoption of metadata mapping and aggregation activities. In analyzing and reporting the data collected, the following themes were emerged and used to report the findings of the study:

Theme 1: Training opportunities offer to librarians on the issues of metadata mapping and aggregation practices

Researcher *"Please Sir, share with me the kind of training opportunities you offer to your staff on the issues of metadata mapping and aggregation practices"*.

From the interview with the participants, P1, P3, P6 and P8 responded "Not yet". Their responses show that presently, they have no any training opportunities in relation to this". P4 pointed out since they have not really commence the project so they are yet to engage in training our staff on that, P5 responded that *"for now they have not yet anything, but they try as much as possible to sponsor some staff especially paraprofessional to attend LRCN, and LRCN also takes care of these aspects in librarianship"* , P7 engages in " Training and re-training and internal workshop for library staff", P10 responded that " the training is provided through FUTO Information and Communication Technology Centre (ICTC) so as to supplement in-house skills, network administration and management of the project", P11 tries to call the stakeholders meeting and then offer them training after which they try to scale it down to other staff, so we encourage Training of Trainers, P12 has an existing in-house training process that guide their staff and equally have international virtual training that they used to attend" P15 encourages staff training on OPAC as an aspects of metadata aggregation', P16 maintained that "very much benefited". These findings justify the submission of Diao and Hernandez (2014) who stated that through collaboration with other metadata professionals, librarians may be able to turn metadata creation into community practice with individual engagement at different professional levels.

Theme 2: Skills the librarians gain from the training

Researcher *"If yes to the availability of training what other skills do you think your librarians gain from the training?"*

As indicated by the majority of the participants, no any training exist on metadata. However, few like P5 responded that **"**These Include technical skills of computers and even the paraprofessionals have been mentored towards that because in their e-library section, they also incorporate paraprofessionals; library assistants that they now mentor them so that in a situation whereby the professionals or heads of the units are not around, such paraprofessionals and those people from computer science will take charge" **,** P7 listed the availability of skills to include " excel, Microsoft and SPSS", P10: identified skills on the provision of adequate storage in doing backup and recovery services, skills on efficient systems management services, skills on migrating to new version of Dspace, skills on how to edit items where required, modify metadata at any stage in line with metadata working paper and many more, P11 maintained that "they are more conversant with the metadata issue so the future that will enable a user to easily locate the materials and then get the information that the users may be looking for", P12 was of the opinion that their staff gain additional insight and new updates regarding the subject matter", P16 responded that "at the moment no any little fund to entertain the training but planning in future to attend such outside the library". This finding corroborates the submission of Igwesi (2010) who observed that librarians in Nigeria particularly, have not yet acquired the skills necessary for digitization especially related to metadata creation. The finding could also be attributed to the study of Adeleke (2016) who found that in Nigeria, digitization projects have not reached its full capacity. He further attributed this to lack of skill sets and competencies and lack of formal professional training.

Theme 3: Sources of funding the practices of metadata mapping and aggregation

According to the participants, P3 responded "library development Tetfund" as their source, P5 responded that "they have Tet-fund support in-kind not in-cash because they don't bring money to them. Secondly they have overdue charges and the money realized is being used to finance such digital services and number 3 is the university itself through the statuary allocation given to the university library, P7 opined their source of funding to include " University management and Tetfund", P10 responded that the university management and Tetfund are the major sources of fund in addition to volunteer philanthropists, P11 maintained that "the chief of all is the Tetfund for digitization which involves all these metadata practices", P12 was of the opinion that " the entire funding processes come from management".

Discussions of findings

With respect to training opportunities offer to librarians on the issues of metadata mapping and aggregation practices, the study established that majority of their responses show that presently, they have no any training opportunities in relation to this. Though some *sponsor some of their staff especially paraprofessional to attend LRCN, and LRCN also takes care of these aspects*. A large percentage of the libraries engage in training and re-training through internal workshop, university Information and Communication Technology Centre (ICTC), stakeholders meeting, Training of Trainers, and international virtual training. This justifies the submission of Diao and Hernandez (2014) who stated that through collaboration with other metadata professionals, librarians may be able to turn metadata creation into community practice with individual engagement at different professional levels.

In response to the Skills the librarians gain from the training, the study discovered that few gain technical skills of computers with which they mentored paraprofessionals, paraprofessionals and library assistants towards that. Other skills listed were skills on excel, Microsoft and SPSS; skills on the provision of adequate storage in doing backup and recovery services, skills on efficient systems management services, skills on migrating to new version of Dspace, skills on how to edit items where required, modify metadata at any stage, skills of being more conversant with the metadata issue so the future that will enable a user to easily locate the

materials and then get the information that the users may be looking for. This finding corroborates the submission of Igwesi (2010) who observed that librarians in Nigeria particularly, have not yet acquired the skills necessary for digitization especially related to metadata creation. The finding could also be attributed to the study of Adeleke (2016) who found that in Nigeria, digitization projects have not reached its full capacity. He further attributed this to lack of skill sets and competencies and lack of formal professional training.

For the Sources of funding to finance the practices of metadata mapping and aggregation, the study revealed that majority rely on Tetfund as their Source of funding. Other source as indicated was overdue charges are used to finance such services, then the university itself through the statuary allocation given to the university library, and lastly volunteer philanthropists.

Conclusion

Implementing effective metadata mapping and aggregation technologies in Nigerian federal universities will significantly enhance the accessibility and management of academic resources, contributing to the overall quality of education and research in the country. Thus, librarians and IT staff must be aware of the importance of metadata mapping and aggregation, which involves the harmonization of various metadata schemas to ensure that resources can be searched, accessed, and retrieved across different systems. Therefore, training programs should focus on the technical aspects, including the use of specific tools and software for metadata mapping (e.g., Dublin Core, MARC, MODS) and aggregation platforms (e.g., Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). Understanding data curation, quality control, and the standardization of metadata records are essential to ensure that the aggregated data is accurate and usable. The training should also foster collaboration between different departments within the university, and even across universities, to standardize metadata practices.

Moreover, significant investment is needed for the technological infrastructure, including servers, databases, and high-speed internet connections to support metadata mapping and aggregation activities. Funding should also support Research and Development to explore new technologies and methodologies in metadata mapping and aggregation, ensuring that Nigerian federal universities remain at the forefront of digital library innovations. Adequate funding must be allocated for hiring and retaining skilled personnel, including metadata specialists, data scientists, and IT professionals. Continuous professional development through workshops, seminars, and advanced training programs requires funding. This includes collaboration with international organizations for knowledge exchange and capacity building. In addition, licensing and maintenance of specialized software tools for metadata mapping and aggregation require ongoing financial support.

Recommendations

Based on the findings of the study, the following recommendations were proposed:

1. Federal government agencies and university administrations should prioritize the adoption of these technologies by providing the necessary policies, funding, and support.
2. Collaborations with private sector companies and international organizations can provide additional funding and expertise.
3. Implementing pilot projects in selected federal universities can serve as a model for wider adoption across the country
4. Government and university administrators should seek alternative funding sources such as grants, donations, and partnerships with international organizations.
5. To overcome resistance, it is important to emphasize the long-term benefits of metadata technologies, including improved access to research resources and enhanced global visibility.
6. Continuous training and professional development programs should be put in place to address the gaps in technical skills and knowledge

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Training for Librarians on the Use of Information and Communication Technologies in Tertiary Institutions in Kebbi State in the Fifth Industrial Revolution Era

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Abstract

The main purpose of this study is to determine the training methods adopted by librarians on the use of ICT in Tertiary Institutions in Kebbi State, Northwest, Nigeria. The study was conceived against the background of the importance of ICT in library services especially in the era of fifth industrial revolution and how librarians as information practitioners are being trained to effectively apply it in their routine services. Five research objectives guided the study that seeks to identifying the ICT skills required for training librarians in Tertiary Institutions in Kebbi State, Identify the methods librarians employ to acquire ICT skills; determining the extent to which the training methods are effective in library service delivery; identifying the deficiencies in ICT training methods employed by the Librarians; proffer strategies towards effective training methods in ICT by librarians in the Tertiary Institutions in Kebbi State. The study used the survey research method. The entire population of 46 librarians used for the study. The questionnaire was the instrument used to collection. The data was presented in tables and analyzed using frequency and simple percentages. Findings revealed that training in computer centre, seminars/workshops, teaching by friends, in-house training, training in commercial cafes and self-teaching are methods employed by librarians to acquire ICT training. However, the method found to be effective are training in computer centre, training in commercial cafes, self-teaching, teaching by friends and in-house training. The study recommended among other things that all the librarians must obtain ICT skills using suitable training methods to be a tune with the current innovation and changes brought by the Fifth Industrial revolution. Internet service providers should provide strong services to accommodate wide variety trainees demand and qualified system engineers should be engaged to ensure regular maintenance of ICT facilities.

Keywords: Training, Librarians, ICT, Tertiary Institutions, Fifth Industrial Revolution (IR5.0).

1. Introduction

The role of the library in the information age and the place of ICT in an effective information provision and its wide acceptance in most tertiary institution underscores the urgent need for training of librarians in ICT use especially in the era of 5th Industrial Revolution. This is particularly true when viewed from the background that no matter how important a technology is, it is worthless or inactive without the human agent to apply and manipulate it, Ugwuja, (2012). Librarians therefore, as managers of library resources stand conspicuously at the center of ICT application in libraries, (Lodico, 2016). The emergence of powerful technologies, vast amounts of information in multimedia and other digital formats and more technologically talented users means that librarians, particularly those in the tertiary institutions in Kebbi State are faced with the great challenge of dealing with information revolution, (Khalid, 2017).

Information and Communication Technology (ICT) is unarguably man's foremost scientific invention and will remain so indefinitely. It has revolutionized every human activity with a far-reaching impact on knowledge than Guttenberg's invention of the printing press in the 15th century, a development which liberalized literacy, (Ekoja, 2017). UNESCO defined Information Technology (IT) as "the scientific, technological and engineering disciplines and the management technique used in information handling and processing; their applications; computers and their interactions with man and machines; and associated social economic and cultural matters" (Audu, 2016). Henderson cited in Anunobi, (2015) recorded the benefits of ICT to library users. These include provision of speedy and easy access to information, provision of remote access to users, provision of round – the – clock access to users, access to unlimited information from different sources and providing more current information. Indeed, ICT hold the key to effective and more appropriate library operations in this information age, (Ahmed, 2017).

Bello (2017) noted that the introduction of internet is one of the greatest wizardry of the current ages. He defines it simply as "a global network of numerous computers and computer networks all over the world". It allows users to access information over the network. Information can also be exchanged, stored and retrieved. Bello listed the tools of the internet to include; electronic-mail (E-mail). File transfer protocol; telnet, use net news; and World Wide Web (www). Daniels and Matthew (2020) describe the new development as tools for information delivery in the new millennium. They enumerated the tools as follows: internet; www, e-mail, bibliographic control tools; online searching; creativity and innovations and the new information professionals. In the views of Oketunji as cited in Anunobi, (2015), ICT resources available for library include: personal computer; Compact Disk-Read-only-memory (CD-ROM); telefascimile (fax); network; electro copying (scanning); and internet. Other ICT resources applicable in tertiary institution could include; storage devices like optical and magnetic disks, printers, television, video recorder, taper recorder etc.

Tertiary institution could apply varieties of telecommunication networks for different purposes; like the Local Area Network (LAN) to link the terminals within a library house-keeping system, Wide Area Network (WAN) to connect databases in remote systems, National data and voice networks to access videotext and telephone calls, and broadcast services to receive teletext, (Afolabi, 2019). These entire networks enhance interconnection and easy access to information. The main purpose of networking of tertiary institution's library are to facilitate the exchange of bibliographic records, publication and distribution of electronic journals and other documents; making resources available in the databases to individual libraries and users; revealing the contents of a large number of libraries or a large number of publications using on-line public Access Catalogue (OPAC) interfaces, (Mahmood, 2022).

Statement of the Problem

Information and Communication Technology has unstoppably revolutionized every sphere of human endeavour including of course the library. Indeed, the library appears to be its primary constituency as the technology is purely information. The global practice in library and information management is fast moving into the electronic platform. Tertiary institution, particularly in the Kebbi State of Nigeria increasingly face the danger of becoming obsolete and irrelevant if they remain in the purely conventional terrain, hence the digitization efforts. However, this paradigm shift has necessitated that individual librarians adjust accordingly by obtaining relevant ICT competencies. This is the only way they can affect the migration and sustenance of their resources in a networked environment, as well as remain relevant themselves.

The need for librarians to obtain ICT skills is particularly compelling in view of their role as the interphase between information resources and users. This is Moreso that operational activities in computerized libraries are becoming increasingly sophisticated, as new technologies are displayed to offer users the options to search for required information online or through internet access. Most users seeking information are unskilled in the use of ICT facilities and therefore depend on the librarian's expertise in accessing the information. It will be a disaster therefore, if librarians are incapable of meeting this noble obligation.

Previous studies particularly Anunobi (2015) and Igun (2016) point to inadequate ICT skill and use among librarians and tertiary institutions. Librarians require skills in areas such as computer use, accessing online databases, downloading files from online databases, creating own databases, communicating using e-mail and voice mail, use of search engines, digitization of documents, etc. These skills can be acquired through varieties of methods such as self-teaching, teaching by friends, in-house training, training in commercial centers etc. ICT skills call for a well-organized and properly articulated as opposed to a haphazard method. This is because the training method employed to obtain ICT skills has direct implications on the output, as learning outcome is greatly influenced by the learning method. It is the ICT training methods employed by librarians in Kebbi State and their implications on information services that this study seeks to establish.

Objectives of the Study

The main Objective of this study is to determine the training methods for librarians in ICT use in Kebbi State. Specifically, it is aimed at:

a) Identifying the ICT skills required for training librarians in Kebbi State.
b) Identifying the methods librarians employed to acquire ICT skills in Kebbi State.
c) Determine the extent to which the training methods are effective in library service delivery in the study area
d) Identifying the deficiencies in ICT training methods employed by the librarians.
e) Proffer strategies towards effective training methods in ICT by librarians in the Kebbi State.

Research Questions

The under listed questions have been drawn to guide the study:

1. What are the ICT skills necessary for librarians in the Kebbi State?
2. What training methods do librarians adopt to acquire ICT skills in Kebbi State?
3. To what extent are the ICT training methods effective in library service delivery?
4. What are the deficiencies in ICT training methods adopted by librarians in Kebbi State?
5. What strategies can be employed to ensure effective training in ICT by the Librarians in Kebbi State?

2. Review of Related Literature

Conceptual Framework

Information and Communication Technology (ICT) encompasses computer hardware, software, telecommunication tools, and media for processing and transmitting information (World Bank, 2016). It includes both Information Technology (IT) and Communication Technology (CT), providing systems that manage data across various platforms. ICT tools—such as computers, networks, radio, and television—are crucial in developing nations (Afolabi, 2019).

Academic librarians, as defined by the Okore, 2015, are responsible for organizing, managing, and teaching information access skills. Their roles have expanded due to the integration of ICT into library services, necessitating expertise in electronic resource management and database systems. Consequently, training in ICT is vital for their professional effectiveness.

ICT Use in Library Operations

The core mission of a library is to collect, organize, and disseminate information to support education and development. With ICT, libraries now use digital tools for resource acquisition, cataloguing, and access (Ani, 2017). E-resources like e-books and online journals are increasingly cost-effective, and digitized content is hosted on institutional intranets for wide access.

Issa (2020) categorized library ICT functions into "housekeeping" (acquisition, cataloguing, circulation) and user-facing services (reference, indexing). Cataloguing has been especially transformed through tools like Online Public Access Catalogues (OPAC), enabling global access (Khalid, 2017; Ani, 2017). Nigeria's virtual library project (Issa, 2020) reflects ongoing national efforts to modernize academic libraries.

ICT Skills Required for Librarians

Librarians must develop a wide range of ICT skills to function effectively. These include metadata use, web design, network capability, and digitization of resources (Igun, 2016; Omekwu, 2016; Mahmood, 2022). Soft skills such as communication and management are also emphasized (Okore, 2015). Mahmood (2022) further highlighted competencies in system planning, automated cataloguing, digital libraries, and virtual reference services.

Inadequate ICT skills have historically undermined automation initiatives, stressing the need for structured training programs (Igun, 2016). Thus, librarians need continuous professional development to keep up with evolving technologies.

Methods of ICT Training

Training methods fall into verbal (lectures), visual (demonstrations), and practical (hands-on) categories (Ahmed, 2017). Practical methods are most effective for ICT due to their focus on active learning and problem-solving. However, in Nigeria, the dominant lecture method is considered ineffective for ICT skill acquisition because it often promotes passive learning (Olowoye, 2019).

Innovative approaches include self-teaching, peer-led instruction, and web-based resources like the UK's Resource Discovery Network (Place et al., 2019), which offers over 50 subject-specific tutorials. Nigerian students also acquire ICT skills through friends, books, and cyber cafés (Audu, 2016), aligning with the "individualized instruction" philosophy (Ajayi & Ogunyemi, 2019). According Olowoye, (2019), the most prevalent method of instructional delivery in university system is the lecture method. Other methods such as experimental, project, tutorial and discussion are sometimes employed by the university lecturers, depending on the course of study and issues under consideration. The goal of every instruction is that learning should take place.

Constraints to Effective ICT Training

A number of impediments to ICT use which invariably affects training have been identified. Some of those reported by Anunobi, (2015) include; insufficient power supply, low quality telecommunication facilities, lack of trained man power with the required skills, acute shortage of funds. He added other problems with include; frequent changes in ICT and absence of technical support. Inadequate power supply is a common problem mentioned among authors, including Ain, (2017). They noted that "inadequate power supply is an acute problem that affects the use of computer and internet since the computer and associated devices cannot work without power, it becomes an issue to contend with in ICT training. Other factors identified by the duo are high cost of ICT facilities and harsh climatic environment. Computers and its peripherals work in a dust free, well-ventilated and constantly low temperature. It could be difficult to achieve this level of air conditioning in an average office or information centre without considerable expenses. According to Nwachukwu, (2015) some of the major problems associated with ICT use in library operations include: general inadequacy in the level of relevant infrastructure, especially telecommunication facilities and power supply; a largely exploitative local computer ICT market and unsatisfactory after sales, maintenance and support, as some ICT companies regard the developing countries as dumping grounds for unsatisfactory products; inadequate pool of relevant technocrat staff and problems of recruitment and retention; the poor ICT skills and competencies possessed by both library personnel and users; the conservation disposition of library staff in their resistance to the introduction and use of ICT in library operation and services; the observed user resistance and facture to adopt to the use of digitized information others are; the database conversion problems, frequent changes in technology and funding problems.

Strategies for Effective ICT Training

This work has among other issues discussed the methods of ICT training for librarians and constraints to effective ICT training. This section takes a cursory look at some of the strategies for effective ICT training, particularly among academic librarians. The provisions of basic infrastructural faculties are germane to effective ICT training. A critical gadget is the computer. The choice of computer is dependent on the type of service needed. For effectiveness and a more practical utilization of the internet facility, one needs no less than a 386 model, however, if graphics are required, then a Pentium personal computer is recommended. The purchase and distribution of laptop computers by some library managements to staff for installment payment is a welcome development. Increase in number of computers by commercial café operators could also enhance training. Improvement in telecommunication facilities can greatly impact on ICT services, hence training.

Telephone lines are required in internet connection as the modem which ensures communication cannot function without these lines. ICT facilities like other technologies are power-driven. A provision of sustained power can greatly boost ICT services including training.
For effective ICT training, engagements of well qualified personnel who are versed in both the theoretical and practical aspects of ICT are critical to sound knowledge transfer. Apart from these competent instructors, qualified systems engineers are required for regular maintenance and repairs when necessary. Furthermore, training opportunities could be created for librarians. This could entail regular organization of ICT seminars and workshops, sponsorship of staff on ICT training by library management, organization of special in-house ICT training by library management. On their part, librarians could create sufficient training hours for themselves, particularly those engaged in commercial cyber cafés or self-teaching.

3. Research Methodology

The study adopted descriptive survey research design. It was conducted in Kebbi State which is located in the North West Geo political zone of Nigeria. The population of this study consisted of all academic librarians and Senior Library Officers in seven (7) tertiary institutions in Kebbi State including Federal University Birnin Kebbi, Kebbi State University of Science and Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State Polytechnic, Dakingari, Adamu Augie College of Education, Argungu, School of Nursing and Midwifery, Birnin Kebbi and School of Health Technology, Jega respectively. The entire population of 46 representing 100% was for the study. The researcher employed questionnaire titled "Training Methods for Librarians in ICT Questionnaire (CMLICTQ)" as the instrument for data collection. The researcher subjected the questionnaire to face validation by three lecturers in the Department of Library and Information Science in Federal University of Technology Minna and Kebbi State Polytechnic Dakingari respectively. Copies of the questionnaires were administered to the respondents by the researcher in the areas understudy. The data obtained through the questionnaire was presented in tables and analyzed using frequency and simple percentage. Any item that scored the average of 50 percent and above was considered accepted while those below the average score was considered rejected.

4. Results: Data Presentation and Analysis

The data collected were presented according to the research questions. Data relevant to each research question were presented in tables and analyzed using frequency and simple percentages. A total of 46 questionnaire representing 100 percent response rate were returned.

Table 1A: Years of experience of Respondents (N= 46)

S/no.	Years of Experience	Frequency	Percentage
1	0-5	8	17.39
2	6-10	16	34.78
3	11-15	6	13.043
4	16-20	7	15.22
5	21-25	3	6.52
6	26-30	4	8.70
7	> 30	2	4.35

From the table above, 16 librarians or 34.78 percent which is the majority have working experience of between 6 to 10 years. 8 or 17.39 percent of them have 11 - 15 years of experience while 7 or 15.22 of them have 16 - 20 and 6 or 13.04 11–15-year experience while 2 or 4.35 have experience of above 30 years respectively. This implies that all librarians have considerable experience in the field of Librarianship.

Table 1B: Distribution of Respondents by Section (N= 46)

S/no.	Section	Frequency	Percentage
1	Cataloguing	11	23.91
2	Reference	8	17.39
3	Acƙuisition	8	17.39
4	Collection deɓelopment	3	6.52
5	Serials	6	13.04
6	Circulation	4	8.70
7	Goɓt. document	4	8.70
8	Africana/Special collection	2	4.35

Librarians in the cataloguing section constitute majority of respondents, being 11 or 23.91 percent. This is followed by those at acquisition and reference with 8 respondents or 17.39 percent each. The least number comes from special collection with 2 or 4.35 percent.

Research question 1: What are the ICT skills necessary for librarians in the Tertiary Institutions in Kebbi State? The data are presented in table 2 below.

Table 2: ICT Skills for Librarians (N=46)

S/No	ICT Skills	Frequency	Percentage	Decision
1	Communication using e-mail	46	100	Accepted
2	Computer skills	46	100	Accepted
3	Downloading files from online databases	45	97.83	Accepted
4	Use of internet for browsing/surfing	45	97.83	Accepted
5	Bisiting websites	45	97.83	Accepted
6	Digitization of documents	45	97.83	Accepted
7	Downloading from internet	44	95.65	Accepted
8	Accessing databases in CDs and DBDs	43	93.48	Accepted
9	Accessing online databases	43	93.48	Accepted
10	Use of search engines	43	93.48	Accepted
11	Creating of own databases	41	89.13	Accepted
12	Printing from downloaded files	41	89.13	Accepted
13	Web page design	37	80.43	Accepted
14	Communication using boicemail	32	69.57	Accepted
15	Use of Telefacsimile	25	54.35	Accepted

Tables 2 above shows that all the ICT skills listed are acceptable to the respondents. Each of the item scored no less than 54 percent which is above 50% bench mark. Computer skills and communication using e-mail had the highest score of 100 percent each. The least score though well above the average is 54.35 percent in favour of use of Telefacsimile

Research Question 2: What training methods do librarians in the Tertiary Institutions in Kebbi State employ to acquire ICT skill? The result is drawn out in the table 3 below.

Table 3: Methods of ICT skill acquisition by librarians (N=46)

S/No	Training Methods	Frequency	Percentage	Decision
1	Reading books/manuals	27	58.70	Accepted
2	Training in the computer centre	26	56.52	Accepted
3	Teaching by friends	23	50.00	Accepted
4	Seminars/workshops	23	50.00	Accepted
5	In-house training	26	56.52	Accepted
6	Self-teaching	19	41.30	Accepted
7	Training in commercial cafes	19	41.30	Accepted
8	Lectures in faculties	14	30.43	Rejected
9	Not yet trained in ITC	3	6.52	Rejected

It is observable from above table that majority of respondents or 58.70 percent employ reading of books/ manual to obtain their ICT training. 26 or 56.52 percent of them train in their institutions' computer centre. 3 respondents representing 6.52 percent are not yet trained at all in ICT.

Research question 3: To what extent are the ICT training methods effective in library services delivery?

Table 4: Extent of effectiveness of ICT Training Methods. (N=46).

S/No	Training Methods	Frequency	Percentage	Decision
1	Training in computer centre	38	82.61	Accepted
2	Training in commercial cafes	15	32.61	Accepted
3	Self-teaching	29	63.04	Accepted
4	Teaching by friends	30	65.22	Accepted
5	In-house training	41	89.13	Accepted
6	Reading books/manuals	21	45.65	Rejected
7	Seminars/workshops	22	47.83	Rejected
8	Lectures in faculties	21	45.65	Rejected

Data presented in table 4 above shows that five of the items are accepted while three are rejected. Among those accepted, are "training in computer centre" with the highest mean score of 38 representing 82.61 percent, followed by self-training with 29 equivalents to 63.04 percent. Conversely, "Training in Commercial Cafe" got the least with 15 representing 32.61 percent, while seminars/workshops and reading books/manuals attracted 22 and 21 representing 47.83 and 45.65 scores respectively, the three items are therefore rejected.

Research question 4: What are the constraints to ICT training methods adopted by librarians in the Tertiary Institutions in Kebbi State?

Table 5: constraints to ICT training (N=46)

S/No	Constraints	Frequency	Percentage	Decision
1	Commercial cafes charges high fees	43	93.48	Accepted
2	Slow speed of serƀer/modem	41	89.13	Accepted
3	Unstable power source	46	100.00	Accepted
4	Seminars/workshops periods are too short	38	82.61	Accepted
5	Inadeƙuate number of computer systems	40	86.96	Accepted
6	Lack of sufficient time for training	40	86.96	Accepted
7	Self-teaching is not effectiƀe	43	93.48	Accepted
8	Persistent eƙuipment failure	38	82.61	Accepted
9	Computers are too edpensiƀe	41	89.13	Accepted
10	Non-aƀailability of net-worked computers in the library	37	80.43	Rejected
11	High cost of training books/manuals	22	47.83	Rejected
12	No in-house training section is organized in the library	21	45.65	Rejected
13	Trainers are not proficient enough	22	47.83	Rejected
14	Aƀailable ICT infrastructures are irreleƀant	19	41.30	Rejected
15	Lack of dedicated training centre	31	67.39	Rejected

Data in table 5 above shows that 10 items out of 15 are accepted as being constraints to ICT training. The three highest being; commercial cafes charges high fees, slow speed of sever/modem and unstable power source with mean scores of 3.87, 3.38 and 3.34 respectively. Items like "lack of university training centre", "available ICT infrastructures are irrelevant" and "trainers are not proficient enough are rejected with mean scores of 2.09, 2.11 and 2.17 respectively".

Research question 5: What strategies can be employed to ensure effective training on ICT by librarians in Tertiary Institutions in Kebbi State?

Table 6: Strategies for effective ICT training (N=46)

S/No	Strategies	Frequency	Percentage	Decision
1	Engagement of ƙualified systems engineer for regular maintenance	45	97.82609	Accepted
2	Sponsorship of staff in ICT training by library management	46	100	Accepted
3	Engagement of well ƙualified ICT trainers	42	91.30435	Accepted
4	Establishment of ICT training hours by institutions	37	80.43478	Accepted
5	Organization of regular ICT training seminars/workshops	40	86.95652	Accepted
6	Organization of special in-house ICT training by library management	32	69.56522	Accepted
7	Creation of sufficient training hours by librarians	30	65.21739	Accepted
8	Proɓision of net-worked computers by library management.	39	84.78261	Accepted
9	Application of ICT training software to enhance self-teaching	37	80.43478	Accepted
10	Increase in the speed of serɓes/modem by interned serɓice/proɓiders	33	71.73913	Accepted
11	Increase in number of computers by commercial café operations	38	82.6087	Accepted

The table above shows that each of the items listed as possible strategies to ICT training with a percentage rating above the average of 50% bench mark. The highest ones however are: engagement of qualified systems engineer for regular maintenance, sponsorship of staff in ICT training by library management as well as engagement of well qualified ICT trainers. These have percentage rating of 97.82%, 100% and 91.30% respectively.

1. Summary of Findings

The major findings of the study are as follows:

1. The ICT skills necessary for librarians are computer skills, accessing online database, downloading files from online databases, printing from downloaded files, accessing database in CDs and DVDs, creating own databases, communication using e-mail, communication using voicemail, use of search engine, use of internet for browsing/surfing, visiting websites, downloading from internet, use of telefacsimile, web page design and digitization of documents.
2. ICT training methods employed by librarians in the institutions under study are: reading books/manuals, training in computer centre, seminars/workshops, teaching by friends, in-house training, training in commercial cafes and self-teaching.
3. ICT training methods effective in library service delivered are: training in computer centre training in commercial cafes, self-teaching, teaching by friends and in-house training.

4. Factors that constitute constraints to effective ICT training among librarians in the universities studied were identified as; commercial cafes charges high fees, slow speed of sewer/modem, unstable power supply, seminars/workshop periods are too short, inadequate number of computer systems, lack of sufficient time for training, self-teaching is not effective, persistent equipment failure and computers are too expensive.
5. Engagement of qualified systems engineer for regular maintenance, sponsorship of staff in ICT training, engagement of well qualified ICT trainers, increase in members of computers by commercial café operators, increase in speed of server/modem by internet service providers, provision of net-worked computers by library management, creation of sufficient training centre by librarians, establishment of ICT training hours by Institutions of regular ICT training seminars/workshops, organization of special in-house ICT training by library management as well as application of ICT, training software to enhanced ICT training among librarians.

6. Recommendations

The following recommendations are made based on the findings and implications of the study.

1. All librarians in the institutions under study must of necessity ensure that he/she obtains ICT skills using suitable training method(s). The library management should ensure that this is done.
2. Libraries management should provide computers and network them as well as organize effective in-house ICT training, employing qualified trainers for the benefit of her staff.
3. Internet services providers should increase the speed of server/modem for internet users to have value for their time and money. Government should evolve policies that could compel them to do so.
4. The institution's authorities should create sufficient training centres for the development of their staff, particularly librarians.
5. Qualified system engineer should be engaged to ensure regular maintenance and repairs as the case may be of ICT infrastructures.
6. Government should intensify efforts to improve the epileptic state of public power provision in the country as this would go a long way to facilitate ICT training among librarians.

7. Conclusion

The vantage position of the human agent in any technology including the information and communications technology and its peculiar relevance to the information profession underscores this study. The enormous importance and potentialities of the ICT in library service were uncovered in literature. Several ICT skills were thus identified as necessary for librarians. The methods of obtaining these skills were therefore the focus of this work. A sample of 46 librarians from the Tertiary Institutions in Kebbi State were drawn and administered questionnaires. Data generated were analyzed using frequency count and simple percentages in the appropriate cases.

The result of the study showed that ICT skills necessary for librarians include: computer skills, accessing online database, downloading files from online database, printing form downloaded files, accessing databases in CDs and DVDs, creating own databases, communicating using e-mail and voice mail, use of search engines, use of internet for browsing, visiting websites, downloading from internet, use of telefacsmile, web page design and digitization of documents. To obtain these skills the training methods being employed are: training in computer centre, training in commercial cafes, self-teaching, teaching by friend and in-house training. Furthermore, changing of high fees by commercial cafes, slow speed of server/modem, unstable power supply, etc were identified as constraints to effective ICT training, while engagement of qualified system engineers for regular maintenance, sponsorship of staff in ICT training, engagement of qualified trainers, increase in speed of server/modem, organization or regular ICT training seminars/workshops are among measures for enhanced ICT training. Consequent upon above and other findings, six recommendations were made to redress the trend, some of these were that all librarians in the Tertiary Institutions in Kebbi State must necessarily ensure that suitable methods are used to obtained ICT skills, library management should organize effective in-house training and engage qualified trainers to coach their staff. Government should endeavour to improve the epileptic power supply.

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Transforming Librarianship and Information Service Delivery through Innovative Technology in University Libraries in Benue State, Nigeria

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Abstract
This study examined the transformation of librarianship and information service delivery through innovative technology in University Libraries in Benue State, Nigeria. Descriptive survey design was adopted for the study. Population for this study was 292 librarians of the three universities and was used as sample size. Instrument for the study was questionnaire. Data collected was analysed using mean and standard deviation, t-test, Pearson product moment correlation coefficient and analysis of covariate. Result of the findings revealed no statistical significant difference in mean responses of male and female respondents on the impact of innovative technology on transformation of librarianship and information service delivery in universities (t = 0.780 > 0.05). Finding also revealed no statistical significant difference in mean responses of male and female respondents on the extent at which innovative technology is adopted for transformation of librarianship and information service delivery in universities (t = 0.294. > 0.05) The study found that a perfect positive correlation between innovative technology and transformation of librarianship in universities. (r = .270) Also, the result of finding revealed a perfect positive correlation between innovative technology and transformation of service delivery in universities (r =.287). Finally, the study found no significant different between the mean responses of librarians in the three universities on the challenges militating against full implementation of innovative technology in universities (0.880 > 0.05). The study concluded that transforming librarianship and information service delivery could be achieved through innovative technology. It was recommended that all university libraries in the state should acquire innovative technology tools in order to ensure provision of adequate librarianship and information service delivery.
Keywords: *Transforming, Librarianship, Information Service Delivery and Innovative Technology*

Introduction
In the contemporary era, technology has rapidly permeated various facets of library services. Innovative technology continues to equip and enrich university system especially in library services and assisting students for success in the modern world. The importance of technology in university library services cannot be overstated. Technology tools play a pivotal role, offering multifaceted benefits for library services such as revolutionizing, reshaping the library landscape, transforming librarianship and information service delivery. Librarianship refers to the professional practice of managing, organizing, preserving and facilitating access to information and resources in various forms. It is also a dynamic field that blends traditional skills with modern technologies to meet the information needs of the society (Ashikuzzaman, 2023). As a core mandate, librarianship empowers individuals and communities through access to knowledge, promotes literacy, fosters learning, and supports research and innovation. Librarianship is the profession concerned with the collection, organization, presentation, and dissemination of recorded knowledge in every format, and with providing access to that information and knowledge. Librarians play a crucial role in facilitating access to that information and supporting lifelong learning (American Library Association (ALA), 2020). A Librarianship is a service is a service provided by libraries to answer diverse queries from users, either in real time or virtually, using a combination of online resources and librarian expertise to provide accurate and quick responses (Khot, 2023). Librarianship services are those activities that librarians offer to their users to make information readily available. These services are: cataloging; reference services; information literacy; outreach services; circulation services; interlibrary loan services photocopying and printing services; orientation and information sessions. In the context of this study, librarianship is an activity involving the work of organization, collection, preservation and sharing information in university libraries for effective service delivery.

Service delivery is a component of organization that defines the interaction between providers and clients where the provider offers a service, whether that is information or a task, and the client either finds value or loses value as a result. This includes the regular interactions between the two parties throughout the entire process of the organization supplying the service and the client receiving it (Kaur, 2018). In the context of this study, service delivery is an idea and framework which the main goal is to provide services from an

organization to client. Service delivery also includes the initial interaction, set up, and any follow-up interactions. It provides the core service that university libraries offer to its clients. It is the main goal of which is to provide services from an organization to a customer (Thomson, 2023). Service delivery includes the regular interactions between the two parties throughout the entire process of supplying the service and the customer purchasing it. It also includes the initial interaction, set up, and any follow-up interactions with an organization. Service delivery is an important part of running a business. It invites the opportunity to impress your customers and show them the value you offer. It can help to create a great relationship with clients and secure retention (Thomson, 2023). Service delivery is a common phrase in used to describe the distribution of basic resources citizens depend on like water, electricity, sanitation infrastructure, land, and housing (Campbell, 2024). In view of Macarthur (2023), service delivery is the provision of services to customers or other businesses. This involves the delivery of a range of services, including technical support, software development, and infrastructure management. Macarthur (2023) opined that the goal of service delivery is to ensure that customers are satisfied with the services they receive and that they are delivered in a timely and efficient manner.

According to Eje and Dushu (2018), information service delivery deals with the way information practitioners do relate and act towards the users, organisations and the society. Omekwu in Eje and Dushu (2018) pointed out that information service delivery is meant to support institutions and research by facilitating access to a libraries extensive range of information resources and challenges. In the opinion of Saidu, Badariah and Kling (2016), the public organizations are complex in nature and each organization has a peculiar circumstance. Eje and Dushu (2018) posited that the technology innovative services required by university librarians for effective performance include Artificial Intelligence (AI), Machine Learning (ML), Cloud Computing, RFID (Radio Frequency Identification), Virtual Reality (VR), Augmented Reality (AR), Digital Asset Management Systems, Mobile Apps, Chatbots, Data Analytics, and 3D Printing.

Statement of the Problem

Modern librarianship relies heavily on innovative technology since they improve user experience, accessibility, and efficiency. In the digital era, technology make libraries more relevant and interesting for patrons by enabling them to manage collections efficiently, enable remote access to resources, and provide a greater choice of services. However, the researchers' preliminary information through interaction and interview with university librarians in Benue state revealed that many librarians are employed without innovative technology skills required for effective transformation of librarianship and services delivery. The absence of cutting-edge technology in libraries has a number of negative effects, such as decreased productivity, restricted access to information, decreased patron happiness, and trouble keeping up with changing information demands. The circumstance has a detrimental effect on the library's standing and capacity to draw users. It is against this background that the study is designed to examine transformation of librarianship and information service delivery through innovative technology in university libraries in Benue State, Nigeria.

Objectives

1. Examine the impact of innovative technology on transformation of librarianship and information service delivery in universities
2. Examine the extent at which innovative technology influence transformation of librarianship and information service delivery in universities in Benue state
3. Examine the relationship between innovative technology and transformation of librarianship in universities
4. Determine the relationship between innovative technology information service delivery in universities
5. Identify the challenges militating against the full implementation of innovative technology in universities

Hypotheses

1. There is no significant difference in the mean response of male and female librarians on the impact of innovative technology on transformation of librarianship and information service delivery in universities
2. There is no significant difference in the mean response of male and female librarians on the extent at which innovative technology is adopted for transformation of librarianship and information service delivery in universities in Benue state
3. There is no significant relationship between innovative technology and transformation of librarianship in universities
4. There is no significant relationship between innovative technology information service delivery in universities
5. There is no significant difference in the mean response of librarians from the three universities on the challenges militating against the full implementation of innovative technology in universities

Literature Review

Impact of innovative technology on transformation of librarianship and information service delivery

The impact of technology on library services has been considered greatly in all universities. According to Ehoniyotan and Amzat (2023), technology has caused changes in people's thinking, behaviour, communication, and working methods in university libraries. The authors added that digital libraries have replaced traditional libraries as a result of ICT and globalization. Today, library user needs are now the focus of library operations, which have moved from being service-oriented to user-oriented. Technologies have been merged in library science, libraries and rebranded other services in digital libraries, virtual libraries and hybrid libraries. Mittal (2017) opined that in digital libraries where all work is done by computer, have replaced traditional libraries as a result of ICT and globalization.

Innovative technology use in university libraries

Innovative library and information services use are low in most of the universities in Nigeria. Oduwole, Adekunmisi and Oyedokun (2023) reported that majority of the libraries do not adopted innovative library services. Ogunmodede and Popoola (2021) posited that academic libraries in Nigeria are still striving to comply with the strategy and requirements for the adoption of innovative services and products of libraries in Nigeria.

Use of innovative technology for transformation of librarianship in universities

Innovations technology makes it possible for academic libraries to respond more positively to the changing needs of patrons and simultaneously, making the professional training, retraining, mentorship programs and educational development more germane to library personnel especially, in the media dominated era (Oduwole, Adekunmisi and Oyedokun, 2023). Oduwole, et al, (2023) further stressed that application of innovative technology has makes academic libraries more relevant, more responsive, improved their visibility and strengthened libraries' roles among respective user communities. Similarly, Evjen (2015) added that academic libraries in the developed world have adopt innovative tools for better management of library services with users. In view of Khab (2010), adoption of innovative technology enhances the images of library professionals. The professionals as one of the pillars of innovation deploy expertise using various innovative technological tools, products, services and practices to increase libraries' visibility, strengthen and make libraries' impact in academic environments. Professional and personal development of librarians in the maintenance and sustenance of novelty services, resources, processes and products delivery is essential for academic libraries. Silva and Manatunga (2021) assert that innovative practical demonstration/training, retraining and mentorship programs and usage of ICT applications in libraries creates survival of the library profession and its professionals. Adekunmisi and Odunewu (2016) also said that training and professional expertise in innovative technology is a necessary tool for continuous knowledge and skills upgrade among library professionals.

Use of innovative technology for service delivery in university libraries

The emerging technologies are used for service delivery in the university libraries in different ways. According to Vysakh (2020), numerous innovative technologies have emerged today, and some of these technological facilities are used in the university libraries. As posited by Rouse (2018) in Ehoniyotan and Amzat (2023), big data which are a large and complex number of datasets that traditional data processing application fails to capture, store, share, transfer, and analysis are early used in libraries today. The big data has a direct impact on libraries as the library professionals use bigdata tools to analyze their large data like to know the users better to provide. According to Oduwole, Adekunmisi and Oyedokun (2023), innovative technologies play essential roles in the provision and delivery of innovative library practices, products and services.

Challenges militating against full utilization of innovative technology in libraries in Nigeria

There are various barriers preventing use of innovative technology for libraries resources and services. Krubu and Asowaru (2011) posited that lack of search skills among library staff, inadequate budget, epileptic power supplies, and insufficient management training and staff retraining are challenges of use of innovative technology in librarianship. Lubanga and Mumba (2021) claimed that a number of obstacles that prevent libraries from implementing high-end technologies, including a lack of well-established centers for research and innovation, the unpredictable nature of technological advancement in the twenty-first century, and university cultures that discourage research and innovation. In a view of Saibakumo (2021), the biggest factors affecting use of technology in libraries include lack of funding, a shortage of power, and inadequate maintenance. Both information costs and quality are increasing. The authors added that fiscal restraints, insufficient maintenance and cultural updating, and a problem with record conversion can be linked to infrastructure problems, a lack of informatics/learning, and a lack of government assistance.

Methodology

This study was conducted using three universities in Benue state namely; Joseph Sarwuan Tarka University Makurdi, Benue State University Makurdi and University of Mkar, Mkar. Joseph Sarwuan Tarka University

Makurdi is Federal owned university while Benue State University Makurdi is a state university and the University of Mkar, Mkar is a private university. The design used for this study was a descriptive survey design. The population used for this study was 291 comprising 177 library staff from Joseph Sarwuan Tarka University, 92 from Benue State University 22 and from University of Mkar. There was no sampling technique used for the study. The whole population of 291 was used as sample size since it was manageable. The data collected was analysed using mean and standard deviation, t-test, Pearson product moment correlation coefficient (PPMCC) and Analysis of Covariate (ANOVA).

Results

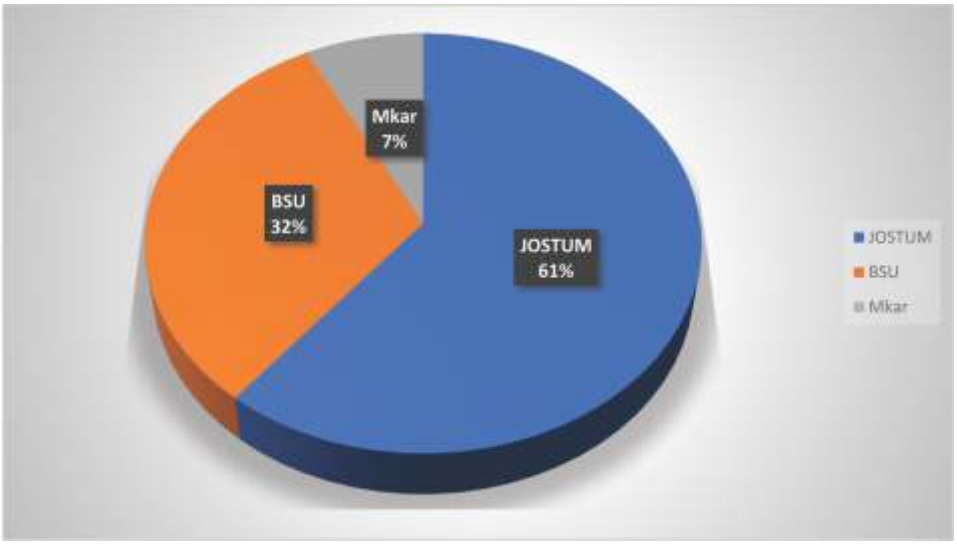


Figure 1: Percentage of Respondents in University Libraries in Benue State
***JOSTUM** = Joseph Sarwuan Tarka University Makurdi, BSU = Benue Stat University and Mkar = University of Mkar
Source: Field Survey, 2025

Result in Figure 1 shows the percentage of respondents in university libraries in Benue State. Librarians from Joseph Sarwuan Tarka University Makurdi were 61% while those from Benue Stat University Makurdi were 32% and University of Mkar**,** Mkar were 7% respectively.

Table 1: Mean Response of Male and Female Librarians on the Impact of Innovative Technology on Transformation of Librarianship and Information Service Delivery in Universities

Group	N	Mean	Std. Deviation	Std. Error Mean	Remarks
Male	188	3.2369	0.54695	0.03989	Impactful
Female	103	3.2189	0.49046	0.04833	
Total	**291**	**3.2279**	**0.51870**	**0.04411**	

Source: Field Survey, 2025

Result in Table 1 shows mean response of male and female librarians on the impact of innovative technology on transformation of librarianship and information service delivery in universities**.** The male respondents had a mean value of 3.2369 while their female counterparts had a mean response of 3.2189 respectively.

Table 2: Mean Response of Male and Female Librarians on the Extent of Adoption of Innovative Technology for Transformation of Librarianship and Information Service Delivery in Universities

Group	N	Mean	Std. Deviation	Std. Error Mean	Remarks
Male	188	2.1926	0.80143	0.05845	Low
Female	103	2.0893	0.80231	0.07905	
Total	**291**	**2.1409**	**0.80187**	**0.06875**	

Source: Field Survey, 2025

Result in Table 1 shows mean response of male and female librarians on the extent of adoption of innovative technology for transformation of librarianship and information service delivery in universities in Benue State. The male respondents had a mean value of 2.1926 while their female counterparts had a mean response of 2.0893 respectively.

Table 3: Relationship between Innovative Technology Strategies and Transformation of Librarianship in Universities

Variable	Mean	Std. Deviation	N	Remarks
Innoɓatiɓe technology	3.2306	0.52686	291	Related
Transformation of librarianship	3.2136	0.68375	291	
Grand Mean	**3.2221**	**0.60531**		

Source: Field Survey, 2025

Result in Table 3 shows relationship between innovative technology strategies and transformation of librarianship in universities. Innovative technology had a mean value of 3.2306 while transformation librarianship had a mean value of 3.2136 respectively.

Table 4: Relationship between Innovative Technology and Information Service Delivery in Universities

Variable	Mean	Std. Deviation	N	Remarks
Innoɓatiɓe technology	3.2306	0.52686	291	Related
Serɓice deliɓery	3.0725	0.63975	291	
Grand Mean	**3.1515**	**0.58330**		

Source: Field Survey, 2025

Result in Table 3 shows relationship between innovative technology and information service delivery in universities. The result revealed that innovative technology had a mean value of 3.2306 while transformation librarianship had a mean value of 3.0725 respectively.

Table 5: Mean Response of Respondents on the Challenges Militating against full Implementation of Innovative Technology in University Libraries

						95% Confidence Interɓal for Mean				
Group		N	Mean	Std. Deɓiation	Std. Error	Lower Bound	Upper Bound	Minimum	Maɗimum	I (I
JOSTU,		177	2.7867	0.64002	0.04811	2.6918	2.8817	1.50	4.00	
BSU		92	2.7473	0.59754	0.06230	2.6235	2.8710	1.50	3.92	
Mkar		22	2.7803	0.35500	0.07569	2.6229	2.9377	2.08	3.50	
Total		291	2.7738	0.60836	0.03566	2.7036	2.8440	1.50	4.00	
Model	Fiɗed Effects			0.61020	0.03577	2.7034	2.8442			
	Random Effects				.03577[a]	2.6199[a]	2.9277[a]			-

*JOSTUM = Joseph Sarwuan Tarka University Makurdi, BSU = Benue Stat University and Mkar = University of Mkar

Source: Field Survey, 2025

Result in Table 5 shows responses of respondents on the challenges militating against full implementation of innovative technology in three university libraries. Joseph Sarwuan Tarka University Makurdi had mean value of 2.7867 while Benue Stat University had 2.7473 and University of Mkar, Mkar had 2.7803 respectively.

Table 6: t-test Result on the Impact of Innovative Technology on Transformation of Librarianship and Information Service Delivery in Universities

	Leϐene's Test for Eϰuality of Bariances		t-test for Eϰuality of Means					
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Differen ce	Std. Error Differen ce	95% Confidence Interϐal of the Difference Lower	Upper
Eϰual ϐariances assumed	0.74 0	0.39 0	0.27 9	289	0.780	0.01806	0.06469	-0.1092 7	0.1453 8
Eϰual ϐariances not assumed			0.28 8	230.08 4	0.773	0.01806	0.06266	-0.1054 1	0.1415 2

Source: Field Survey, 2025

Result in Table 6 shows t-test value of 0.780 and 289 degree of freedom at 2-tailed significant level. This value is greater than the predetermined value of 0.05. This result is not significant. This implies innovative technology on transformation significantly impact librarianship and information service delivery in universities.

Table 7: t-test Result on the Extent of Adoption of Innovative Technology for Transformation of Librarianship and Information Service Delivery in Universities

	Leϐene's Test for Eϰuality of Bariances		t-test for Eϰuality of Means					
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Differen ce	Std. Error Differen ce	95% Confidence Interϐal of the Difference Lower	Upper
Eϰual ϐariances assumed	0.0 18	0.892	1.05 0	289	0.294	0.10323	0.09828	-0.0902 1	0.29668
Eϰual ϐariances not assumed			1.05 0	209.80 4	0.295	0.10323	0.09832	-0.0905 8	0.29705

Source: Field Survey, 2025

Result in Table 7 shows t-test value of 0.294 and 289 degree of freedom at 2-tailed significant level. This value is greater than the predetermined value of 0.05. This result is not significant. This implies that there is no significant difference in mean responses of male and female respondents on the on the low extent of adoption of innovative technology for transformation of librarianship and information service delivery in universities.

Table 8: PPMCC Result on the Relationship between Innovative Technology and Transformation of Librarianship in Universities

		Innovative technology	**Transformation of librarianship**
Innovative technology	Pearson Correlation	1	.270**
	Sig. (2-tailed)		0.000
	N	291	291
Transformation of librarianship	Pearson Correlation	.270**	1
	Sig. (2-tailed)	0.000	
	N	291	291

**. Correlation is significant at the 0.01 level (2-tailed)

Source: Field Survey, 2025

The result in Table 8 shows *r* value of .270 at 2-tailed level of significance. The result is statistically significant. This means that there is a perfect positive correlation between innovative technology and transformation of librarianship in universities.

Table 9: PPMCC Result on the Relationship between Innovative Technology and Library Service in Universities

		Innovative technology	Service delivery
Innovative technology	Pearson Correlation	1	.287**
	Sig. (2-tailed)		0.000
	N	291	291
Service delivery	Pearson Correlation	.287**	1
	Sig. (2-tailed)	0.000	
	N	291	291

Source: Field Survey, 2025

The result in Table 8 shows *r* value of .287 at 2-tailed level of significance. The result is statistically significant. This is an indication that there is a perfect positive correlation between innovative technology and information service in universities libraries.

Table 10: ANOVA Result on the Challenges militating against Full Implementation of Innovative Technology in Universities

	Sum of Squares	df	Mean Square	F	Sig.	Remarks
Between Groups	0.095	2	0.048	0.128	0.880	Not Significant
Within Groups	107.233	288	0.372			
Total	**107.329**	**290**				

Source: Field Survey, 2025

Result in Table 10 shows ANOVA of 0.880 which is greater than the predetermined value of 0.05 at 288 degree of freedom. This result is a statistically not significant. This implies that there is no significant different between the mean responses of librarians in the three universities on the challenges militating against full implementation of innovative technology in universities. The result further indicates that many challenges affect implementation of innovative technology are applicable in all the three universities in Benue state.

Discussion of Findings

Finding of the study revealed a significant impact of innovative technology on librarianship and information service delivery in universities. The finding agrees with that of Ehoniyotan and Amzat (202) which found out that technology has caused changes in people's thinking, behaviour, communication, and working methods in university libraries. The finding also confirms the report of Mittal (2017) which revealed that in digital libraries have replaced traditional libraries as a result of ICT and globalization.

The finding also revealed low extent of adoption of innovative technology for transformation of librarianship and information service delivery in universities. The finding collaborates a report by Oduwole, Adekunmisi and Oyedokun (2023) which found out that majority of the libraries do not adopted innovative library services. The finding is also similar with that of Ogunmodede and Popoola (2021) which revealed that academic libraries in Nigeria are still striving to comply with the strategy and requirements for the adoption of innovative services and products of libraries in Nigeria.

The finding revealed a perfect positive correlation between innovative technology and transformation of librarianship in universities. The finding is not different from a report by Oduwole, et al, (2023) which noted that application of innovative technology has makes academic libraries more relevant, more responsive, improved their visibility and strengthened libraries' roles among respective user communities. The finding also agrees with Khab (2010) who found out that adoption of innovative technology enhances the images of library professionals.

Also, the finding revealed a perfect positive correlation between innovative technology and transformation of service delivery in universities. The finding is in agreement with Vysakh (2020) who found that many libraries

use innovative technology as an effective tool for delivering books from library to patrons and vice versa, where users of the libraries make request for books via mobile library app, concern sections of the libraries receive and process the requests. The finding also affirms a report by Amzat (2023) innovative technology is used where a large and complex number of datasets that traditional data processing application fails to capture; store; share; transfer; and analysis and used in libraries today.

The finding showed that many challenges affect implementation of innovative technology are applicable in all the three universities in Benue stat. This finding agrees with Krubu and Asowaru (2011) who reported that the main barriers include a lack of search skills among library staff, inadequate budget, epileptic power supplies, and insufficient management training and staff retraining. Also, the finding confirms a report by Saibakumo (2021) who noted that the biggest factors affecting use of technology in libraries include lack of funding, a shortage of power, and inadequate maintenance.

Conclusion

University libraries are established with the aim of achieving its full services to users. The advancement of technology in every facet of the academic environment is always considered as a great achievement. This study has revealed the role play by technology in library services. However, there are pockets of problems affecting full implementation of innovative technology in the university libraries. The study concluded that transforming librarianship and information service delivery could be achieved through innovative technology in university libraries in Benue State.

Recommendations

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

1. University librarians should emphasize on the use innovative technology as it impact transformation of librarianship and information service delivery
2. All university libraries in the state should ensure innovative technological tools are highly used to enhance transformation of librarianship and information service delivery
3. Since innovative technology is strongly related to transformation of librarianship and information service delivery, university libraries should ensure full adoption of use of these facilities
4. The universities ensure that adequate measures are put in place in order to eliminate the challenges militating against the full implementation of innovative technology in the libraries.

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Abstract
The evolution of technology has significantly reshaped the landscape of librarianship and information services delivery, driving innovation and redefining professional practices. This study examines how innovative technologies, such as artificial intelligence, cloud computing, big data analytics, and virtual reality, are transforming the roles of librarians and the services they offer. The research highlights the need for librarians to adapt to emerging tools to meet the dynamic information needs of users in an increasingly digital world. By examining literature and current trends, the study underscores the importance of continuous professional development and strategic technological adoption in enhancing user engagement, improving accessibility, and fostering sustainable information management. The findings show that embracing innovative technology is pivotal for the survival and relevance of libraries in the 21st century, offering actionable recommendations for institutions seeking to remain at the forefront of knowledge dissemination in the fifth industrial revolution.
Keywords: Library, Information Services Delivery, Innovation Technologies.

Introduction

The rapid advancement of technology has significantly transformed various sectors, including education, healthcare, and business. Libraries, traditionally viewed as repositories of physical books and journals, are now evolving into dynamic digital hubs that leverage innovative technologies to enhance information services delivery. According to Thiruppathi (2024), libraries are now at a critical juncture, requiring comprehensive adaptation to remain relevant and effective in today's digital-centric world. The digital era presents challenges and opportunities for libraries, the rapid pace of technological change demands continuous learning and adaptation, often straining existing resources and capabilities (Abdin, et.al., 2023). Yet these technologies also offer unprecedented opportunities to enhance service delivery, expand resource access, and innovatively engage with communities (Aharony, 2019; Sain & Negi, 2023).

The integration of artificial intelligence (AI), blockchain technology, cloud computing, and the Internet of Things (IoT) into librarianship has revolutionized how information is accessed, stored, and disseminated (Kumar & Singh, 2022). Librarianship is no longer confined to cataloging and shelving books, it now encompasses digital curation, data management, and user-centric services. The shift from traditional to digital libraries has necessitated the adoption of cutting-edge technologies to meet the changing needs of users in academic, public, and corporate settings (Adeleke & Emeahara, 2021).

In their work, Ikonne et al. (2024) noted that service delivery is the interaction between a provider and a customer where the provider offers assistance that is to be delivered effectively, reliably, and in a customer-friendly manner. The services sector is the leading and fastest-growing sector in the global economy, accounting for a satisfactory share of overall output and employment in most developed countries (Ibrahim & Mayende, 2019). Service delivery defines a relationship between an organization providing services and the clients who are recipients of the services delivered, in which clients either gain or lose value in the services offered by the organization. Service delivery is used to measure performance. High-quality service leads to customer satisfaction, retention, and organizational success.

The implication of poor service delivery may lead to decreased trust and confidence on the part of the clients. Effective service delivery is very fundamental, companies take into cognizance the influencing factors of service delivery before providing services to customers, and these services need to be customized based on customers' needs (Sala et al., 2019). For customer satisfaction provision of high levels of service becomes paramount since it is the key to success in service industries. To ensure effective service delivery, the standard of execution of service must meet the customer's satisfaction. In the banking sector, for instance, customers can

access customer support services anytime through the bank App., Webchat sessions, and short message notifications. This means customers now expect companies to know who they are when they call and respond to inquiries quickly, and resolve complaints. Customers expect that such should be visible in other service delivery agencies as government organizations, regardless of time and location. Service delivery has to do with the availability of effective services in a quick possible way to the intended recipient implying a degree of excellence on the part of the organization (Karanja & Juma, 2020). Service delivery is also one of the important functions of an organization such as the library. Service delivery according to Gaitho (2017) relates both to the provision of tangible public goods and intangible services performed by government institutions, organizations, private companies, non-profit organizations, and individual service providers, the library as a service organization is inclusive.

Libraries serve as centers of information, learning, and knowledge acquisition for the purpose of advancing personal and professional development of the human species in all facets of human struggle. They are vital community hubs that are intended to provide factual, accurate, and timely information resources and services to the society. They are well-organized and fertile spaces that are meant for knowledge enhancement by allowing people to walk in comfortably in order to make consultations or some other research that is likely to quench their intellectual curiosity. Libraries, once repositories of printed materials, have transformed into dynamic information centers incorporating digital resources, automation, and artificial intelligence.

The role of library professionals has undergone a transformative shift, necessitating proficiency in Information and Communication Technology (ICT) skills. The contemporary library is not merely a repository of physical books but a dynamic hub of digital resources and interactive platforms. As guardians of knowledge, library professionals are now expected to navigate the intricacies of ICT with adeptness, leveraging technology to enhance information accessibility, streamline library operations, and foster innovative services. Librarians are occupied with activities that range from collection development, organization of knowledge, library services, and preservation and conservation of information resources, all geared towards making information and information resources available to the needs of all library users. Librarians who deliver services in university libraries are to adapt to the current and future trends/conditions of library users. Maria (2019) stated that service delivery of librarians in university libraries means packages of activities that the library renders to the users to enhance and achieve the goals of the parent institution. Agoh and Omekwu (2021) opined that library service delivery of librarians is essential for library processes and activities deployed by libraries to meet users' needs. This is to enhance the activities and productivity of library users. Thus, it is expected that librarians should perform optimally as they are essential personnel in the library system.

Technology has the ability to completely change the way in which industries operate. Libraries are not immune to the effects that emerging innovations and technology can have on the services they provide to patrons. Walter and Lankes (2015) opine that innovation in academic libraries should be broadly defined to include changes in existing library service programs according to the changing needs of users, new service programs that are enabled by new digital technologies and new services that support new paradigms of teaching and research. The role of library professionals has undergone a transformative shift, necessitating proficiency in Information and Communication Technology (ICT) skills. The contemporary library is not merely a repository of physical books but a dynamic hub of digital resources and interactive platforms. As guardians of knowledge, library professionals are now expected to navigate the intricacies of ICT with adeptness, leveraging technology to enhance information accessibility, streamline library operations, and foster innovative services.

For libraries to gain justification for their existence and face the ever-changing competitive environment, it is necessary that the services of libraries be improved at all levels through effective and efficient service delivery. Curry and Copeman (2005) argued that for effective library service delivery, there must be a good relationship between librarians and library users. Similarly, Jelagat (2016) opined that the library environment must be welcoming and librarians must be patient when serving users if good library service delivery is to be offered by librarians. Ayolugbe et al. (2021) suggested that the success of every university library in the present digital environment largely depends on the quality of library service delivery offered to meet the changing and dynamic information needs of library users. This paper explores how innovative technologies are reshaping librarianship, addressing challenges, and improving efficiency in information management. The discussion will cover emerging trends, the impact of digital tools on library operations, and the future trajectory of information services in an increasingly digital world.

Statement of the Problem

The rapid development of technology has significantly influenced most areas, including information services and librarianship. Traditional library services are increasingly proving inadequate in meeting the evolving needs of modern users, who demand faster, more efficient, and technology-driven access to information. Despite numerous opportunities presented by new technologies such as artificial intelligence, cloud computing, big data analytics, virtual reality, and digital collections, implementation and integration into practice remain problematic for most libraries. Challenges to the successful use of technology to transform librarianship exist. They include inadequate funding, absence of technical expertise in librarians, resistance to changes, poor infrastructure, and scarce institutional support. Despite the growing integration of technology in libraries, many institutions struggle with inadequate infrastructure, resistance to change, and limited funding (Adeleke & Nkiko, 2021). The digital divide also still exists, limiting access to new library services, especially

in developing regions. Without a strategic approach to implementing and sustaining technological advancements in libraries, there is a risk of reduced relevance, decreased user engagement, and ineffective information service delivery.

This study seeks to examine the impact of innovative technologies on transforming librarianship and information services, identify the barriers to their adoption, and propose strategies for effective implementation. By addressing these challenges, libraries can enhance their role in knowledge dissemination, improve user experience, and contribute to sustainable academic and research development.

Study Objectives

1. To examine the transformative impact of innovative technologies on librarianship and information service delivery.
2. To identify the primary challenges that limit the adoption of technological innovations in libraries.
3. To recommend strategies for improving the adoption and utilization of innovative technologies in library settings.

Research Questions

1. How has innovative technology transformed librarianship and information service delivery?
2. What are the key challenges hindering the effective adoption of innovative technologies in libraries?
3. What strategies can be implemented to enhance the integration of technology in library services?

Literature Review

The role of technology in librarianship has been widely discussed in academic literature. According to Omekwu (2004), the integration of ICT in library services has enhanced efficiency, accessibility, and user satisfaction. Ayre (2016) notes that libraries must embrace digital transformation to remain relevant in the information age. The development of artificial intelligence, cloud computing, and big data analytics has further revolutionized how information is managed (Pathak, 2021). New technologies are leading the way in reshaping library services. Chisita and Chiparausha (2019) confirm that technologies such as AI and cloud computing have enhanced the efficiency of cataloging, information retrieval, and user interaction. Modern ILS and electronic repositories make accessing information resources easy, enabling distance learning and research. Omekwu et al. (2014) present the strategic shift towards hybrid and digital library models as a consequence of user expectations and the need for efficiency. Mobile app usage and social media sites for the dissemination of information are becoming common (Adeleke & Olorunsola, 2022). Social media sites take library services out of physical walls and facilitate immediate interaction with users. Additionally, AI-based chatbots and virtual assistants now assist reference services, responding to questions around the clock (Gupta & Singh, 2020).

The integration of innovative technologies into library services has significantly transformed how information is accessed, managed, and disseminated. As digital transformation accelerates, libraries are adopting emerging technologies such as artificial intelligence (AI), blockchain, the Internet of Things (IoT), augmented reality (AR), and cloud computing to enhance efficiency, user experience, and accessibility (Kumar & Singh, 2023).

Emerging Technologies in Libraries

Artificial Intelligence (AI) and Machine Learning (ML)

AI and ML are revolutionizing library services by automating routine tasks, improving search functionalities, and enabling personalized user experiences. AI-powered chatbots, such as those used in academic libraries, provide instant responses to user queries, reducing the workload on librarians (Bansal & Joshi, 2022). Machine learning algorithms enhance information retrieval by analyzing user behavior and recommending relevant resources (Zhang et al., 2023).

Additionally, AI-driven text and data mining (TDM) tools assist researchers in extracting insights from large datasets, facilitating academic discovery (Chen & Wang, 2023). However, concerns about data privacy and algorithmic bias remain challenges in AI adoption (Alabi, 2023).

Blockchain Technology

Blockchain is gaining traction in libraries for its potential to ensure secure and transparent management of digital assets. It helps in:

- **Digital Rights Management (DRM):** Preventing unauthorized distribution of e-resources (Oyelade & Ajuwon, 2023).
- **Decentralized Scholarly Publishing:** Reducing dependency on traditional publishers through open-access blockchain platforms (Nwosu et al., 2023).
- **Authentication and Credentialing:** Verifying academic credentials and combating plagiarism (Singh & Mahajan, 2023).

Despite its advantages, blockchain implementation faces hurdles such as high computational costs and a lack of standardized regulations (Khan & Bhatti, 2023).

Internet of Things (IoT) and Smart Libraries

IoT-enabled devices, such as RFID (Radio-Frequency Identification) tags and smart shelves, enhance library operations by:

- Automating inventory management and book tracking (Igwe & Ezeani, 2023).
- Enabling self-checkout systems, reducing queues (Adeleke & Emeahara, 2023).
- Monitoring environmental conditions (e.g., temperature, humidity) to preserve rare collections (Tella et al., 2023).

Smart libraries leverage IoT to create seamless, user-friendly experiences, though concerns about cybersecurity and data breaches persist (Olanrewaju & Ajayi, 2023).

Augmented Reality (AR) and Virtual Reality (VR)

AR and VR technologies are being used in libraries to create immersive learning environments. Applications include:

- **Virtual Library Tours:** Helping users navigate library spaces remotely (Chisita & Rusero, 2023).
- **Interactive Learning:** Enhancing engagement through AR-enabled educational tools (Zhang & Liu, 2023).
- **Digital Archives Visualization:** Allowing users to explore historical documents in 3D (Kumar et al., 2023).

While promising, AR/VR adoption is limited by high costs and the need for specialized hardware (Adeyemi & Olorunsaye, 2023).

Cloud Computing and Digital Repositories

Cloud-based library management systems (LMS) facilitate:

- Remote access to e-books, journals, and multimedia resources (Oyediran-Tidings et al., 2023).
- Scalable storage solutions for digital archives (Bansal et al., 2023).
- Collaborative research through shared online workspaces (Igwe, 2023).

However, technological change also demands enormous investment in human capital. As Jegede and Onuoha (2021) assert, the success of technology in libraries depends on librarians' digital literacy and the provision of ongoing training. Lack of qualified experts renders the most advanced technologies less likely to achieve the desired effect. Based on the assertion of Eje and Dushu (2018), librarians are expected to brace up for the demand of their work by improving their skills, knowledge, and attitude to enable them to provide appropriate library service delivery. Librarians are expected to be expert searchers and, therefore, should develop information literacy skills to navigate the vast world of information (Saunders et al., 2015). Information literacy skills for the Association of College and Research Libraries (2016) are strategies employed to search, retrieve, and appropriately use information. Acquiring literacy skills is a basic need of librarians to adequately meet the needs of patrons.

Impact of Innovation Technology in Modern Librarianship

According to Ashikuzzaman (2023), the role of library professionals has undergone a transformative shift, necessitating proficiency in Information and Communication Technology (ICT) skills. The contemporary library is not merely a repository of physical books but a dynamic hub of digital resources and interactive platforms. As guardians of knowledge, library professionals are now expected to navigate the intricacies of ICT with adeptness, leveraging technology to enhance information accessibility, streamline library operations, and foster innovative services. From mastering database management systems to navigating the complexities of library management software, ICT skills have become indispensable tools in the librarian's toolkit. This paradigm shift requires a nuanced understanding of digital literacy, information retrieval systems, and the integration of emerging technologies.

Technological advancements have redefined the role of librarians from custodians of books to information specialists who curate digital resources. AI-powered chatbots, for instance, enhance user interactions by providing instant responses to queries (Bansal & Joshi, 2021). Similarly, blockchain technology ensures secure and transparent management of digital assets, reducing issues of plagiarism and unauthorized access (Alabi, 2022). Cloud computing has enabled libraries to store vast amounts of data remotely, facilitating seamless access to e-books, journals, and multimedia resources (Khan & Bhatti, 2020). Furthermore, IoT applications, such as RFID (Radio-Frequency Identification), streamline inventory management and automate check-in/check-out processes, improving operational efficiency (Singh & Mahajan, 2023).

ICT Skills for Library Professionals.

In the rapidly evolving digital landscape, the importance of ICT skills for library professionals cannot be overstated, especially as a new generation of academic librarians grows immersed in the electronic online environment. Younger librarians exhibit a natural affinity for technology-oriented services, making them more flexible and adaptable in leveraging digital resources than their older counterparts, who may be less inclined towards technology-enabled services. Information and Communication Technology (ICT) skills are indispensable for library professionals to thrive and effectively serve their users in the modern library landscape. These skills encompass various technological competencies that enable librarians to navigate the digital realm, manage digital resources, and enhance user experiences. Key ICT skills for library professionals as highlighted by Ashikuzzaman (2023) include: ICT Skills for Digital Resource Management, Enhancing Information Retrieval Capabilities, Promoting Digital Literacy, Harnessing Library Management Systems, Leveraging Social Media and Outreach. By embracing ICT skills, library professionals can continue to evolve and play a pivotal role in shaping the digital era's future of information access and dissemination.

Challenges of innovative technologies

The application of innovative technologies in transforming library and information services delivery has also brought to the fore some challenges, such as:

Inadequate Funding: Many libraries operate under tight budgets, limiting their ability to invest in cutting-edge technologies and infrastructure (Okike, 2023).

Skills Gap: Librarians often lack the necessary technical skills to implement and manage emerging technologies, highlighting the need for continuous professional development (Akinniyi & Olarongbe, 2023).

Resistance to Change: Organizational inertia and fear of redundancy contribute to resistance among staff to embrace new technologies (Obasuyi & Damilola, 2023).

Infrastructure Limitations: Unreliable electricity and poor internet connectivity in developing countries make the consistent use of digital technologies difficult (Iroaganachi & Edewor, 2020).

Digital Divide: Limited access to devices and internet connectivity among users widens the gap in information access, especially in rural areas (Tella, 2022).

Policy and Strategic Gaps: The absence of clear ICT strategies and policies undermines the institutionalization of innovative practices in libraries (Omekwu et al., 2021).

Conclusion and Recommendations

Innovative technology offers unprecedented opportunities to enhance the relevance, efficiency, and inclusivity of librarianship. The transformation from traditional to digital and hybrid service models has empowered libraries to serve users more effectively, regardless of location. However, the transition is not without its challenges, which include funding issues, skills deficits, infrastructural barriers, and institutional resistance. Addressing these challenges requires a multidimensional approach involving investment, policy support, and ongoing training. On the basis of these, the following are recommended.

Increase Investment: Governments, educational institutions, and stakeholders should allocate sufficient funding for library technological infrastructure to keep up with current trends.

Capacity Building: There is a need for adequate capacity building for professionals to meet the realities of modern times. On the strength of this, practitioners require appropriate training to
acquire skills, attitudes, and values that will support them in the task ahead. Training programs and workshops should be regularly organized to upskill library professionals.

Change Management: Libraries should implement strategies to reduce resistance, such as involving staff in planning and demonstrating the benefits of technology.

Infrastructure Development: National and institutional ICT policies should prioritize stable power supply and internet connectivity.

Promote Digital Inclusion: Libraries should develop outreach programs to bridge the digital divide by offering access to devices and digital literacy training.

Strategic Policy Frameworks: Institutions should formulate and implement comprehensive ICT policies to guide technology adoption and sustainability.

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Use of Artificial Intelligence for Cataloguing in Federal University Libraries in North-Eastern Nigeria

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Abstract

This study investigated the use of Artificial Intelligence (AI) for cataloguing in federal university libraries in North-Eastern Nigeria. The study adopted quantitative method with survey research approach as the design. The population of the study comprised of 145 librarians working in six federal universities in North-East, Nigeria. The sampling technique adopted for the study was a total enumeration considering the manageable size of the population. The instrument used was a structured questionnaires designed to collect data from the librarians. The data was analysed using frequencies and percentages. The study found out that manual cataloguing remains dominant in all the libraries studied, librarians perceived that using AI in cataloguing will reduce human error in cataloguing, moderate level of awareness and willingness to adopt AI among library staff, AI tools such as machine learning, natural language processing and OCR were most suitable for enhancing the cataloguing processes. The study finally, found that integration of artificial intelligence in library cataloguing has improve cataloguing accuracy. The study, therefore, concludes that while AI-driven cataloguing offers promising benefits, challenges such as inadequate infrastructure, low awareness, and insufficient training among library staff continue to hinder its adoption. Based on the above findings, the study recommended that universities should invest in AI infrastructure and support systems to address implementation barriers and improve cataloguing efficiency

Keywords: Innovation, Artificial intelligence, Library cataloguing,

Introduction

The integration of Artificial Intelligence (AI) into various sectors has revolutionized operations and efficiency globally, and libraries are no exception. AI technologies have redefined how information is processed, stored, and accessed, making them a critical tool in modern librarianship. Library cataloguing, a fundamental component of library operations, has particularly benefited from AI's capabilities in automating classification, indexing, and metadata generation. As libraries in developed nations adopt AI-driven systems to enhance cataloguing, it is crucial to explore its applicability in under-resourced regions, such as North-Eastern Nigeria, where academic institutions face unique challenges.

Traditional library cataloguing relies heavily on manual labour, requiring librarians to meticulously classify and index resources. This approach, while effective in the past, is increasingly inefficient in handling the vast and growing volume of academic materials in modern universities (Olubiyo & Awoyemi, 2023). Manual cataloguing is time-consuming, prone to human error, and limited in its ability to provide personalized and intuitive search experiences for users. These limitations have prompted libraries worldwide to adopt AI-based solutions to streamline their operations.

AI technologies, particularly Natural Language Processing (NLP) and machine learning, offer transformative potential for library cataloguing. These technologies can automatically classify materials, generate accurate metadata, and facilitate intelligent search functionalities (Ahmed, 2021). For instance, AI algorithms can analyse content, identify key themes, and assign appropriate cataloguing terms, significantly reducing the workload for librarians and improving the accuracy and consistency of catalogue records.

In the context of Nigerian universities, libraries face significant challenges, including inadequate funding, a lack of skilled personnel, and limited digital infrastructure (Igbo & Imo, 2024). These constraints hinder their ability to adopt and implement modern technologies. However, the growing availability of affordable AI solutions presents an opportunity to bridge these gaps. By leveraging AI, libraries in this region can enhance their cataloguing processes, improve resource accessibility, and better meet the needs of their academic communities.

The importance of effective library cataloguing cannot be overstated. Accurate and efficient cataloguing ensures that library resources are discoverable, accessible, and usable by students, researchers, and faculty members. Inadequate cataloguing systems can lead to underutilization of resources, negatively impacting academic productivity and knowledge dissemination (Oghenekaro, 2020). Therefore, addressing cataloguing inefficiencies through innovative technologies is imperative for academic libraries in Nigeria.

Globally, AI-driven cataloguing systems have demonstrated their potential to transform library services. For example, libraries in Europe and North America have successfully implemented AI tools to automate metadata generation and enhance user search experiences (Asemi & Nowkarizi, 2020). These advancements have significantly reduced cataloguing time and improved the accuracy of resource classification. Such successes provide valuable insights into how AI can be applied in other regions, including North-Eastern Nigeria.

Despite these advancements, the adoption of AI in library cataloguing in developing regions remains limited. Challenges such as lack of awareness, resistance to change, and the digital divide impede progress (Moustapha & Yusuf, 2023). Addressing these barriers requires targeted interventions, including capacity-building initiatives for librarians, investment in digital infrastructure, and advocacy for the benefits of AI technologies.

Moreover, the application of AI in library cataloguing aligns with global trends in digital transformation and knowledge management. The United Nations' Sustainable Development Goals (SDGs) emphasize the importance of quality education and equitable access to information (UNESCO, 2022). By adopting AI-driven cataloguing systems, libraries in North-Eastern Nigeria can contribute to these goals by ensuring that academic resources are accessible to a wider audience, including marginalized and underserved populations.

The role of librarians in this transformation is crucial. While AI can automate many aspects of cataloguing, librarians remain essential for overseeing and refining these processes. Training programs and professional development initiatives are necessary to equip librarians with the skills needed to work alongside AI technologies effectively (Ibrahim, 2015). Such initiatives will empower librarians to harness AI's potential while maintaining the human touch that is vital to library services.

In addition to enhancing cataloguing efficiency, AI-driven systems offer opportunities for personalization and user engagement. Intelligent search functionalities can provide users with tailored recommendations based on their preferences and research interests (Manjunatha, 2023). This personalization enhances the user experience, encouraging greater engagement with library resources and fostering a culture of academic excellence.

The adoption of AI in library cataloguing also has implications for research and innovation. By streamlining access to resources, AI can facilitate interdisciplinary research and collaboration, driving innovation in various fields. North-Eastern Nigerian universities, which face unique socio-economic challenges, stand to benefit significantly from such advancements (Abudulsalami, Kingsley–Omoyibo, Kapia, Ligola, Frieda, Ovigue, Obande & Bilal,, 2024). Enhanced cataloguing systems can support research efforts aimed at addressing local and global challenges, contributing to sustainable development.

Furthermore, the implementation of AI-driven cataloguing systems requires a supportive policy framework. Governments and educational institutions must prioritize investments in digital infrastructure and create enabling environments for technology adoption. Policies that promote public-private partnerships can facilitate the development and deployment of AI solutions tailored to the needs of academic libraries in Nigeria (Irele, 2021).

As the digital landscape evolves, libraries must adapt to remain relevant and effective. The integration of AI in cataloguing represents a significant step toward modernizing library services and addressing the challenges of information overload. By embracing innovative technologies, libraries in North-Eastern Nigerian universities can position themselves as leaders in the digital age, providing exemplary services that meet the demands of 21st-century academia.

This study seeks to explore the potential of AI in transforming library cataloguing in North-Eastern Nigeria. It aims to assess the current state of cataloguing practices, identify challenges and opportunities for AI adoption, and propose strategies for successful implementation. The findings will contribute to the growing body of knowledge on the role of AI in librarianship and provide actionable insights for stakeholders in the region.

In conclusion, the innovative use of AI for library cataloguing holds great promise for North-Eastern Nigerian universities. By addressing existing challenges and leveraging technological advancements, libraries can enhance their services, support academic success, and contribute to broader societal goals. This study underscores the need for a proactive approach to technology adoption, emphasizing the transformative potential of AI in shaping the future of librarianship.

Statement of the Problem

Despite global advancements in Artificial Intelligence (AI) for automating library cataloguing, universities in North-Eastern Nigeria continue to rely heavily on manual cataloguing practices, which are often inefficient, error-prone, and labour-intensive. These challenges hinder timely access to academic resources, negatively impacting research, teaching, and learning outcomes (Oyighan, Ukubeyinje, David-West & Oladokun, 2023). Additionally, the lack of sufficient digital infrastructure, limited funding, and inadequate training of library staff exacerbate the problem, leaving academic libraries in this region unable to meet the growing demands of their users (Sahabi & Otobo, 2021). While AI-driven cataloguing systems have demonstrated significant benefits, including accuracy, efficiency, and user personalization in other parts of the world (Ahmed, 2021; Boateng, 2014), their adoption in North-Eastern Nigerian universities remains minimal. This gap poses a critical issue, as ineffective cataloguing undermines the discoverability and accessibility of library resources, thus limiting their utility for academic and research purposes. Addressing this problem requires an in-depth exploration of the potential of AI technologies to transform cataloguing practices in these libraries, as well as an understanding of the challenges and enablers of AI adoption in resource-constrained environments.

Objective of the study

The specific objectives of the study are to:

1. identify the types of artificial intelligence technologies that can enhance library cataloguing efficiency in the context of North-Eastern Nigerian universities.

2. assess the potential benefits of integrating artificial intelligence in the cataloguing processes of university libraries in the region.
3. examine the level of readiness of library staff in North-Eastern Nigerian universities towards adopting artificial intelligence tools for cataloguing.
4. explore the impact of artificial intelligence on the accuracy, speed, and accessibility of catalogued resources in university libraries in North-Eastern Nigeria.

Research Questions

1. What types of artificial intelligence technologies are used for cataloguing processes in university libraries in North-Eastern Nigeria?
2. What are the perceived usefulness of integrating artificial intelligence into the cataloguing processes of university libraries in North-Eastern Nigeria?
3. What is the level of readiness of library staff in North-Eastern Nigerian universities regarding the adoption of artificial intelligence for cataloguing?
4. To what extent does the integration of artificial intelligence in library cataloguing impact the accuracy, speed, and accessibility of catalogued resources in universities in North-Eastern Nigeria?

Literature Review

Artificial intelligence technologies, such as machine learning algorithms, semantic web technologies, and automated metadata generation tools, have proven useful in enhancing the cataloguing process (Das & Islam, 2021). In the context of Nigerian university libraries, AI tools like Optical Character Recognition (OCR) and AI-powered cataloguing software can automate the extraction of metadata and reduce manual cataloguing efforts. These technologies can also improve resource discoverability and enable more accurate categorization of materials. However, there is a need for tailored solutions that consider the specific challenges faced by libraries in North-Eastern Nigeria, such as infrastructure and connectivity issues (Akinola, 2024).

The use of artificial intelligence in library cataloguing is perceived to enhance the efficiency and accuracy of information management. AI technologies, such as natural language processing (NLP) and machine learning, offer the potential to automate cataloguing processes, significantly reducing human error and time delays (Patrick & Neema, 2025). Several studies highlight the ability of AI to analyse large datasets, identify patterns, and generate metadata that is consistent and accurate, thereby improving the overall cataloguing process (Molaudzi & Ngulube, 2025). In Nigerian universities, AI integration could streamline cataloguing tasks, improve resource accessibility, and foster a more dynamic library system (Oyetola, Oladokun, Maxwell & Akor, 2023).

The level of awareness and readiness among library staff in Nigerian universities towards AI adoption is generally low. According to studies, many library staff members in North-Eastern Nigeria still have limited exposure to advanced technologies, which affects their ability to embrace AI-driven cataloguing systems (Perifanis & Kitsios, 2023). Additionally, a lack of proper training programs and professional development opportunities in AI-related fields contributes to the reluctance to adopt such technologies. However, there is growing recognition of the potential for AI to improve library services, prompting calls for training and capacity-building programs to prepare staff for technological advancements (Jatto & Tella, 2024).

The integration of AI in library cataloguing has been shown to improve accuracy, speed, and accessibility of catalogued resources. AI-driven cataloguing systems can process large volumes of data more quickly and accurately than traditional methods (Nishad, Sharma, Lonkar, Meshram & Dubey, 2025). Studies have demonstrated that AI reduces cataloguing errors and increases the speed at which resources are made available to users. In the context of Nigerian universities, AI could enable faster access to information, improving library service delivery and supporting the academic needs of students and researchers (Achugbue, 2024). However, these improvements depend on the effective implementation of AI technologies and overcoming the infrastructural challenges specific to the region.

Methodology

The study on the Use of Artificial Intelligence for Cataloguing in North-Eastern University libraries adopted quantitative method with survey research design. A survey was conducted among 145 library staff in the selected universities in North-Eastern Nigeria to gather data on current cataloguing practices, challenges faced, and the awareness and readiness for AI adoption. The sampling technique adopted for the study was a total enumeration. The instrument used was a structured questionnaires designed to collect information on perceived benefits of AI, and staff preparedness for AI integration, types of artificial intelligence technologies and impact of artificial intelligence among librarians. The data was analysed using descriptive statistics such as frequencies and percentages.

Data Analysis and Presentation of Findings

This section presented the data analysis and interpretation in line with the specific objectives that guided the study.

Demographic Information

Table 1: Response Rate

S/N	Respondents Institutions	No of Respondents	Questionnaire Distributed	Questionnaire Returned	% of Questionnaire Returned
1	Abubakar Tafawa Balewa University, Bauchi	37	37	35	95
2	Federal University Kashere	21	21	21	100
3	Federal University Gashau	13	13	13	100
4	University of Maiduguri	44	44	43	98
5	Madibbo Adama University Yola	13	13	13	100
6	Federal University Wukari	17	17	17	100
	Total	**145**	**145**	**142**	**98**

The study achieved a high response rate, with 98% of the distributed questionnaires being returned. This high return rate indicates strong participation from respondents, ensuring the reliability of the findings. Notably, Federal University Kashere, Federal University Gashau, Madibbo Adama University Yola, and Federal University Wukari all had a 100% response rate, suggesting high engagement. Meanwhile, Abubakar Tafawa Balewa University and the University of Maiduguri had slightly lower response rates of 95% and 98%, respectively, but these figures still reflect excellent participation levels.

Research Question One: What types of artificial intelligence technologies are used for cataloguing processes in university libraries in North-Eastern Nigeria?

Table 2: Artificial Intelligence Technologies for Library Cataloguing

SN	Statement	SA	%	A	%	D	%	SDA	%
1	Machine Learning improves cataloguing accuracy and speed	20	14	120	85	2	1	0	0
2	Natural Language Processing enhances classification and keyword tagging	21	15	100	70	20	14	1	1
3	Optical Character Recognition converts printed materials into digital records	20	14	102	72	20	14	1	1
4	AI-powered chatbots assist in real-time cataloguing	40	28	80	56	20	14	2	1
5	Semantic Web improves resource discoverability	40	28	90	63	9	6	3	2
6	AI automates metadata generation, reducing errors	90	63	42	30	10	7	0	0
7	AI recommendation systems suggest relevant classifications	10	7	90	63	30	21	2	1
8	Voice Recognition enables hands-free data entry	10	7	95	67	30	21	7	5
9	AI image recognition helps catalogue visual materials	11	8	96	68	35	25	0	0
10	Blockchain AI enhances cataloguing security.	30	21	96	68	15	11	1	1
11	AI classification tools improve resource organization	40	28	95	67	5	4	2	1
12	AI implementation requires staff training	90	63	50	35	0	0	2	1

The responses in table 2 suggest strong agreement that various AI technologies enhance cataloguing. Machine learning (99%), natural language processing (85%), and OCR (86%) were highly supported for improving accuracy and classification. AI-powered chatbots (84%) and the semantic web (91%) were also seen as

beneficial for discoverability. Moreover, 93% acknowledged AI's role in automating metadata generation, while 70% believed in AI-based recommendation systems. Notably, 74% supported voice recognition for data entry. The results indicate a strong perception that AI can significantly modernize library cataloguing systems.

Research Question Two: What are the perceived usefulness of integrating artificial intelligence into the cataloguing processes of university libraries in North-Eastern Nigeria?

Table 3: Perceived Usefulness of Integrating Artificial Intelligence

SN	Item	SA	%	A	%	D	%	SD A	%
1	AI integration in cataloguing improves the speed of processing library materials	**30**	**21**	**92**	**65**	**20**	**14**	**0**	**0**
2	Artificial intelligence enhances the accuracy of metadata creation during cataloguing	**50**	**35**	**90**	**63**	**3**	**2**	**0**	**0**
3	The use of AI minimizes human errors in cataloguing processes	**80**	**56**	**60**	**42**	**2**	**1**	**0**	**0**
4	AI-driven cataloguing systems simplify the retrieval of library materials for users	**20**	**14**	**90**	**63**	**30**	**21**	**2**	**1**
5	Artificial intelligence reduces the workload of library staff in cataloguing operations	**85**	**60**	**55**	**39**	**0**	**0**	**2**	**1**
6	The application of AI in cataloguing improves the overall efficiency of library services	**108**	**76**	**34**	**24**	**0**	**0**	**0**	**0**
7	AI technology enables faster updating and maintenance of library catalogues	**25**	**18**	**110**	**77**	**7**	**5**	**0**	**0**
8	The use of AI ensures consistency in cataloguing practices across different library collections	**102**	**72**	**39**	**27**	**1**	**1**	**0**	**0**
9	AI tools can enhance the discoverability of resources through advanced search capabilities	**101**	**71**	**40**	**28**	**1**	**1**	**0**	**0**
10	Integrating AI in cataloguing promotes better resource organization and management	**100**	**70**	**30**	**21**	**8**	**6**	**4**	**3**
11	The integration of AI in cataloguing can help libraries adapt to evolving user needs.	**80**	**56**	**50**	**35**	**10**	**7**	**2**	**1**
12	AI technologies facilitate the inclusion of digital and multimedia resources in library catalogues	**92**	**65**	**50**	**35**	**0**	**0**	**0**	**0**

The result from table 3 reveal widespread support for AI integration in cataloguing, with 86% of respondents (SA and A) agreeing that AI improves speed and accuracy. A significant 98% agreed that AI minimizes human errors, and 99% saw efficiency improvements in library services. AI was also recognized for reducing staff workload (99%), improving cataloguing consistency (99%), and enhancing resource discoverability (99%). These findings strongly indicate that AI adoption would significantly enhance cataloguing efficiency, accuracy, and overall library service quality.

Research Question Three: What is the level of readiness of library staff in North-Eastern Nigerian universities regarding the adoption of artificial intelligence for cataloguing?

Table 4: Level of Readiness of Library Staff Towards Adopting Artificial

SN	Item	VH	%	H	%	L	%	VL	%
1	I am aware of AI in cataloguing	30	21	90	63	20	14	2	1
2	I have trained in AI cataloguing tools	30	21	25	18	50	35	37	26
3	I am confident using AI for cataloguing	20	14	95	67	25	18	2	1
4	My library supports AI training	40	28	90	63	9	6	0	0
5	AI improves cataloguing efficiency	120	85	21	15	0	0	1	1

6	I am willing to adopt AI tools	50	35	7	5	75	53	10	7
7	My library has AI infrastructure	30	21	100	70	10	7	2	1
8	I am willing to learn AI tools	30	21	100	70	10	7	2	1
9	Management supports AI adoption	20	14	90	63	20	14	12	8
10	AI reduces cataloguing workload	20	14	102	72	20	14	2	1
11	I know AI tools for libraries	25	18	105	74	10	7	2	1
12	AI implementation support is available	20	14	105	74	13	9	4	3

The result in table shows moderate awareness and willingness to adopt AI among library staff. While 84% of respondents reported awareness of AI in cataloguing, only 39% had received training, indicating a skills gap. Confidence in using AI tools was moderate, with 81% feeling confident. However, library support for AI training was high (91%), and 85% believed AI improves efficiency. Interestingly, while 40% were willing to adopt AI, 60% showed hesitation, possibly due to infrastructure limitations or a lack of training. Nonetheless, 91% agreed that their library had the necessary infrastructure for AI adoption, showing potential for implementation.

Research Question Four: To what extent does the integration of artificial intelligence in library cataloguing impact the accuracy, speed, and accessibility of catalogued resources in universities in North-Eastern Nigeria?

Table 5: Impact of AI on Accuracy of Catalogued Resources

SN	Item	SA	%	A	%	D	%	SDA	%
1	AI reduces errors in metadata entry	90	63	50	35	2	1	0	0
2	AI improves consistency in bibliographic records.	110	77	30	21	0	0	2	1
3	AI enhances subject classification and indexing	105	74	37	26	0	0	0	0
4	AI reduces duplication of catalogue records	110	77	30	21	0	0	0	0
5	AI improves resource descriptions and annotations	40	28	90	63	12	8	0	0
6	AI minimizes misclassification of library resources	100	70	40	28	2	1	0	0
7	AI enhances the reliability of search results	120	85	20	14	0	0	2	1
8	AI updates and refines cataloguing standards	50	35	20	14	0	0	2	1
9	AI improves resource accessibility through accurate metadata	130	92	12	8	0	0	0	0
10	AI enhances the efficiency of resource organization	130	92	5	4	7	5	0	0
11	AI achieves higher cataloguing accuracy than manual methods	100	70	17	12	20	14	5	4
12	AI still requires human oversight for accuracy	0	0	80	56	60	42	2	1

Table 5 revealed that AI was overwhelmingly seen as improving cataloguing accuracy. A majority (98%) agreed that AI reduces errors in metadata entry, enhances bibliographic record consistency (98%), and improves subject classification (100%). Additionally, 98% recognized AI's role in reducing duplication, and 91% noted its effectiveness in refining cataloguing standards. AI was also found to improve search result reliability (99%) and resource accessibility (100%). However, while 70% believed AI outperforms manual methods, 56% emphasized the need for human oversight, indicating that AI should complement, rather than replace, human intervention in cataloguing.

Discussion

Table 2 findings confirm that AI technologies like machine learning, natural language processing, and optical character recognition enhance cataloguing accuracy and classification (Nishad, Sharma, Lonkar, Meshram, & Dubey, 2025). AI-powered chatbots and the semantic web improve resource discoverability, aligning with research on automated search tools (Jatto & Tella, 2024). The recognition of AI-driven metadata generation supports literature emphasizing automation in cataloguing (Akinola, 2024). The findings suggest that AI can modernize library cataloguing systems for improved efficiency (Molaudzi & Ngulube, 2025).

Table 3 results show strong support for AI in cataloguing, reinforcing studies on its efficiency, accuracy, and ability to minimize errors (Molaudzi & Ngulube, 2025). Research also emphasizes AI's role in improving service delivery and reducing staff workload, aligning with the majority response (Oyetola, Oladokun, Maxwell & Akor, 2023). AI's potential to enhance resource discoverability is consistent with studies highlighting automation in metadata generation (Das & Islam, 2021). The findings suggest that AI adoption would significantly improve cataloguing processes (Achugbue, 2024).

The result in Table 4 reveals that while there is moderate awareness and a fairly positive attitude toward adopting AI for cataloguing among library staff, several challenges remain. A significant majority (84%) are aware of AI in cataloguing, yet only 39% have received relevant training, highlighting a critical skills gap. Confidence in using AI is relatively high at 81%, and most staff (91%) believe their libraries support AI training, which is encouraging. Furthermore, 85% agree that AI enhances cataloguing efficiency. However, only 40% of respondents are fully willing to adopt AI tools, suggesting lingering hesitations due to limited exposure, lack of confidence, or infrastructure concerns. This aligns with Perifanis and Kitsios (2023), who found that many library staff in North-Eastern Nigeria lack sufficient exposure to advanced technologies. Jatto and Tella (2024) also emphasized the need for more robust training and professional development to close these gaps. Despite current limitations, the availability of AI infrastructure in many libraries presents a strong foundation for future adoption, provided targeted capacity-building initiatives are implemented.

Table 5 results validate existing research on AI's role in improving cataloguing accuracy by reducing errors and duplication (Patrick & Neema, 2025). AI's ability to enhance bibliographic record consistency and refine subject classification aligns with studies on automated cataloguing standards (Oke, 2020). While AI is seen as superior to manual methods, concerns about human oversight are consistent with literature discussing the balance between automation and professional judgment (Perifanis & Kitsios, 2023). AI should complement, rather than replace, human expertise in library cataloguing (Akinola, 2024).

Conclusion

In conclusion, this study reaffirms the existing literature on the inefficiencies of traditional cataloguing methods in North-Eastern Nigerian university libraries and the potential of artificial intelligence to enhance efficiency, accuracy, and accessibility. While AI-driven cataloguing offers promising benefits, challenges such as inadequate infrastructure, low awareness, and insufficient training among library staff continue to hinder its adoption. Addressing these barriers through targeted investments in digital infrastructure, capacity-building programs, and policy frameworks is essential for the successful implementation of AI in library cataloguing. Ultimately, leveraging AI technologies can significantly improve information management in university libraries, supporting better service delivery for students and researchers.

Recommendation

Based on the findings of this study the following recommendations were made:

1. Librarians in should as a matter of urgency adopt the use of artificial intelligence for cataloguing in order to enhance their performance.
2. The universities should organize regular AI training workshops for library staff to bridge the skills gap and enhance AI adoption in cataloguing
3. The universities should invest in AI infrastructure and support systems to address implementation barriers and improve cataloguing efficiency

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Use of Digital Technologies for Teaching among Lecturers in Federal Polytechnics in North-Central, Nigeria

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Abstract

This paper examined the use of digital technologies for teaching among lecturers in federal polytechnics in North-Central, Nigeria. The study was guided by three objectives and three research questions. The objectives of the study were to: ascertain the teaching activities among lecturers in federal polytechnics in North-central, Nigeria; identify the types of digital technologies available for teaching in federal polytechnics in North-central, Nigeria;and utilisation of digital technologies for teaching by lecturers in federal polytechnics in North-central, Nigeria. The total population for the study consisted of 2,455 lecturers drawn from the federal polytechnics in North-central, Nigeria. Krejcie and Morgan table was used to determine the sample size of the study which was 333. Questionnaire and checklist were the research instruments used for data collection. Out of 333 copies of questionnaire administered, 261 copies were filled, returned and used for the analysis representing 78% response rate. Descriptive statistical tools, mean and standard deviation were used to analyse the data. The findings of the study revealed among others that teaching activities carried out by lecturers such as lectures, organising workshops and laboratory sessions, project, field trips and industrial attachment supervisions, mentoring and advising students were strongly agreed had weighted mean score $\bar{x}$ of 2.90. The study concluded that the roles of digital technologies in teaching cannot be underestimated because digital technologies is helping to solve many problems in the educational institutions especially the polytechnic system. The study recommended among others that the management of federal polytechnics in North-central, Nigeria should develop programmes through conferences, workshops and seminar organised for lecturers to enhance their teaching activities as well as learning process of students especially with the usage of digital technologies.

Keywords: Digital technologies, Lecturers, Teaching, Use

Introduction

Teaching is regarded as both an art and science. As an art, it lays stress on the imaginative and artistic abilities of the teacher in creating a worthwhile situation in the classroom to enable students to learn. As a science, it sheds light on the logical, mechanical, or procedural steps to be followed to attain an effective achievement of goals. Different educationists hold different ideas regarding the concept of teaching (Isola, 2019). Various activities are carried out in polytechnics such as learning, research, community development and teaching.

The various teaching activities carried out by lecturers include lecture delivery, discussions, giving assignments, setting examinations and test questions, grading assignment and examinations and proving feedback to students, supervising student projects, taking students to field trips, organising practical classes among others. Education in the 21st century has experienced a lot of innovative changes ushered in by technology. This changes has affected a wider area of coverage in educational institutions including teaching and learning. Educational institutions all over the world have recognised the important role technology play in the teaching and learning environment. This is why teaching and learning all over the world has experienced a shift from the existing traditional approach to accommodate the digital based learning environment.

This could be the reason why Idika *et al*. (2021) defined digital technologies as information, communication and administration of technologies and software which ranges from devices such as computers, laptops and tablets that are either connected or not to the Internet and mobile phones equipped with Global Positioning System (GPS) sensors of different kinds, as well as whiteboards and projectors with or without interactivity. In a similarly view, Schriever (2018) defined digital technology as a branch of information communication technology (ICT) that enables access to share of information and also provides a means of communication.

According to Cambridge International (2017), digital technology can be taken to mean digital processing systems that encourage active learning, knowledge construction, inquiry and exploration on the part of the learners which allow for remote communication as well as data sharing to take place between teachers and/or learners in different physical classroom locations. In this study, digital technologies are instructional technologies which include computer hardware and software, tools and techniques that are used in or outside lecture rooms in facilitating, and improving the effectiveness and efficiency of teaching and learning. Specifically, digital technologies refer to the common technology-based tools such as computer, digital camera, scanner, DVD player, digital pen, PC video camera, mobile phone and projector that are being used by lecturers and students to facilitate teaching and learning processes. Sadaf-Salavati (2019) argued that terms such as information technology (IT), information and communication technology (ICT) and educational technology are used interchangeably to describe digital technology.

The utilisation of digital technologies in teaching has the potential for enhancing greater achievement among lecturers through effective teaching as well as collaborations with researchers in other institutions by opening of wider opportunities to share information. The utilisation of digital technologies in teaching expands the range of choices and opportunities by facilitating greater access to educational resources. It also opens up

equal opportunities as well as helps to level the playing field by increasing students' participation. The ineffective use of digital technologies in teaching and learning limits the teaching and learning process and outcomes (White-Harris, 2017).
In situations where these digital technologies are accessible but not utilised, it results in a low pace in teaching which consequently, will affect the learning process and outcome of producing students who can favorably compete with other students elsewhere in the world. Pathetic as it may be most polytechnics in the developing countries fall in this category of which those in North-central, Nigeria are among. It is therefore saddening that the use of digital technologies in polytechnics are bedeviled by a lot of factors. Utilisation is an important factor that may influence the impact of digital technologies in teaching and learning. It is for this reason that this study investigated the use of digital technology for teaching among lecturers in federal polytechnics in North-central, Nigeria.

1.2 Statement of the Research Problem

Teaching is one of the activities carried out by lecturers in polytechnics. It enables them to create new ideas and develop the competencies and skills necessary for students to contribute to the nation's development. Due to the importance of teaching, lecturers are expected to apply multiple tasks and goals simultaneously while imparting knowledge to students using modern technology. The continued reliance on the use of traditional tools for teaching such as blackboards, chalks and printed materials leads to limited engagement and interactivity, insufficient use of time and resources, outdated contents and materials as well as impeding the ability of lecturers to provide high-quality, inclusive and effective education and must be addressed through the integration of digital tools and innovative teaching methods.
Hence, it was observed by the researcher that most lecturers in federal polytechnics in North-central, Nigeria do not have the required digital knowledge and right attitude to confidently and creatively integrate digital technologies for teaching and instructional delivery. These limit the knowledge of lecturers on digitally based learning environment and also causing negligence in the use of digital tools for effective teaching.
Internet bandwidth in the polytechnics are not functioning at its optimum point as expected which affect optimal and effective utilisation. Lecturers require students to come with their laptops during practical classes because there are no computers to be used in the computer laboratory. These and more raise doubts on the utilisation of digital technologies in teaching by lecturers in federal polytechnics. Therefore, it is against this backdrop that this study assessed the use of digital technologies for teaching among lecturers in federal polytechnics in North-central, Nigeria.

Aim and Objectives of the Study

The aim of this study is to investigate the use of digital technologies for teaching among lecturers in federal polytechnics in North-central, Nigeria. The specific objectives were to:

1. ascertain the teaching activities among lecturers in federal polytechnics in North-central, Nigeria;
2. identify the types of digital technologies available for teaching in federal polytechnics in North-central, Nigeria;
3. find out the extent of utilisation of available digital technologies by lecturers for teaching in North-central, Nigeria.

Literature Review

2.1. Teaching Activities among Lectures in Polytechnics

Digital tools refer to online resources and offline tools that enable effective teaching and learning by lecturers and students. Examples of digital tools include graphic tablets, interactive whiteboards, social media applications, learner management systems and so on. Oikonomou and Patsala (2021), described digital technology tools as software, programmes, applications, platforms, and resources (online or offline) that can be used with computers, mobile devices or other digital devices, and which incorporate text, audio and visual stimuli. Additionally, Olurinola (2020) clarifies digital technology tools as educational programs, websites or online resources and digital processing systems that encourage active learning, knowledge construction and exploration in the teaching and learning process. These definitions point to the technical nature of digital technology tools and their association with benefits such as access to information, visualisation of critical concepts, personalisation of teaching and learning and automation (Srinka, 2022; Heick, 2020).
Considering the influence evolution in technology has had on developments in education, one has to consider the corresponding effects in teaching. Technology integrates every branch of learning, providing the management of educational sectors with a heterogenous collection of technological tools and assets to produce, store, transfer, control and optimise information. In education, digital tools (which are technological tools) enforce, promote and augment the delivery of information. Its implementation in education provides movements and methods of integrating ICT into educational activities (Mohammed, 2021). Furthermore, digital technology tools amplify 21st Century skills such as critical thinking, collaboration, communication, creativity and digital literacy. As a result, educational practices are subjected to critical reviews and changes that are arguably the outcome of developments in information and communications technology (Idika and Ezinwa, 2023).
According to Idika and Ezinwa (2023), previous studies conducted have revealed that the proper use of digital technologies can increase the quality of education and link learning to real-life situations. However, the use of digital technologies are associated with a lot of challenges which can affect the effective teaching as well as

learning in the polytechnic environment. Lecturers struggle with the disruptions that digital technology tools can trigger, especially when they are used inefficiently (Hyndman, 2018). Integrating digital technologies in teaching and learning vary in different conditions based on their application. Nevertheless, certain significant steps such as provision of required digital technologies and extensive training of lecturers can be taken to solve the problems associated with the use of digital technologies in teaching.

2.2 Types of Digital Technologies Available for Teaching in the Federal Polytechnics

Issues around lecturing in large classes in Nigeria tertiary institutions are becoming more overwhelming probably due to factors associated with already existing crises and challenges confronting the current practice and trends which include overcrowding in lecture rooms resulting from infrastructure deficit; poor classroom control and management (Aina *et al*., 2020). In an attempt to curtail these menaces, lecturers as well as students in polytechnics and other tertiary institutions of learning can import the use of digital technology that have the potential to effectively manage the outrageous number of students in a class.

Marafa and Shehu (2023) identified some of the digital technologies for teaching and learning which include: Edmodo Device, Socrative Device, Project Device, TED-Ed, EduClipper, Animoto, smart phones, Notability and GoConqr

1 Edmodo device

Edmodo is an educational tool that connects lecturers and students and is assimilated into a social network. Using Edmodo device, lecturers can create online collaborative groups, administer and provide educational materials, measure students' performance among other functions. According to Aina *et al*. (2020), Edmodo has more than 34 million users who connect to create a learning process that is more enriching, personalised, and aligned with the opportunities brought by technology and the digital environment.

2 Socrative device

Socrative device is a system that allows lecturers to create exercises which students can solve using mobile devices, whether smartphones, laptops or tablets. Lecturers can see the results of the activities and can modify the subsequent lectures in order to make them more personalised.

3 Project device

This project is a tool that allows lecturers to create multimedia presentations, with dynamic slides in which they can embed links, online quizzes, Twitter timelines and videos among other options. According to Abah (2019), during a lecture session, lecturers can share with their students, their academic presentations which are visually adapted to different devices.

4 TED-Ed

It is an educational platform that allows creating educational lessons with the collaboration of lecturers, students and people who want to expand their knowledge and good ideas. This website allows access to information for both teachers and students. Using TED-Ed, people can have an active participation in the learning process of others (Aina *et al.,* 2020).

5 EduClipper

This platform allows lecturers and students to share and explore references and educational material. In the EduClipper, lecturers can collect information found on the internet and then share it with the members of previously created groups, which offers the possibility to manage more effectively the academic content found online, improve research techniques, and have a digital record of what students achieved during the course. Likewise, it provides the opportunity for lecturers to organise a virtual class with their students and create a portfolio where all the work carried out is stored (Song, 2017).

6 Animoto

This is a digital tool that allows lecturers to create high-quality videos in a short time and from any mobile device, inspiring students and helping improve academic lessons. The Animoto interface is friendly and practical, allowing lecturers to create audiovisual content that adapts to educational needs. (Abah, 2019)

7 Smart Phones

The smartphone has become one of the most valuable tools for students in higher education and has come to play an important role in in-class learning, study organisation and management, dealing with finances, and personal safety and security.(Abah, 2019; Aina, *et al.*, 2020).

8 Notability

Notability has been ranked as one of the best note-taking apps available. More than a note-taking app, students can annotate PDFs/images/GIFs, brainstorm their ideas and make quick and easy notes of them for future reference, record lectures, and many other functions. Students can often find it difficult to follow lectures while attempting to take notes. This app lets students manage their own lectures and notes, plus share, connect, and synchronise with other students. Notability can synchronize with Dropbox, Google Drive, and One Drive (Song, 2017).

9 GoConqr

In an attempt, to retain the massive information that accumulates over the course of a semester or the first few weeks of school resumption can be so challenging. However, GoConqr can assist with this challenge by providing students with interactive functions such as courses, mind maps, flashcards, notes, quizzes, slides, and flowcharts. This is education and learning management at its best. This app features an extensive digital library for students, the means for lecturers to create their own learning materials and create an interactive community among their students and can provide and support institutions with campus portals and campus groups (Abah, 2019; Aina, *et al*., 2020).

2.3 Extent of Utilization of Available Digital Technologies by the Polytechnic Lecturer

Technology has become an integral part of human life in the 21st century. The advent of globalisation is largely due to the advent of technology. It is probably in recognition of this that technological or digital literacy is an important skill of the twenty -first century. The sure way to equip students is by integrating technology for teaching and learning. According to Danlami, (2021), technology integration in Education is a process by which lecturers plan and use technology purposefully and meaningfully to enhance teaching and learning rather than using it randomly, arbitrarily sporadically. According to Abani, (2015), meaningful integration can only occur when lecturers are grounded in technology and can perceive the interplay between it and content knowledge. Siyam, (2019) posited that successful integration aims at utilising accessible and readily available resources to help students to be more actively involved in the learning process and be engaged in various projects.

The lecturers' perception is a pertinent issue in technology integration for teaching and learning. Despite the advantages of digital technology, many lecturers experience a lack of training opportunities to help them to fully understand how to use and implement the digital technology with their students (Ajuwon *et al.* 2016). The researchers further noted that, lecturers are aware of the significant benefit of how digital technology can support and help them in teaching. However, they are faced with some challenges such as cost and lack of training or preparation to use digital technology during lectures. Many lecturers reported that they need additional practice and experience on how to select, adjust and implement the digital technology tool to be able to provide the appropriate support for students in learning literacy.

Lecturers benefit from the effective use of digital technology as it can provide them with more options to use in addressing different teaching needs. Digital technology also allows lecturers to spend more time on group activities and to give students more one - on - one attention but all these depend to a large extent on how much a lecturer knows about digital technology devices and how competent the lecturers is in the use of these devices.

Methodology

The study adopted descriptive survey research design in order to gather data for the study. Descriptive research design is a type of design that describes a population, situation or phenomenon that is being studied. Hess *et al.* (2022) defined survey research as a method used to collect data that is used to gain insight on a specific topic. The population of the study was 2,455 which consisted of lecturers drawn from the federal polytechnics in North-central, Nigeria. The sample size of the population was 333. Krejcie and Morgan 1970 sampling table was used to determine the sample size of the population. The research instruments used for data collection for this study were questionnaire and checklist. The data from this study were organised and analysed using descriptive statistical tools such as the use of frequency tables, percentages, mean and standard deviation.

Results and Discussion

Table 1: Teaching Activities Carried out by Lecturers

S/N	Statements	SA	A	D	SD	N	FX	$\bar{x}$	STD	Decision
		4	**3**	**2**	**1**	**261**				
1	I lecture my students	113	97	27	24	261	821	3.14	0.65	Agreed
2	I take part in seminars and tutorials	73	98	62	28	261	738	2.83	0.33	Disagreed
3	I organise laboratory sessions	72	85	77	27	261	724	2.77	0.27	Disagreed
4	I organise workshops for students	99	105	39	18	261	807	3.09	0.59	Agreed
5	I assess and grade students assignments, tests and examinations	88	106	38	29	261	775	2.97	0.47	Agreed
6	I take part in curriculum development	33	45	91	92	261	541	2.07	0.43	Disagreed
7	I mentor and advise students	88	120	37	16	261	802	3.07	0.57	Agreed
8	I supervise research projects	107	99	34	21	261	814	3.19	0.62	Agreed
9	I supervise field trips and industrial attachment	109	73	42	37	261	776	2.97	0.47	Agreed
	Weighted mean							**2.90**		

Key: Strongly Agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD), n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Weighted mean = 2.90)

Table 1 showed the teaching activities carried out by lecturers. Out of the nine items listed, six items listed produced high mean scores which were above the weighted mean of 2.90. These items include item 8: I supervise research projects ($\bar{x}$=3.19; SD=0.62), item 1: I lecture my students ($\bar{x}$=3.14; SD=0.65), item 4: I organise workshops for students ($\bar{x}$=3.09; SD=0.59), item 7: I mentor and advise students ($\bar{x}$=3.07; SD=0.57), item 5: I assess and grade students assignments, tests and examinations ($\bar{x}$=2.97; SD=0.47) and item 9: I supervise field trips and industrial attachment ($\bar{x}$=2.97; SD=0.47). On the other hand, three items produced low mean scores which were below the weighted mean of 2.90. These items include item 2: I take part in seminars and tutorials ($\bar{x}$=2.83; SD=0.33), item 3: I organise laboratory sessions ($\bar{x}$=2.77; SD=0.27) and item 6: I take part in curriculum development ($\bar{x}$=2.07; SD=0.43). The weighted mean of 2.90 and above is considered as the mean rate of the teaching activities carried out by lecturers in the study areas. Above all, the highest mean score was discovered from item 8 on the supervision of research projects. This is not far from the fact that lecturers are expected to supervise students' (both undergraduate and postgraduate) projects, theses and dissertations before the exit of their programme. From the analysis, the study revealed that items 8, 7, 1 and 4 was strongly agreed, while items 5 and 9 was agreed by the respondents. On the other hand items 2, 3 and 6 were strongly disagreed as teaching activities carried out by lecturers.

Table 2: Types of Digital Technology available for Teaching

	Name of Federal Polytechnics											
Digital Technologies	**Federal Polytechnic, Bida**		**Federal Polytechnic, Idah**		**Federal Polytechnic, Nasarawa**		**Federal Polytechnic, Nyak**		**Federal Polytechnic, Offa**		**Federal Polytechnic, Wannune**	
Types of Digital technology	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA
Laptops	√		√		√		√		√		√	
Smartphones	√		√		√		√		√		√	
Collaboration tools	√		√		√			X	√			X
Digital content creation tools such as Adobe spark	√			X		X		X	√			X
Video conferencing tools such as online quizzies, kahool and quiziz		X		X		X		X		X		X
Virtual whiteboards		X		X		X		X		X		X
Electronic smart boards		X		X		X		X		X		X
Learning management system such as Moodle	√		√		√			X	√			X
Digital camera	√		√		√			X	√			X
Digital pen		X		X		X		X		X		X
DVD Player	√		√		√			X	√			X
Projectors	√		√		√		√		√		√	
Smart boards		X		X		X		X		X		X

Key: Available (√), Not Available (x)

The result in Table 2 showed the types of digital technologies available and those not available in the federal polytechnics in North-central, Nigeria. Six (6) of the federal polytechnics had laptops, smartphones and projectors, while collaborative tools, digital camera and learning management system such as Moodle were available in only four (4) federal polytechnics (Bida, Idah, Nasarawa and Offa) respectively. Similarly, digital content creation tools such as Adobe spark were available in only two (2) federal polytechnics (Bida and Offa) respectively. On the other hand, video conferencing tools such as online quizzies, kahool and quiziz, virtual whiteboards, electronic smart boards, digital pen and smart boards were not available in all the six (6) federal polytechnics.

Table 3: Extent of Utilisation of Available Digital Technologies by Lecturers for Teaching

S/N	Statements	VHE 4	HE 3	LE 2	VLE 1	n 261	FX	$\bar{x}$	STD	Decision
1	I use digital technologies in preparing lecture notes	86	105	57	13	261	786	3.01	0.51	Agreed
2	I use digital technologies to surf through the Internet for research purposes in teaching students	122	103	30	6	261	863	3.31	0.81	Agreed
3	I use digital technologies to project lecture notes and for presentation by students	87	93	57	24	261	765	2.93	0.43	Agreed
4	I use digital technologies to access bulk of information on the world wide web	91	80	49	41	261	743	2.84	0.34	Agreed
5	I use digital technologies to carry out complex analysis	19	53	105	84	261	529	2.03	0.47	Disagreed
6	I use digital technologies with the use of electronic interactive smart boards for instructional delivery	29	40	120	72	261	548	2.09	0.40	Disagreed
	Weighted mean							**2.70**		

Key: Very High Extent (VHE), High Extent (HE), Low Extent (LE), Very Low Extent (VLE)

n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Weighted mean = 2.49)

Table 3 showed the extent of utilisation of available digital technologies by lecturers for teaching. Out of the six items listed, four items listed produced high mean scores which were above the weighted mean of 2.70. These items include item 2: I use digital technologies to surf through the Internet for research purposes in teaching students ($\overline{x}$=3.31; SD=0.81), item 1: I use digital technologies in preparing lecture notes ($\overline{x}$=3.01; SD=0.51), item 3: I use digital technologies to project lecture notes and for presentation by students ($\overline{x}$=2.93; SD=0.43) and item 4: I use digital technologies to access bulk of information on the world wide web ($\overline{x}$=2.84; SD=0.34). On the other hand, two items produced low mean score below the weighted mean of 2.70 which are item 6: I use digital technologies with the use of electronic interactive smart boards for instructional delivery ($\overline{x}$=2.09; SD=0.40) and item 5: I use digital technologies to carry out complex analysis ($\overline{x}$=2.03; SD=0.47). The weighted mean of 2.70 and above is considered as the extent of utilisation of available digital technologies by lecturers for teaching and vice versa. Above all, the highest mean score was discovered from item 2 on the use digital technologies to surf through the Internet for research purposes in teaching students. This is not far from the fact the lecturers are expected to update their knowledge by surfing through the Internet, library and other sources to gather materials that will enable them in their teaching and research. From the analysis, the study revealed that items 2 and 1 were strongly agreed, while item 4 and 3 were agreed by the respondents as the extent they utilise available digital technologies for teaching.

Discussion

The findings of the study as regards to research question 1, revealed that lectures, organising seminars, workshops, laboratory sessions, project, field trips and industrial attachment supervisions, mentoring and advising students were teaching activities carried out by lecturers. Based on the teaching activities carried out by lecturers, the respondents indicated that the lectures organise workshops for students, assess and grade students' assignments, tests and examinations, mentor and advise students, supervise research projects and supervise field trips and industrial attachment.. This is in line with the findings of Danlami (2021) who posited that the various teaching activities carried out by lecturers include lecture delivery, discussions, giving assignments, setting examinations and test questions, grading assignment and examinations and providing feedback to students, supervising student projects, taking students to field trips, organising practical classes among others.

The findings of the study as regards to research question 2, six (6) of the federal polytechnics had laptops, smartphones and projectors, while collaborative tools, digital camera and learning management system such as Moodle were available in only four (4) federal polytechnics (Bida, Idah, Nasarawa and Offa) respectively. Similarly, digital content creation tools such as Adobe spark were available in only two (2) federal polytechnics (Bida and Offa) respectively. The availability of these digital technologies could be because they enhance effective teaching and learning. This is in line with the findings of Danlami (2021) who posited that technology integration in Education is a process by which lecturers plan and use technology purposefully and meaningfully to enhance teaching and learning rather than using it randomly, arbitrarily sporadically.

In response to research question 3, the extent of utilisation of available digital technologies by lecturers for teaching is moderate. The respondents revealed that they use digital technologies in preparing lecture notes, to surf through the Internet for research purposes in teaching students, for projecting lecture notes and for presentation by students and use digital technologies to access bulk of information on the World Wide Web.

However, majority of the respondents disagreed that they use digital technologies to carry out complex analysis and use digital technologies with the use of electronic interactive smart boards for instructional delivery. This could be because the lack experience with the use of digital technologies for teaching and instruction delivery. This is in line with the findings of Ajuwon *et al.* (2016) that despite the advantages of digital technology, many lecturers experience a lack of training opportunities to help them to fully understand how to use and implement the digital technology with their students.

Conclusion

In conclusion, the roles of digital technologies in teaching cannot be underestimated because digital technologies is helping to solve many problems in the educational institutions especially the polytechnic system. The availability of digital technologies for teaching is low. The extent of utilisation of available digital technologies by lecturers for teaching is moderate. Lecturers revealed that they use digital technologies in preparing lecture notes, surf through the Internet for research purposes in teaching students, project lecture notes and for presentation by students and use digital technologies to access bulk of information on the World Wide Web.

Recommendations

1. The management of federal polytechnics in North-central, Nigeria should develop programmes through conferences, workshops and seminar organised for lecturers to enhance their teaching

activities as well as learning process of students especially with the usage of digital technologies.

2. The management of federal polytechnics in North-central, Nigeria should provide adequate digital technologies such as online quizzies, kahool and quiziz, virtual whiteboards, electronic smart boards, digital pen and smart boards in order to enhance effective teaching activities. This will enable lecturers and students to develop critical thinking, problem-solving, communication, collaborative skills and knowledge.
3. The management of federal polytechnics in North-central, Nigeria should provide digital technologies for all lecturers at a subsidised rate so that they can effectively make adequate use of these technologies for teaching. Also, digital technologies such as electronic interactive smart boards should be provided in classrooms/lecture rooms and computer laboratories. When these measures are taken, there will be an increase in the extent of utilisation of digital technologies for teaching.

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Utilization of Digital Information Resources for Effective Research by Undergraduates in Nnamdi Azikiwe Library, University of Nigeria, Nsukka

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Abstract

This study investigated the Utilization of Digital Information Resources for Effective Research by Undergraduates in Nnamdi Azikiwe Library (NAL), University of Nigeria, Nsukka (UNN). It was necessitated due to the researcher's perceived inability of undergraduates to utilize the available Digital Information Resources (DIRs) for effective research. Six research questions guided the study. A descriptive survey design and purposive sampling was adopted for the study. The population of the study was 3,436 registered undergraduate users of NAL, UNN. A sample of 240 respondents was drawn of the population, out of which 206 responded which consist of 86% respondents. A structured questionnaire was the instrument used for data collection. Collected data was analyzed using the frequency counts, simple percentage and weight Mean. A mean score of 2.50 and above was taken to be positive. The findings showed that the library/parent institution has DIRs such as E-Mail, E-book, Online Academic Database, OPAC, E-Journal, Website, Digital Reference Collection, Social media platforms, E-Theses and Dissertation, Digital Archive, CD-Rom, Diskettes etc and undergraduates are aware of DIRs. Major challenges associated with utilization of DIRs for effective research were Poor Internet connectivity, Low power supply in library, High cost of digital resources accessibility, Lack of ICT skills by Undergraduates for research in library and High number of closed access to E-resources. Strategies to improve utilization of DIRs include to Enhance internet connectivity, Making discount for cost of E-resources accessibility, Providing backup file for digital resources, Training and orientation on use of ICT in the library and to create more open access database in the library. The major recommendations were on compulsory orientation for first year undergraduate students on the utilization of digital information resources, renewal of their subscription when it expires and finally to improve the utilization of these Digital information Resources for effective research in Nnamdi Azikiwe Library.

Keywords: *Digital Information Resources, Effective Research, Undergraduates, Utilization*

Introduction

Digital information resources (DIRs) are now essential instruments for conducting productive research in the rapidly changing academic environment of today. The transition from conventional print-based materials to digital formats has greatly expanded information availability, allowing researchers to carry out thorough and effective research. For undergraduate students, who are honing their research techniques and setting the groundwork for future academic endeavors, this shift is especially important. The University of Nigeria, Nsukka's Nnamdi Azikiwe Library is an essential center for scholarly endeavors, offering a wide range of DIRs to meet the educational and research requirements of its undergraduate students. But the mere fact that these resources are available does not ensure that they will be used effectively. The degree to which undergraduates interact with and gain from DIRs depends on a number of factors, including awareness, accessibility, information literacy, and perceived usefulness. Thus, the purpose of this study is to find out how undergraduate students at the University of Nigeria, Nsukka's Nnamdi Azikiwe Library use digital information resources for productive research. It aims to determine which DIR kinds are most commonly used, evaluate the difficulties in using them, and investigate how information literacy affects study results. In the end, this study aims to offer information that can guide strategies for boosting undergraduates' efficient use of DIRs, raising the caliber of research and academic performance at the University of Nigeria, Nsukka.

Advancement in information communication technology has made information resources available in electronic form, libraries no longer have to own an article or a certain piece of statistical information for example to obtain it quickly (Kumar, 2016). A digital library, also called an online library, an internet library, a digital repository, a library without walls, or a digital collection, is an online database of digital objects that can include texts, images, audio, video, digital documents, or other digital media formats or a library accessible through the internet. Objects can consist of digitized content like print or photographs, as well as originally produced digital content like word processor files or social media posts. In addition to storing content, digital libraries provide means for organizing, searching, and retrieving the content contained in the collection. The digital content may be stored locally and utilized remotely via computer networks. A researcher with her computer can now go directly to an online service to locate, order, and receive a copy of an article without ever

leaving her home. Although the development of digital libraries means that people do not have to go to a building for some kinds of information, users still need help to locate the information they want. In a traditional library building, a user has access to a catalog that will help locate a book. In a digital library, a user has access to catalogs to find digital information but much of the information cannot be found through one commonly accepted form of identification.

The emergence of Digital Information Resources (DIRs) in the 21st century has greatly changed the information-seeking attitude of students and undergraduates globally. Abubakar and mamman (2020) noted the global trend is characterized by a fundamental shift from the traditional information environment to Digital environment where the emphasis is placed more on the acquisition of resources such as e-books, e-journals, as well as online databases. In recent times digital information resources have been identified as the major sources of information dissemination in academic institutions. Generally speaking, Digital Information Resources play a vital role in all areas of human endeavors in academic libraries and they have increasingly become more dependent on them. According to the online Dictionary of Library and Information Science ODLIS (2004), Digital Information Resources can be defined as materials consisting of databases, magazines, archives, theses, conference papers, government papers scripts, and monographs in electronic form.

Digital information resources are available on the Internet which can be accessed free of charge via open-access or through institutions' subscriptions to provide free online database access to their customers to support academic activities, especially in the area of research, teaching, and learning (Abbas & song 2020). The major benefits of Digital information resources in academic libraries are the ease of access to information by academic users in their offices and lecture halls or at home without a physical visit to the library. Thus DIRs promote efficiency in the dissemination of information for effective research in academic institutions like Nnamdi Azikiwe Library, UNN (Thanuskod, 2012). Essentially, DIRs are more easily updated than print resources and DIRs can be accessed electronically with the use of ICT facilities (Ukachi, 2013). Digital resources provide a vast array of materials, including scholarly articles, e-books, online journals, databases, and research repositories, which can be accessed globally and instantaneously.

This accessibility of digital information resources through research activities fosters broader dissemination of knowledge across geographical boundaries, allowing researchers, academics, and undergraduates from different parts of the world to access the same information simultaneously (Adetomiwa & Okwilagwe, 2018). Furthermore, digital resources facilitate the rapid dissemination of new research findings, enabling the timely exchange of ideas and advancements within academic and professional communities through online platforms and digital libraries (Zhang, 2001). Digital resources promote collaboration and knowledge-sharing, encouraging interdisciplinary research and fostering innovation (Kanai & Umemoto, 2009). Additionally, the digitization of resources reduces barriers to entry, making knowledge more accessible and affordable to a wider audience, including individuals who may not have access to physical libraries or scholarly journals for effective research.

Research is the systematic and objective analysis and recording of controlled observation that may lead to the development of generalization, principles, and theories, resulting in the prediction and ultimate control of many events and specific activities. According to Mole (2019), research is a systematic inquiry aimed at providing adequate evidence upon which inference, conclusions, and solutions to a research problem are arrived at. Mole further stated that research entails searching and searching again until solutions to problems are found. Digital information resources are invaluable research tools that complement the print-based resources in the traditional library. Their advantages include access to information resources that might be restricted to the users due to geographical location, finances, access to more current information, and provision of extensive links to additional information resources or related content.

Effective research often serves a major role in attaining success in academic institutions as it is related to promotion, tenure, salary, etc. of researchers' academic staff (Okonedo, 2015). Effective research is as much about planning as it is about the research itself. To research effectively you must plan your research to efficiently use time and proper Digital information resources to analyze information sources carefully and cite them properly. Digital information resources appear to be very important in effective research. Quality research is a factor in functional access to Digital information resources. If Undergraduates are to conduct quality and effective research they require access to a wide range of relevant Digital information resources, up-to-date and easily accessible. DIRs can be found in various online scholarly databases and subscriptions through the library which are vehicles for effective research (Abubakar, 2009). These databases such as EBSCOhost (Elton B- Stephen company), Science Direct, AGORA (Global Online Research in Agriculture), HINARI (Health, inter-network Access to Research Initiative), OARE (Oonline Access to Research in Environment), DOAJ (Directory of Open Access Journals, JSTOR (journal storage), (IFLA,2012) and among others holds millions of scholarly articles in various areas of human endeavors. As the body of knowledge grows, the DIRs also increase because the platforms provide visibility for published research works quickly with ease and give the researcher global recognition in academic institutions.

Utilization refers "to make use of something" (Gadsby, 2000). It also means putting into service the state or manner in which particular tools and services are used for their inherent or natural purpose. The impact of Digital information resources on research has been profound, reshaping the landscape of academic inquiry and revolutionizing the way undergraduates access, share, and collaborate on knowledge. Digital information resources have empowered Undergraduates with unprecedented access to a vast array of scholarly resources, accelerating the research process of undergraduates and enabling the exploration of diverse perspectives. The

ability to connect and collaborate across geographic and disciplinary boundaries has fostered interdisciplinary research and accelerated scientific progress. Furthermore, Digital information resources have facilitated data analysis, visualization, and preservation, ensuring the long-term availability and accessibility of research outputs.

Utilization of electronic information resources refers to the act of making practical and effective use of the available Digital information resources. Digital information resource is more of a tool to assist in conducting research and also a way of scanning a lot of materials quickly (Ellis & Oldman, 2005). Also, Electronics information resources have provided excellent opportunities to access and utilize scholarly information which was previously beyond the reach of users due to a geographical constraint. Effective research by undergraduates requires the utilization of digital information resources. Digital information resources have transformed research practices, enabling undergraduates to tackle complex problems, engage in collaborative endeavors, and make significant contributions to their respective fields. As technology continues to evolve, the utilization of Digital Information Resources will remain essential in driving innovation, collaboration, and the pursuit of discoveries in research institutions. The Digital resources have emerged as one of the primary sources of information for effective research, teaching, learning activity and educational purpose by undergraduates. Undergraduates are mostly unaware of both open access and university subscribed digital resources, hence they rely primarily on Google search. According to Oladokun and Adeoye (2022) despite these benefits of digital resources, Akussah, Asante and Adu-Sarkodee (2015) and other researchers such as Lavanya, and Santharooban (2018) reported low patronage of digital resources by undergraduate users of the library with the high level of awareness of digital resources, This trend was also observed by Amankwah (2016) and Kwafoa et al. (2014) who also found that the use of digital resources has been low in some Ghanaian Universities.

Problem Statement

Many academic libraries especially those without DIRs have discovered that they experience low patronage because most of the information people seek in recent times are those that appear in digital format. This is because it is easily accessible without restrictions, at your convenience time, and place. Information access is not necessarily the problem but careful utilization. This is because undergraduates do not always understand which information resources are appropriate for their needs. Therefore, library users need skills to make comparisons between print and Digital Information Resources. Digital information resources have a positive impact on the effective research of undergraduates but could be limited by factors such as information overload, inadequate search skills, power outages, poor internet connectivity, lack of awareness, and others that make adequate researchers' use of Digital information resources barely possible. This study hence will examine the utilization of digital information resources electronically for the effective research by undergraduates in the Nnamdi Azikiwe Library, University of Nigeria, Nsukka.

Purpose of the Study

The primary purpose of this study is to examine the utilization of Digital information resources for effective research in the Nnamdi Azikiwe library at the University of Nigeria, Nsukka.

Specifically, the objectives of this study are to:

1. Identify the types of DIRs in Nnamdi Azikiwe Library, University of Nigeria, Nsukka.
2. Determine the level of awareness of DIRs by undergraduates for research in NAL, UNN.
3. Identify the benefits of DIRs to undergraduate research in NAL, UNN.
4. Examine the extent of utilization of DIRs by undergraduates for research in NAL, UNN.
5. Determine the challenges associated with the utilization of DIRs by undergraduates for research in Nnamdi Azikiwe Library, UNN
6. Proffers strategies for improving the utilization of DIRs for research in NAL, UNN

Literature Review

Digital information resources are those resources in which information is stored electronically and which require Digital systems / devices and networks to access and use (Adeleke & Nwalo, 2017). The term digital Information resources is a broad term that includes a variety of different models like e-journals, e-books, online databases, CD-ROMs, e-mail, Online Public Access Catalogues (OPACs), etc. Hence, in this context, the term DIRs (Digital Information Resources) means “a Digital product that delivers a collection of data, be it text, numerical, graphical or time based as a commercially available resource that has been published with a sole aim to be marketed and for information dissemination.” The DIRs refer to those materials that require computer access or any other Digital devices. The DIRs may either be accessed remotely via the Internet or locally.

Digital information resources (digital resources) according to Ekwelem, Okafor, and Ukwoma (2009), may be defined as information sources that are available and can be accessed electronically through computer network facilities, such as online libraries, government portals, and websites, CD - ROM databases, online academic databases such as Medline, or subscription to databases such as EBSCOhost. Also, digital resources

provide access to literally thousands of magazines and newspapers, far more than the orthodox library could subscribe to in a paper format. The digital resources are free to library users who can access them from any computer with internet access, 24 hours a day, 7 days a week (24/7). One does not have to wait for the library to open to access them. Through digital resources, undergraduates can find articles on particular topics at the same time without having to search each Publication separately. Commenting on the advantages of digital resources Daddies (2007) opined that Digital resources give access to information that might be restricted to the users due to geographical location or finances.

A Digital resource is defined as a resource that requires computer access or any Digital product that delivers a collection of data, be it text referring to full text bases, Digital journals, image collections, other multimedia products, and numerical, graphical, or time-based, as a commercially available title that has been published with an aim to being marketed. These may be delivered on CD ROM, on tape, via the Internet, etc. (Keene, 2012). Over the past few years, several techniques and related standards have been developed, allowing documents to be created and distributed electronically. Hence to cope with the present situation, librarians are shifting towards new media, namely Digital resources, for their collection developments so that users' documents are better fulfilled. The Digital resources on magnetic and optical media have a vast impact on the collections of University libraries (Gakibayo et al, 2013). These are more useful due to inherent capabilities for manipulation and searching, providing information access is cheaper to acquiring information resources, savings in storage and maintenance, etc. Digital information resources have types that are broadly categorized into online digital information resources and offline digital information resources. Online digital information resources refer to digital materials accessible through the Internet. Users can access these resources through various Digital devices such as computers, smart phones, and tablets. Examples of online Digital resources include e-books, e-journals, online databases, online magazines, and e-newspapers etc. These resources are accessed through websites, digital libraries, and online platforms, and users can search, view, and download them. (Thanuskodi & Ravi, 2011)

Research is the process of discovering new knowledge. This knowledge can be either the development of new concepts or the advancement of existing knowledge and theories, leading to a new understanding that was not previously known. Research is a systematic investigation (i.e. the gathering and analysis of information) designed to develop or contribute to generalizable knowledge and research can be carried out by anyone in any field, most research is usually done to broaden knowledge in the physical, biological, and social worlds. Research is considered to be an integral part of the growth of institutions and the importance of research to the academic environment cannot be overlooked. Mason (2011) referred to research as "the systematic search for information". Research provides a good platform for Lecturers to become accomplished scholars through their research productivity. According to Kothari (2006) Research is a pursuit of trust with the help of study, observation, comparison, and experiment, the search for knowledge through objective and systematic methods of finding solutions to a problem. Kothari (2004), defines research as an original contribution to the existing stock of knowledge making for its development. The systematic approach concerning generalizations and formulation of a theory is also research. Research is a systematic, formal, rigorous, and precise process employed to gain solutions to problems or to discover and interpret new facts and relationships. This can range from learning why certain materials behave the way they do, to asking why certain people are more resilient than others when faced with the same challenges. Research methods are designed, data collected and analyzed, and research results are joined into one or more 'research conclusions'. These research conclusions are then shared with the rest of the scientific community to add to the existing knowledge and serve as evidence to form additional questions that can be investigated. It is this cyclical process that makes Research a systematic investigation towards increasing the sum of human knowledge (Wootton, R.A. 2013).

The term undergraduate student is commonly associated with a student in a college or university who has not yet received a degree. Bukky (2006) regarding the nature and category of students stated that the term undergraduate is used in this context as an adjective. Rajeev and Kaur (2006) stated that an undergraduate student is a person who studies or is studying at a college, school, or university. He or she should therefore be a person who is learning to fulfill his powers and to find ways of using them in the service of mankind. From the research conducted by Glenda, Sonia, Dwayne, sophomore and Alleyne (2006) one can deduce that this concept embraces all undergraduates irrespective of gender difference and faculties. Parks and Snow (2009) asserted that an undergraduate student is someone who is studying in a higher institution or university for a first-degree program in any discipline. Random House Kernerman Webster's College Dictionary (2010) posit in similar words that an undergraduate is a college or university student who has not yet received a bachelors or similar degree. An undergraduate student is simply a Student who is studying to gain a bachelor's degree or just a degree as the case may be. It could be a three-year course or four, depending on the nature of the course being studied in a higher institution. Merriam-Webster dictionary defines an undergraduate as a student at a college or university who has not received a first and especially a bachelor's degree. Undergraduates at the University of Nigeria, Nsukka are first-year to final-year students which can be 400-level, 500-level or 600-level as the case may be, it also includes the direct entry students of every form. This set of people happens to be the audience of this research. It is to know the awareness, importance, and utilization of digital Information resources for effective research by undergraduates.

Utilization is defined as the action of making practical and effective use of something. Utilization of information resources in this study refers to the practical use of facilities and instructions to enhance effective

research and learning among undergraduates of UNN. The utilization of digital information instills confidence, excitement, potential, and capabilities among users academically and socially. For digital information resources to be utilized they must first be accessed by awareness created. Uga (2008) noted that the more information sources are accessible the more students are likely to utilize them through awareness which helps for effective research of undergraduates. Thus the utilization of digital information resources for effective research by students in the library is determined by awareness and access to these information resources (Oghenetega 2016).

Thus Ajayi and Akinniyi (2004) opined that students' inability to use the library has led to frustration. Also contributing Oyediran and Tiding (2004) observed that the unavailability of desired information resources has led to low usage of the library by students. The utilization of the library is approximately 80% dependent on awareness, available information resources, and research skills needed for proper library activities. Uga (2007) studies have shown that digital information resources are widely in use in tertiary institutions such as the case of UNN. Eason (2000) and Tenopir (2003) analyzed the results of over 200 studies on the use of digital resources in libraries published between 1995 and 2003. The important findings of the study indicate that digital resources are rapidly adopted in academic areas but the behavior of users differ according to their discipline. Seventy-eight respondents in their view feel the use of Digital journal has created a dependency on their research work and digital documents supply service (Madhusdhan, 2008). Thus to increase the use of digital information resources there is a need for broad training programs for users.

Methodology

The research design chosen for the study was descriptive survey research design. Nworgu (2015) defined descriptive surveys as those studies that aim to collect data by describing systematically, the characteristics, and facts about a given population. Therefore this design was deemed most appropriate for this study as the study was designed to describe data on the examination of utilization of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, University of Nigeria, Nsukka, Enugu State, Nigeria. The area of study was considered appropriate because of large number of undergraduates, availability of digital resources, and high rate of ICT usage for effective research. The population of this study was 3,436 registered undergraduate users in 2021/2022 section of NAL, UNN (Circulation Section of NAL UNN, 2024). A sample of two hundred and forty (240) respondents was drawn and used for the study. The research instrument that was used for data collection was the Questionnaire. A structured questionnaire entitled utilization of digital information resources for effective research by undergraduates in NAL, UNN (UDIRERUQ) was used. The data was collected, organized and presented in a frequency distribution table, and the mean score as well as percentage was used to analyze the data.

Results

TABLE 1: Sex Distribution of the Respondents

Sex	**Frequency**	**Percentage (%)**
Male	66	32.0%
Female	140	67.9%
Total	**206**	**100%**

Table 1 show the sex Distribution of the Respondents. As indicated in the table, out of 206 respondents 66 (32.0%) were Male while 140 (67.9%) were female. The Implication of the results is that greater number of respondents was female.

TABLE 2: Distribution of the Respondents by level of study

Level of Undergraduates users of NAL, UNN	**Frequency**	**Percentage (%)**
Year one	75	36.4%
Year two	60	29.1%
Year three	30	14.5%
Year Four	-----	-----
Year five	41	19.9%
Year six	------	---------
Total	**206**	**100%**

Table 2 shows the Distribution of the Respondents by level of study. The table indicated that out of 206 respondents 75((36.4%), were 100L, 60(29.1%) were 200L, 30(14.5%) and 41(19.9%) 500L. This result implies that the majority of respondents are from 100L and 200L.

Research Question 1: What are the DIRs in Nnamdi Azikiwe Library, UNN?

Table 3: Frequency and percentage distribution of the types of digital information resources in NAL, UNN.

	Frequency	**Frequency**	**PERCENTAGE (%)**	**RANk**	**DECISION**
1	E- MAIL	196	95	Ist	Available
2	E-book	193	94	2nd	Available
3	Online Academic Database	191	93	3rd	Available
4	OPAC	186	90	4th	Available
5	E- Journal	186	90	4th	Available
6	Website	186	90	4th	Available
7	Digital Reference collection	174	84	5th	Available
8	Social media platforms	168	82	6th	Available
9	E- Theses and Dissertation	163	79	7th	Available
10	Digital Archive	159	77	8th	Available
11	CD - ROM	152	74	9th	Available
12	DISKETTES	148	72	10th	Available
13	E- Newspapers	101	49	11th	Not Available
14	E- Magazines	97	47	12th	Not Available

Response options: A= Available, NA= Not Available

The results in TABLE 3 show the DIRs in NAL, UNN. Out of fourteen items investigated, E- MAIL (95%), E-book (94%), Online Academic Databases (93%), OPAC (90%), E- Journal (90%), Website (90%), Digital Reference collection (84%), Social media platforms (82%), E- Theses and Dissertation (79%), Digital Archive (77%) CD - ROM (74%), DISKETTES (72%), were available while E- Newspapers (49%) E- Magazines (47%) were not available. This was analyzed using simple percentages and a percentage of 50% and above is considered to be positive.

Research questions 2: Level of Awareness of digital information resources for effective research by undergraduates of NAL, UNN.

Table 4: Mean responses on Level of Awareness of digital information resources for effective research by undergraduates in NAL, UNN.

S/N	**ITEM STATEMENT**	**HA**	**A**	**LA**	**NA**	**MEAN**	**RANK**	**DEC**
1	E- Book	151	38	11	6	3.62	1st	HA
2	E- Mail	140	48	15	3	3.57	2nd	HA
3	Online Academic Database	127	46	28	5	3.43	3rd	A
4	E- Journal	120	57	20	9	3.39	4th	A

S/ N	ITEM STATEMENT	HA	A	LA	NA	MEAN	RANK	DEC
5	OPAC	125	44	27	10	3.37	5th	A
6	WEBSITE	118	52	27	9	3.35	6th	A
7	Social media platforms	99	59	37	11	3.19	7th	A
8	Digital Reference collection	68	86	32	20	2.98	8th	A
9	E- Theses and Dissertation	73	72	43	18	2.97	9th	A
10	Digital Archive	60	80	49	17	2.88	10th	A
11	CD-ROM	60	58	60	28	2.72	11th	A
12	Diskettes	45	76	52	33	2.64	12th	A
13	E- Newspaper	38	40	87	41	2.36	13th	LA
14	E- Magazine	35	49	68	54	2.31	14th	LA

Keys: HA= Highly Aware, A= Aware, LA= Less Aware, NA = Not Aware

The results of Table 4 show the extent of awareness of DIRs by undergraduates in NAL, UNN which includes E- Book with mean (3.62), E- Mail (3.57), Online Academic Database (3.43), E- Journal (3.39), OPAC (3.37),WEBSITE (3.35), Social media platforms (3.19), Digital Reference collection (2.98), E- Theses and Dissertation (2.97), Digital Archive (2.88), CD-ROM (2.72), Diskettes (2.64), while E- Newspapers (2.36), E- Magazine (2.31) attracted a negative response respectively. It was analyzed using weight Mean (real limit of numbers) of 2.50 and above as positive result.

Research question 3: Benefits of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Llibrary, University of Nigeria, Nsukka.

Table 5: Mean responses on Benefits of digital information resources for effective Research in NAL, UNN.

S/ N	ITEM STATEMENT	SA	A	D	SD	MEAN	RANK	DEC
1	Improve quality of research work	171	28	3	4	3.77	1st	SA
2	Access to current information	158	41	3	4	3.71	2nd	SA
3	Quick retrieval of information	159	35	8	4	3.69	3rd	Sa
4	It encourages research on project	146	41	14	5	3.59	4th	A
5	Convenience in information retrieval	110	80	10	6	3.42	5th	A
6	It saves the time of users	110	74	16	6	3.39	6th	A
7	Access to quality information	103	83	15	5	3.37	7th	A
8	It improves ICT skills of undergraduates	98	91	11	6	3.36	8th	A
9	Access to wider range of information	106	75	20	5	3.36	8th	A
10	It is use to get current news for research	109	66	26	5	3.35	10th	A
11	Faster access to information	75	97	24	10	3.15	11th	A
12	It encourages inter library cooperation	54	99	39	14	2.93	12th	A
13	It encourages political service in library	24	54	104	25	2.36	13th	D
14	It encourage good health in library	33	44	84	45	2.32	14th	D

Keys: SA=Strongly Agree, A= Agree, D=Disagree, SD= Strongly Disagree

This Table showed the benefits of DIRs which includes: Improve quality of research work (3.77), Access to current information (3.71), Quick retrieval of information (3.69), It encourages researchers on project (3.59), Convenience in information retrieval (3.42), saves the time of users (3.39), Access to quality information (3.37), improves ICT skills of undergraduates (3.36), Access to wider range of information (3.36), It is use to get current news for research (3.35), Faster access to information (3.15), It encourages inter library cooperation (2.93), attracted positive responses while it encourages political service in library (2.36), and it encourages good health in library (2.32) attracted negative responses.

Research question 4: Extent of utilization of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, University of Nigeria, Nsukka.

Table 6: Mean responses on Extent of utilization of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, UNN.

S/N	ITEM STATEMENT	HU	MU	LU	NU	MEAN	RANK	DEC
1	Social media platforms	149	37	18	2	3.61	1st	HU
2	E- Mail	127	53	24	2	3.48	2nd	MU
3	OPAC	111	52	37	6	3.30	3rd	MU
4	Online Academic Database	113	37	42	14	3.21	4th	MU
5	E- Book	102	52	38	14	3.17	5th	MU
6	E- Journal	105	41	50	10	3.16	6th	MU
7	Website	106	41	36	23	3.12	7th	MU
8	Digital Reference collection	67	72	42	25	2.89	8th	MU
9	E- theses and Dissertation	58	80	50	18	2.86	9th	MU
10	Digital Archive	56	77	52	21	2.81	10th	MU
11	CD-ROM	52	65	56	33	2.66	11th	MU
12	Diskettes	70	35	57	44	2.63	12th	MU
13	E- Newspapers	35	38	73	60	2.23	13th	LU
14	E- Magazine	30	37	58	81	2.07	14th	LU

Keys: HU=Highly utilized, MU= moderately utilized, LU= Less utilized, NU= Not utilized

This results of Table 4 shows the extent of utilization of DIRs of undergraduates in NAL, UNN which includes: Social media platforms (3.61), E- MAIL (3.48), OPAC (3.30), Online Academic Database (3.21), E-Book (3.17), E- JOURNAL (3.16),Website (3.12), Digital Reference collection (2.89), E- theses and Dissertation (2.86), Digital Archive (2.81), CD-ROM (2.66), DISKETTES (2.63), respectively attracted positive responses while E- NEWSPAPERS (2.23), E- magazine (2.07) attracted negative response.

Research question 5: Challenges associated with utilization of digital information resources for effective research by undergraduates in NAL, UNN.

Table 7: Mean responses on Challenges associated with utilization of digital information resources for effective research by undergraduates in NAL, UNN.

S/N	ITEM STATEMENT	SA	A	D	SD	MEAN	RANK	DEC
1	Poor Internet connectivity	130	50	20	6	3.48	1st	A
2	Low power supply in library	110	59	24	13	3.29	2nd	A
3	Lack of relevant of DIRs	105	57	33	11	3.24	3rd	A
4	High cost of digital resources accessibility	103	62	28	13	3.24	3rd	A
5	Loss of digital resources files	98	67	31	10	3.22	5th	A
6	Inadequate access to available database in library	110	42	35	19	3.17	6th	A
7	Lack of ICT skills by Undergraduates for research in library	91	51	43	21	3.03	7th	A
8	High number of closed access E - resources	91	48	38	29	2.97	8th	A
9	Lack of security measures on digital information resources	78	53	61	14	2.94	9th	A
10	Lack of assistance to undergraduatesby Library staff	71	68	48	19	2.92	10th	A

11	Lack of fund for digital information resources subscribe	54	83	54	15	2.85	11th	A
12	Lack of knowledge, skills for use of computers.	66	63	56	21	2.84	12th	A
13	Attack from computer viruses	58	70	67	11	2.84	12th	A
14	Belief that ICT can cause several health hazard like eye problems, cancer etc	36	48	80	42	2.37	14th	D

Keys: SA= Strongly Agree, A= Agree, D=Disagree, D= Strongly Disagree

These results of TABLE 7 shows challenges associated with utilization of DIRs which includes Poor Internet connectivity (3.48), Low power supply (3.29), Lack of relevant of DIRs (3.24), High cost of digital resources accessibility (3.24), Loss of digital resources files (3.22), Inadequate access to available database in library (3.17), Lack of ICT skills by undergraduates for research in library (3.03), High number of closed access E-resources (2.97), Lack of security measures on digital information resources (2.94), Lack of assistance to undergraduates by Library staff (2.92), Lack of fund for digital information resources subscription (2.85), Lack of knowledge, skills for use of computers.(2.84), Attack from computer viruses (2.84), Belief that ICT can cause several health hazard like eye problems, cancer etc (2.37).

Research question 6: Strategies for improving the utilization of digital information resources for effective research by undergraduates in NAL, UNN.

Table 8: Mean responses on Strategies for improving the utilization of digital information resources for effective research by undergraduates in NAL, UNN.

S/N	ITEM STATEMENT	VA	A	FA	NA	MEAN	RANK	DEC
1	Enhance internet connectivity	170	26	7	3	3.76	1st	VA
2	Enhance relevant digital resources in library	170	25	9	2	3.75	2nd	VA
3	Providing a stable power supply in library	157	38	9	2	3.69	3rd	VA
4	Making discount for cost of E - resources accessibility	157	38	38	2	3.69	3rd	VA
5	Providing backup file for digital resources	154	31	19	2	3.63	5th	VA
6	Adequate access to available database in library	144	48	13	1	3.62	5th	VA
7	Training and orientation on use of ICT in library	145	44	12	5	3.59	7th	VA
8	Providing library assistant to undergraduates	139	53	11	3	3.59	7th	VA
9	Create more open access database in library	150	30	15	6	3.59	7th	VA
10	Providing adequate security on E - resources	150	35	15	6	3.59	7th	VA
11	Providing adequate funds for subscription	147	37	18	4	3.58	11th	VA
12	Inclusion of basic ICT training in school curriculum	147	39	14	6	3.58	11th	VA
13	Provision of technical knowhow on DIRs access and Utilization in library	134	53	16	3	3.54	13th	VA
14	Compulsory acquisition of laptop for Ist years through part payment	61	33	80	32	2.59	14th	A

Keys: VA=Very Appropriate, A=Appropriate, FA=Fairly Appropriate, NA=Not Appropriate

Table 8 shows the strategies for improving utilization of DIRs which were: Enhance internet connectivity (3.76), Enhance relevant digital resources in library (3.75), Providing a stable power supply in library (3.69), Making discount for cost of E - resources accessibility (3.69), Providing backup file for digital resources (3.63), Adequate access to available database in library (3.62), Training and orientation on use of ICT in library (3.59), Providing library assistants to undergraduates (3.59), Create more open access database in library (3.59), Providing adequate security on E- resources (3.59), Providing adequate funds for subscription (3.58), Inclusion of basic ICT training in school curriculum (3.58), Provision of technical knowhow on DIRs access and utilization in library (3.54), Compulsory acquisition of laptop for first years through part payment (2.59).

Discussion of the findings

The discussion of the findings is based on the research purposes and questions that guided this study. The findings revealed that the type of DIRs in NAL, UNN include: E- MAIL, E-book, Online Academic Database, OPAC,E- Journal, Website, Digital Reference collection, Social media platforms, E- Theses and Dissertation, Digital Archive, CD - ROM, DISKETTES. However, two were found not to be available and they are E-Newspapers and E- Magazines. This is in accordance with the finding of Ezema (2015) who stated that E-book, Online Database, CD- Rom, internet connectivity was available in libraries and students are aware of them even those that are not available in libraries.

On the second research question which is on the level of awareness of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, University of Nigeria, Nsukka, the findings revealed that undergraduates were aware of twelve DIRs out of fourteen item which includes: E- Book and E-Mail, Online Academic Database, E- Journal, OPAC, WEBSITE, Social media platforms, Digital Reference collection, E- Theses and Dissertation, Digital Archive, CD-ROM, Diskettes while they are unaware of E-Newspaper and E- Magazine. This is in accordance with the findings of Osinulu (2020) which revealed that majority of the students were aware of available DIRs. It also revealed low frequent usage. The finding indicated that few respondents used DIRs for academic purposes.

With regards on the benefits of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, University of Nigeria, Nsukka, the findings of study revealed that benefits of utilization of DIRs includes improve quality of research work, Access to current information, Quick retrieval of information, it encourages research on project, Convenience in information retrieval, it saves the time of users, Access to quality information, It improves ICT skills of undergraduates among others except for it encourages political service in library and It encourage good health in library. This is in accordance with the findings of Ferdinand, Ruth and Paul (2015) who stated that most respondents utilize DIRs for research, assignment, current awareness, and information acquisition among others.

On the Extent of utilization of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, University of Nigeria, Nsukka; the findings revealed that undergraduates' extent of utilization was high in Social media platforms and moderate in E- Mail, OPAC, Online Academic Database, E-Book, E- Journal, Website, Digital Reference collection, E - theses and Dissertation, Digital Archive, CD-ROM, Diskettes, However there is low utilization of E- Newspapers and E- magazine. This is in accordance with Nzokurum and Eseyin (2020) in the findings of their study which revealed that there was a high extent to which a statistical database is used for research activities while e-books were utilized to a low extent in public universities in Rivers State. It was recommended among others that academic staff should be given stipends to regularly subscribe to e-book sites that are relevant to the research activities of staff of these universities.

With regards to challenges associated with utilization of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, UNN**;** the findings revealed the major challenges encountered by undergraduates in utilization of DIRs were Poor Internet connectivity, Low power supply in library, Lack of relevant DIRs, High cost of digital resources accessibility, Loss of digital resource files and among others except Belief that ICT can cause several health hazard like eye problems, cancer etc. This is in accordance with Oladokun and Adeoye (2022) whose findings show that there is a low level of digital resource utilization among undergraduates. It was also found that challenges such as lack of information retrieval skills, slow internet, and inadequate computer systems are among the challenges affecting the utilization of digital information resources by undergraduates.

Finally, on the Strategies for improving the utilization of digital information resources for effective research by undergraduates in NAL, UNN**;** the findings revealed the major strategies for improving utilization of DIRs which includes: enhance internet connectivity, enhance relevant digital resources in library, Providing a stable power supply in library, Making discount for cost of E - resources accessibility, Providing backup file for digital resources, adequate access to available database in library, Training and orientation on use of ICT in library etc This is in accordance with Georgina (2022) who stated that the hindrance of use of DIRs which are lack of internet connectivity, poor power supply, cost of E - resources accessibility, loss of file for digital resources, lack of trained library staff etc should be minimized. The strategy is expected because the university needs a broad bandwidth that will serve students in their hostels and staff in their residential areas and offices.

Recommendations

1. There should be compulsory orientation for first year students both undergraduates and Postgraduates students on utilization of digital information resources.
2. The library should strive to provide alternative means of power supply which can be a standing generator as these DIRs do not work without electricity.
3. Recruitment of trained professional staff in the library that will help in educating students on how to utilize digital information resources.
4. The library should endeavor to renew their subscription when it expires because some of the online Database stops working at its expiration.
5. The library and parent institution should improve bandwidth connectivity so as to enhance effective utilization of digital information resources.

Conclusion

The study examined the utilization of digital information resources for effective research by undergraduates in Nnamdi Azikiwe Library, UNN. Based on the findings of the study, it was concluded that E- MAIL, E-book, Online Academic Database, OPAC, E- Journal, Website, Digital Reference collection, Social media platforms, E- Theses and Dissertation, Digital Archive, CD - Rom, Diskettes are available in NAL, UNN. However two were found not to be available and they are E- Newspapers and E- Magazines. The findings also concluded that undergraduates of NAL, UNN are aware of the following DIRs which includes E- Book and E- MaiL, Online Academic Database, E- Journal, OPAC, WEBSITE, Social media platforms, Digital Reference collection, E - Theses and Dissertation, Digital Archive, CD-ROM, Diskettes. e.t.c. The major benefits of utilization of DIRs are Improve quality of research work, Access to current information, Quick retrieval of information, it encourages research on project, Convenience in information retrieval, It saves the time of users, Access to quality information. The findings of the study concluded that extent of utilization of DIRs are as follows: social media platforms are utilized at high extent and moderate in E- MAIL, OPAC, Online Academic Database, E- Book, E- Journal, Website, Digital Reference collection, E - theses and Dissertation, Digital Archive, CD-ROM, Diskettes, however there is low utilization of E- Newspapers and E- magazine. The major challenges concluded are Poor Internet connectivity, Low power supply in library, Lack of relevant of DIRs, High cost of digital resources accessibility, Loss of digital resources files and among others except - Belief that ICT can cause several health Hazard, like eye problems, cancer etc. The major strategies for improving utilization of DIRs are Enhance internet connectivity, enhance relevant digital resources in library, Providing a stable power supply in library, Making discount for cost of E - resources accessibility, Providing backup file for digital resources, Adequate access to available database in library, Training and orientation on use of ICT in library which cannot be overemphasized.

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Utilization of Family Planning Information for Health Management among Residence of Unguwan Dosa Community, Kaduna North Local Government Area of Kaduna State

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Abstract

This study explores the use of family planning information for health management in Unguwan Dosa Community, Kaduna North LGA, Kaduna State. It identifies the types of available family planning information, examines the level of awareness and knowledge, assesses the impact of cultural and religious factors, and highlights challenges in utilization. Quantitative methodology and survey research design was used for the study. Questionnaire was used as instruments for data collection. Data was collected through questionnaires distributed to 217 respondents and analyzed using statistical methods. Findings showed that implants were the most commonly available family planning method, and radio was the primary source of information. Cultural and religious factors were found to positively influence acceptance of family planning, though challenges like limited access to contraceptive options and misconceptions were also reported. The study emphasizes the importance of family planning services in promoting socio-economic development, reducing poverty, and lowering maternal and infant mortality rates. It recommends that the Kaduna North Local Government, healthcare providers, and NGOs improve awareness through community health fairs and workshops, while strengthening collaborations with local radio stations to address concerns and correct misconceptions about family planning.

Keywords: *Family Planning Information, Utilization, Health Management, Contraceptive Use, Awareness*

INTRODUCTION

Nigeria, with a population exceeding 220 million, continues to experience rapid growth, putting increasing strain on its healthcare systems, economic resources, and social infrastructure (United Nations, 2022). Despite global recognition of the importance of family planning in improving maternal and child health, the utilization of family planning information and services in Nigeria remains low. The 2018 Nigeria Demographic and Health Survey (NDHS) revealed that only 17% of married women aged 15–49 use modern contraceptives, a figure far below international targets (National Population Commission, 2019). This low uptake undermines effective health management, particularly in communities where high fertility rates contribute to maternal deaths, unwanted pregnancies, and increased infant morbidity.

In many parts of Nigeria, especially in the northern regions, deeply rooted cultural and religious beliefs discourage the use of family planning methods. Family planning is often seen as conflicting with religious teachings, and this perception, combined with traditional gender roles, limits women's ability to make independent reproductive health decisions (Afolabi et al., 2023). As a result, health management suffers, with many women experiencing complications from closely spaced pregnancies, including anemia, unsafe abortions, and other preventable health risks (Okeke et al., 2022).

Furthermore, limited access to accurate family planning information, especially in rural areas, continues to hinder informed reproductive choices. Misinformation, fear of side effects, and myths about infertility contribute to low acceptance of modern contraceptive methods (Ezeh et al., 2022). These knowledge gaps not only restrict women's autonomy but also have serious health implications, increasing the burden on already fragile healthcare systems.

Efforts by government and NGOs have shown that community-based programs can improve the utilization of family planning information, thereby promoting better health outcomes. The involvement of trained community health workers has been effective in educating underserved populations and improving access to services (Olufemi et al., 2021). However, the success of these initiatives depends on the degree to which they address the socio-cultural and gender-related factors influencing reproductive behavior.

Given the increasing health risks associated with poor reproductive choices and the persistent barriers to accessing family planning services, this study seeks to explore the utilization of family planning information for health management among residents of Unguwan Dosa Community in Kaduna North Local Government Area. Understanding how community-specific factors affect both the use of family planning information and overall health outcomes is crucial for designing more effective interventions.

Statement of the Problem

Family planning information enables people to make informed choices about their sexual and reproductive health. Family planning information represents an opportunity for women to pursue additional education and participate in public life, including paid employment in non-family organizations. Additionally, having smaller families allows parents to invest more in each child. Children with fewer siblings tend to stay in school longer than those with many siblings (Orji, 2003).

However, residents of Unguwan Dosa, mainly of Hausa and Fulani background, face cultural, religious, and economic challenges that limit the use of family planning information. Frequent childbirth has caused serious health problems for mothers, including loss of blood and increased death rates. Beliefs against controlling childbirth have led to unwanted pregnancies, poor child spacing, and rising cases of sickness among infants. These problems have worsened poverty and reduced the standard of living in the area. There is a need to study how family planning information is being used to improve health in Unguwan Dosa community, Kaduna North local government area of Kaduna State.

Objective of the Study

The objectives of this study are to:

1. Find out the type of information on family planning services available to the UnguwanDosa residents.
2. Find out the level of awareness and knowledge of family planning methods among the residents of UnguwanDosa, Kaduna North LGA.
3. Identify how cultural and religious factors influence the acceptance and utilization of family planning information among the residents of UnguwanDosa Kaduna North LGA.
4. Examine the challenges faced on the utilization of family planning information and services in UnguwanDosa Kaduna North LGA.

LITERATURE REVIEW

Concept of Family Planning

Family planning refers to the deliberate decision regarding the timing and number of children a couple wishes to have, often achieved through the use of contraceptive methods and other reproductive health services. It encompasses a broad range of practices, including sexual education, prevention and treatment of sexually transmitted infections (STIs), pre-conception counseling, and infertility management. While the term is often used interchangeably with birth control, family planning also includes long-term methods such as sterilization and, in some cases, pregnancy termination (Olaitan, 2009). Moreover, it involves the broader responsibilities of child-rearing, which demand considerable social, financial, emotional, and environmental resources.

Types of information on Family Planning.

A primary category of family planning information includes details about contraceptive methods, which are broadly categorized into modern and traditional methods. Modern methods include oral contraceptives, implants, injectables, intrauterine devices (IUDs), male and female condoms, sterilization, and emergency contraception. Traditional methods encompass the calendar method, withdrawal, and lactational amenorrhea.
Information on where and how to access family planning services is vital for promoting utilization. This includes details about health facilities, outreach programs, telemedicine services, and community health workers. Availability of free or subsidized services and the operating hours of clinics are also integral components. Studies from Sub-Saharan Africa emphasize the role of local health campaigns in disseminating such information to underserved populations (WHO, 2020).

Awareness and Knowledge of Family Planning Methods.

Globally, awareness of family planning methods—particularly modern contraceptive options such as oral contraceptives, condoms, and intrauterine devices (IUDs)—remains high. According to recent Demographic and Health Surveys, more than 90% of women of reproductive age have heard of at least one modern contraceptive method (Guttmacher Institute, 2022). However, awareness does not necessarily equate to comprehensive knowledge. Misconceptions and partial understanding of both modern and traditional contraceptive methods persist, particularly in low- and middle-income countries (LMICs). Traditional methods, such as the rhythm method or withdrawal, are less widely recognized and are often excluded from mainstream family planning campaigns, resulting in lower levels of understanding (Choi et al., 2023). Furthermore, even for widely known modern methods, knowledge about correct usage and potential side effects is frequently inadequate, pointing to persistent gaps in educational and counseling efforts within reproductive health programs.

How Cultural and Religious Factors Influence the Acceptance and Utilization Of Family Planning Information.

Cultural norms, particularly those surrounding gender roles, continue to play a significant role in shaping the acceptance and use of family planning in Nigeria and across Sub-Saharan Africa. In many patriarchal societies, men are considered the primary decision-makers on reproductive matters, often restricting women's autonomy in accessing contraceptive services. Recent studies show that male opposition to contraceptive use is frequently rooted in traditional beliefs that associate large family sizes with masculinity, wealth, and social status (Akinyemi et al., 2022). In such cultural contexts, pro-natalist attitudes are deeply ingrained, often tied to economic, religious, and social imperatives—such as the need for farm labor, the desire for lineage continuity, and the expectation that children will provide support in old age. Even when women are aware of modern family planning methods, these prevailing cultural attitudes significantly reduce the likelihood of adoption, particularly in rural areas where such beliefs are more strongly held (Ibrahim et al., 2023).

Challenges Faced on the Utilization of Family Planning Information and Services

A significant barrier to the utilization of family planning services is the lack of awareness and widespread misinformation. Many individuals lack comprehensive knowledge about available contraceptive methods and their proper use. Misinformation, such as beliefs that contraceptives cause infertility or severe health complications, further discourages use. Studies in rural Nigeria reveal that inadequate education exacerbates these misconceptions (Obisesan et al., 2018).

Deeply ingrained cultural norms and traditions often oppose contraceptive use. In many patriarchal societies, women's access to family planning services is restricted by male partners or family elders. Additionally, societal expectations of large family sizes contribute to low acceptance of contraceptive methods.

Research Methodology

The researcher adopted quantitative research methodology. According to Gay, mills &Airasian (2006) quantitative methodology is "the collection and analysis of numerical data in order to explain, predict and or control phenomena of interest. The study adopts a survey research design to explore and analyze the Utilization of Family Planning Information for Health Management among residence of Unguwan Dosa Community, Kaduna North local government area of Kaduna State. The population of Unguwan Dosa in Kaduna North Local Government Area of Kaduna State, Nigeria, was estimated to be approximately 60,000 (National Bureau of Statistics, 2006). To determine the appropriate sample size for this study, the researchers adopted the Krejcie and Morgan (1970) sample size determination table. According to their guideline, for a population ranging between 50,000 and 74,000, the required sample size is 381 respondents. The study employed purposive sampling technique. This is a sampling technique in which the researcher interview respondents he come across. This technique is chosen because of its simplicity and reliability in collecting information directly from the respondents by the researcher. A sample size of 381 residence of Unguwan Dosa Community, Kaduna North local government area of Kaduna State will be targeted to provide sufficient data for analysis.

Data Analysis and Discussion

A total of three hundred and eight one (381) copies of questionnaire were administered to the residence of Unguwan Dosa Community, Kaduna North local government and only two hundred and seventeen (217) copies were returned duly completed and found usable for the study representing 57% response.

This section presents the data collected from the respondents of this study. It is presented as follows:-

Table 1: What are the Types of information on Family Planning available to you in Unguwan Dosa Community?

Types of family planning information	Frequency	Percentage
Information on Pill	48	22%
Information on Implants	119	55%
Information on Female & Male condom	40	18%
Information on Male Sterilization	10	5%
Total	**217**	**100%**

Source: Field Survey, 2025.

The data presented in Table 4.5 highlights the analysis of the responses regarding the types of family planning information available to residents of UnguwanDosa. The respondents with the highest frequency are Information on Implants, with 119 respondents (representing 55%) indicating that they are aware of this type of information. This strong preference suggests an effective communication strategy regarding implants, which could correlate with their perceived reliability and effectiveness as a long-term contraceptive method. In contrast, the option for Information on Male Sterilization garnered the lowest frequency, with only 10 respondents (or 5%) reporting access to this type of information. This stark underrepresentation might reflect social and cultural attitudes towards male sterilization, which is often viewed as a taboo subject in many communities. This agrees with the findings of Aikins (2014), whose study revealed that over 90% of respondents were aware of at least one method of modern contraception, with injectables being the most commonly known modern method of family planning in the study area.

These findings imply a significant gap in awareness and acceptance of the full range of family planning options, particularly methods such as male sterilization. This underscores the importance of addressing gender dynamics and information accessibility in reproductive health programs, as informed decision-making requires both men and women to have comprehensive knowledge of all available contraceptive methods.

Table 2: Where do you have access to information on family planning in UnguwanDosa?

Sources of family planning information	Frequency	Percentage
Television	20	9%
Radio	98	45%
Hospital	42	19%
Friend/Relatives	49	23%
Social media	8	4%
Total	**217**	**100%**

Source: Field Survey, 2025

Table 2 presents the level of awareness and knowledge of family planning methods among residents of UnguwanDosa. The highest frequency indicated is Radio, which was selected by 98 respondents, accounting for 45% of the total responses.

This indicated that radio is the predominant medium through which individuals in UnguwanDosa access information on family planning. Conversely, the option with the lowest frequency is social media, with only 8 respondents (or 4%) indicating that they rely on this platform for family planning information. This low engagement with social media as a source of knowledge may reflect various barriers, including limited internet access, lack of familiarity with digital platforms, and the prevailing cultural context that might reduce the likelihood of using online sources for health-related information.

The finding aligns with the research conducted by Adegoke et al. (2018), which revealed that radio remains a vital source of health information in many underserved communities, particularly in regions where literacy levels may impact access to written resources. The prominence of radio in this context suggests that it serves as an effective tool for disseminating vital health information, reaching a wide audience in a manner that is both accessible and engaging.This analysis justifies the importance of leveraging traditional media, such as radio, while also encouraging initiatives that enhance digital literacy and access to online platforms for a more comprehensive outreach strategy.

Table 3: How do cultural factors and religious influence the acceptance of family planning information among the residents of UnguwanDosa?

Options	Frequency	Percent
Positively	112	51%
Negatively	82	38%
Neutral	24	11%
Total	**217**	**100%**

Source: Field Survey, 2025.

Table 3 reveals a clear trend regarding the influence of cultural and religious factors on the acceptance of family planning information among the residents of UnguwanDosa, Kaduna North LGA. The most prominent finding is that 51% of respondents indicated a positive influence of cultural and religious factors on their acceptance of family planning information. This suggests that a significant portion of the community perceives these factors to be supportive and beneficial in understanding and utilizing family planning resources. Conversely, the 11% of respondents who declared a neutral position indicate a level of ambivalence that may require further investigation to understand the complexities surrounding their views.

The findings align with existing study conducted by Kahn et al. (2020) emphasizes how cultural beliefs can significantly shape perceptions and practices concerning family planning. Specifically, they found that in many communities, strong adherence to cultural and religious norms can create support for family planning when framed within the context of health and family welfare. Likewise, when these factors are interpreted negatively, they can lead to misinformation.

Justifying these findings, it is essential to recognize that cultural and religious contexts are key drivers of health behavior. As indicated by the significant percentage of individuals responding positively, it appears that when family planning information is congruent with the values and beliefs prevalent in the community, there is a notable acceptance that facilitates utilization. This indicates that cultural beliefs and community structures significantly influence perceptions of family planning, suggesting that acceptance of such practices is more likely when discussions are aligned with culturally relevant narratives and supported by influential community figures.

Table 4: What are the challenges faced on the utilization of family planning information ?

Challenges faced	Frequency	Percent
Low knowledge of contraceptives	67	31%
Negative perceptions	93	43%
Side-Effects	43	20%
Religious Concerns	14	6%
Total	**217**	**100**%

Source: Field Survey, 2025

Table 4.highlights the challenges faced by residents of UnguwanDosa, Kaduna North LGA, when it comes to utilizing family planning information and services. The table shows that Negative perceptions which accounted for 93 (43%) of the respondents indicated it as a major factor affecting the utilization of Family Planning in UnguwanDosa community. This shows that the attitudes and beliefs surrounding family planning methods contribute significantly to their underutilization in the community. In contrast, the lowest frequency is represented by religious concerns, with only 14 (6%) of respondents identifying this factor as a challenge. This disparity suggests that while religious factors might play a role, they are less critical compared to other challenges such as negative perceptions, which could encompass stigma, misinformation, or cultural biases surrounding contraceptive use.

This agrees with the findings of Ghulam, et al (2015), where his findings concerning reasons for not using family planning information and modern contraception included; negative perceptions, in-laws' disapproval, religious concerns, side-effects, and lack of access to quality services.

Justifying these findings, the significant prevalence of negative perceptions highlights the strong influence of misinformation and cultural stigma on contraceptive use. This underscores how deeply entrenched myths and social attitudes can hinder the acceptance and utilization of family planning methods within the community.

Findings:

1. The study revealed that Implant was the major type of family planning information available to residents of Unguwan Dosa.
2. Radio was the major access to information on family planning knowledge and family planning methods among residents of Unguwan Dosa.
3. Majority of residents in Unguwan Dosa perceive cultural and religious factors as positively influencing their acceptance of family planning information.
4. Negative perceptions such as stigma, misinformation, and cultural biases are the most significant challenge to utilizing family planning information in Unguwan Dosa,

Conclusion

Based on the findings of this study, the researcher concluded that access to family planning information is a critical factor in achieving improved health management outcomes. When individuals have accurate and comprehensive information, they are better equipped to make informed decisions about if, when, and how to have children, which supports healthier timing and spacing of pregnancies. This informed decision-making contributes to the reduction of maternal and infant health risks, improved household well-being, and more effective management of reproductive health. By enabling individuals to align their reproductive choices with their personal and socio-economic realities, family planning information serves as a foundation for healthier families and communities. These outcomes, in turn, reflect the broader significance of family planning information in promoting public health and supporting long-term development goals.

Recommendation

1. The Kaduna North Local Government Authority, in partnership with healthcare providers and non-governmental organizations, should conduct regular community health outreaches and mobile clinics in Unguwan Dosa. These events should provide practical education on the full range of family planning methods, explaining how each works, their benefits, possible side effects, and where to access them.
2. Authorities should collaborate with local radio stations to produce and broadcast family planning programs in local languages. These should include expert interviews, real-life testimonies, and call-in sessions where listeners can ask questions and receive accurate responses.
3. Cultural and religious leaders should be trained with correct and respectful information about family planning. These leaders can then help communicate the benefits during sermons, town meetings, and community gatherings in ways that align with local beliefs and values.
4. A targeted campaign should be launched to address and reduce the stigma surrounding family planning. This should involve drama performances, community dialogues, posters, and trained peer educators who can explain facts, share personal stories, and correct common myths within the community.

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Utilization of Internet Resources and Search Strategies for Academic Activities among Academic Staff in Tertiary Institutions Kebbi State, Nigeria

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Abstract

This study examines the utilization of internet search strategies for academic activities among academic staff in tertiary institutions in Kebbi State. it was guided by three (3) research objectives that seeks to Identify the types of Internet resources available for the academic staff in the tertiary institutions in Kebbi State, find out the types of internet search strategies employed by academic staff in utilizing internet resources and challenges encountered by academic staff during internet searches for academic resources. The study employed cross-sectional survey design and quantitative data were collected through self-administration of semi-structured questionnaires to 313 academic staff that was randomly selected in the 9 tertiary institutions in Kebbi State. Using the Statistical Package for Social Sciences (SPSS) software, the data were on the demographic characteristics of the respondents and research questions were analyzed with descriptive (frequency distribution) technique. The study found out that those e-journals, e-books, online databases, e-theses and e-dissertations, e-conference proceedings, e-technical reports, e-reference documents and e-mail as the commonly available Internet resources, available and use, by the academic staff. The study also found that all the academic staff were aware of Internet resources made available and accessible to them on desktops, smart-phones, tablets and laptops. The Google was found to be the most familiar, friendly and usable search engine, while Google Scholar was the most known information search technique. Fastness, smartness and reliability were the reasons for the use of a given search engine by most academic staff, who also revealed that teaching and research as their purposes for using Internet resources. It was therefore recommended that Government should collaborate with relevant agencies to provide efficient internet resources for academic staff in the tertiary institutions in Kebbi State, Academic staff should be properly oriented on the appropriate search strategies, Capacity buildings, Trainings, Workshops and Conferences should be organized routinely and Relevant stakeholders should intensify efforts towards addressing epileptic power supply as well as well as ICT Facilities Deficit.

Keywords: *Internet, Internet Search Strategies, Internet Resources, Academic Staff*

1. Introduction

The use of information and communication technologies (ICTs), particularly the Internet has become an integral part of today's educational system. Many educational activities, such as research, teaching, learning, management and administration have increasingly become dependent on ICTs. This is because information and communication are central to educational development. The Internet, as one of the components of ICTs is used to enhance communication between individuals and groups, thereby facilitating the sharing of knowledge. The Internet has literally expanded the horizon of knowledge through information gathering, storage and retrieval system. The Internet has also made the sharing of information easier, more convenient and more time saving for both the knowledge sharers and seekers (Sellan & Sornam, 2018). The Internet has also increased collaborations among academic staff, students and institutions around the world. The use of the Internet in libraries and information centers make available to the information user a wide range of learning resources available on the net especially the World Wide Web (www) and the electronic mail. Uloaku (2017) expressed that Internet resources are electronic information carrying medium made available and accessible to users through the manipulation of computer and other electronic devices in networked environment. The internet is a mechanism that allows people through their computer to access information; the resources shared through the Internet include e-books, e-journals, e-dictionaries, e-encyclopaedias, e-bulletins, e-reports, e-news and other learning materials uploaded by private and commercial institutional repositories and database.

2. Statement of the Problem

Despite the increasing availability of online resources and search tools, academic staff encounter various issues that impact their ability to leverage digital platforms effectively for research purposes. This is largely due to Limited Access to High-Quality Online Resources, Inadequate Digital Literacy Skills, Limited Awareness of Open Access Platforms and Challenges in Information Organization and Retrieval. This inefficiencies and challenges among many other ones hamper the effective utilization of Internet resources by academic staff. This study is however conducted to examine the utilization of internet resources and search strategies for academic activities among academic staff in tertiary institutions in Kebbi State with the aim of

identifying the causal agents and proffering practicable solutions to address the identified challenges that hinder efficient research and knowledge dissemination.

3. Objectives of the Study

The following are the research objectives for the study

1. To Identify the types of Internet resources available for the academic staff in the tertiary institutions in Kebbi State.
2. To identify the types of internet search strategies employed by academic staff in utilizing internet resources
3. To Identify the challenges encountered by academic staff during internet searches for academic resources

4. Research Questions

The following questions were formulated to guide the study:

1. What are the types of Internet resources available for the academic staff in the tertiary institutions in Kebbi State?
2. What are the types of internet search strategies employed by academic staff in utilizing internet resources?
3. What are the challenges encountered by academic staff during internet searches for academic resources?

5**. Review of Related Literature**

This focuses on the review of related Literatures that are relevant to the objectives of the study. The review is done to identify gaps and chart ways to address the gaps through this study.

Types of Internet Resources available for Academic Activities

Internet resources (electronic resources or e-resources) are information stored in electronic format in computer or computer related facilities such as flash drives, digital libraries and the internet. Harisan and Khan (2009) defined internet resources as aggregate of information stored electronically and which are accessible through electronic systems and networks. They also referred to information carrying resources made available and accessible only through the internet, they include e-books, e-journals and online databases. Internet resources are any particular piece of information published through the Web. According to Thanuskodi (2012) internet resources can be seen as various resources, tools and facilities on the World Wide Web (www) available to access and use. Dhanavandan and Tamizhchelvan (2012) defined e-resources as resources that require computer access or any electronic product that delivers a collection of data, such as full-text databases, electronic journals, image collections, other multi-media (audio and visual) products, including numerical and graphical representations.

The Internet is very important to academic staff because they need to have access to timely, accurate and relevant academic information (Adomi, Omodeko and Otolo, 2004). Internet sources like the search engines and Web have greatly increased the speed of searching out information. Internet resources have brought about considerable relief to academic staff in all tertiary institutions, as academic staff can conveniently walk into any library that has its holdings on Internet and have access to unlimited information.

Electronic Journals

Electronic journals provide efficient access to information and they are easy to distribute to library patrons in the financial stringent environment of higher education system. Electronic journals have become a medium which is cheaper than the traditional printed journals (Ellis & Oldham, 2015). According to Rowley (2016), electronic journal do not necessarily need a publisher and can be managed by an editor and the scholarly community. Meera and Ummer (2010) argued that the transition from print-on-paper journals to electronic journals is among the most fascinating developments in the information field. With the emerging electronic information environment, electronic journals have brought a new paradigm in research in tertiary institutions (Kumar & Ansari, 2012). Johnson *et al.* (2012) also added that e-journals are journals provided in a digital format for access via an internet browser, a computer or other electronic device.

Electronic Books

Johnson et al. (2012) defined e-books as various books that are prepared in different volumes, sizes and are provided in a digital format for checkout or use via an internet browser, a computer or any other electronic device like an e-book reader. They are electronic textbooks that are accessed and read only through the power of electric energy anytime and anywhere.

Full-Text Databases

Online databases are collection of electronic information resources such as e-journals and e-books published from various academic disciplines (Afolabi, 2013). Johnson et al. (2012) viewed full-text databases as a collection of data in a server or computer for easy access to format that gives full-text document instead of just

a citation typically in portable document format (pdf) or hyper text markup language (html). Chowdhury (2004) noted that e-databases are large discipline-oriented databases; interdisciplinary databases with coverage based on key or core journals; cross-disciplinary databases; small, more specialized databases serving a particular technology or application, and databases that covered a specific type of publication.
Chowdhury (2004) added that examples of the full-text databases are Health Internetwork Access to Research Initiative (HINARI) which consists of health disciplines; Access to Global Online Resources in Agriculture (AGORA) database which provides environmental and agricultural disciplines; Emerald Insight which provides a wide range of management, library and information management journal; Science Direct; Ebscohost, a multidisciplinary database which provides access to many databases including communication, mass media business, religion and philosophy and other disciplines; and LexisNexis which provides access to full-text glossaries, legislation, etc.

Electronic Mail
Johnson et al., (2012) define electronic mail (e-mail) as a method of exchanging digital messages from an author to one or more recipients. They argued that modern e-mail operates across the internet or other computer networks and e-mail servers accept, forward, deliver and store messages. According to Johnson et al. (2012) neither the users nor their computers are required to be online simultaneously, instead they only need to connect briefly and typically to a mail server, for as long as it takes to send messages. E-mail uses technology to communicate a digital message over the internet. Users use e-mails differently, based on how they think about it. There are many software platforms available to send and receive emails. The popular software platforms are Gmail, Hotmail, Webmail, Yahoo, Outlook and many others. The 'at' sign (@), is part of every Simple Mail Transfer Protocol (SMTP) e-mail address expressed Johnson et al., (2012).

Electronic Newspapers and Magazines
There has been increasing migration from the production, distribution and consumption of print newspapers and magazines to electronic versions over the last few years in not only developed countries, but also in developing countries, such as Nigeria. It is evident that most of Nigeria's national dailies have gone online, which implies that their news and programs are easily available, accessible and affordable on internet services. Nigeria's dailies, such as The Punch, Daily Trust, Daily Post, This Day, Premium News, Tribune News, Vanguard News, Guardian News, including Daily Times are often read online and their information contained in them are easily extracted without much trouble, while their online web addresses are used in citation and final references.

Types of search strategies utilized by academic staff to access internet-based resources
Search strategy is a specialized program that facilitates information retrieval from large segments of the Internet. Search engines attempt to help a user locate desired information or resources by seeking matches to user-specified key words. The usual method for finding and isolating this information is to compile and maintain an index of Web resources that can be queried for the key words or concepts entered by the user.
Different engines are appropriate for different kinds of searches, and most can be optimized for specified results. It allows academic staff to enter words and phrases about what is being looked for and then tries to find the closest match in its database. Some common search engines are AltaVista, Excite, Google, Info seek and Yahoo. The search engine performs keyword searches against the database and retrieves a set of Web Pages matching the query. A search engine is a giant database of many Web sites on the Internet
A search engine is a collection of software programs that collect information from the Web, index it, and put it in a database so it can be searched. So, the search engine is an automated software usually known as a 'spider' or 'crawler' that gather information from web and other servers and generate indexes. It crawls the networks continuously to update their databases. It usually indexes the full-text of web page and holds lot of information in the databases. The individual search engines compile their own searchable databases on the web, whereas the meta-search engines compile databases from multiple individual engines that results in multiple lists or a single list. The multiple lists display search results in separate lists received from each engine. Search engines and meta-search engines are good for precise information searching, searching for organizations and searching quickly as well as widely.
In the same vein, Salako and Tiamiyu (2007) define search engines and meta-search engines as facilities that usually assist information seekers to find required information on the internet. A search engine is a set of computer programs that look for web pages on the internet, index the pages in a database, and make the database available for searching by information seekers through an appropriate user interface at its website. Therefore, it is an internet robot that indexes data by itself. Danny Sullivan, the former editor of search engine ewatch.com, listed the categories of some search engines (Sullivan, 2004), which are as follows:
A. Meta-search engines
B. General Purpose Search Engines
C. Free Text Search Engines
D. Index or Directory-Based Search Engines
E. Natural Language Search Engines
F. Full Text Search Engines

Challenges Encountered By academic staff during internet searches for academic resources

The internet resources have improved the overall access to information by researchers worldwide. However, its uses by the researcher pose some challenges. Salaam (2008) found out the constraints being faced by academic staff in the use of internet resources include poor telecommunication system, unreliable electrical supply, and lack of internet service providers in some parts of Nigeria as well as poor funding of some tertiary institutions. The study by Ishola (2016) revealed that almost all (99.32%) the respondents indicated erratic power supply as one factor affecting their usage of internet resources, while close to (90.27%) pointed at lack of adequate information, knowledge and retrieval skills as the obstacles to internet usage, whereas majority (85.52%) blamed high cost of ICT for low usage of internet and about three-fifths (59.04%) considered lack of updated ICT strategy as the challenges associated with the use of internet resources by academic staff members in Nigeria.

Omosekjimi, Ijiekhuamhen and Emuejevoke (2016) found in their research that challenges faced by Nigerian academics in the use of internet resources are enormous, especially slow internet service (95.8%), internet connection failure (100%), and shortage of funds for internet services and lack of support for maintaining internet facilities (62.8%). While Nwokedi and Nwokedi (2017) observed that inadequate searching skills is one of the factors against good use of internet resources among Ogunjobi and Fagbami (2012) revealed in their study that weak internet connectivity and inadequate browsing skills were the main obstacles in the use of the internet. Studies found that irregular power supply, slow internet access speed, delay in connectivity, too long to view/download page, missing link and high cost of internet access are major challenges faced by academics (Fasae & Aladeniyi, 2012; Aqil & Ahmed, 2011; Pattanaik & Pattanaik, 2011; Ugah & Okafor, 2008). Also, Adekunmisi, Ajala and Iyoro (2013) reported that frequent loss of signal, poor internet skills and difficulty of judging relevant information hampered the use of internet at OOU, Nigeria.

6. Methodology

According to Redman and Mory (2013) viewed methodology as systematic ways employed in solving research problem and also a technique used to describe the research design, research setting, population of the study, respondents' group, sample size and sampling technique, research instrument, validity and reliability of the instrument, method of data collection and data analysis.

This study adopted a quantitative approach using cross-sectional survey design. The cross-sectional survey design involved collection of quantitative data from a sampled population and at a single point in time in order to generalize about the entire study population on the basis of the samples drawn (Bryman & Bell, 2007).

Table 1. Population Distribution of Study

S/N	Tertiary Educational Institutions (Study Areas)	Year of Establishment	Location	No. of Academic Staff
1	Federal University Birnin Kebbi	2014	Kalgo	315
2	Kebbi State University of Science and Technology Aliero	2006	Aliero	279
3	Waziri Umaru Federal Polytechnic, Birni Kebbi	2007	Birnin Kebbi	205
4	Kebbi State Polytechnic Dakingari	2014	Dakingari	44
5	Adamu Augie College of Education, Argungu	1993	Argungu	140
6	College/University of Agriculture, Zuru	1991	Zuru	226
7	College of Basic and Advanced Studies, Yauri	2007	Yauri	58
8	College of Nursing Birnin Kebbi	2007	Birnin Kebbi	65
9	College of Health Technology Jega	1978	Jega	98
	Total			**1,430**

Source: ministry for higher education Kebbi State. (2025)

Sample Size

The term sample size is the determination of how much sample you will use when conducting a study involving a large population. To get the sample size that is acceptable, researchers usually use either one of these or both. Use a recommended table for determining the sample size or use a formula to calculate the number of the samples required. In this research, Yamane's formula was used to arrive at a convenient sample size. After the calculation the formula recommended a sample size of 313, from a population of 1430 academic staff members that are in active service in the nine selected tertiary institutions of Kebbi State. The formula is:

$$n = \frac{N}{1+Ne^2}$$

Where: n = the sample size
N = the total population
e^2 = Margin Error $(0.05)^2$
Thus:-
.0025 X 1430 = 3.575
1+3.575 = 4.575
1430/4.575 = 312.56830601
n = 313 sample size

The above calculation expressed the formula used and steps involved in arriving at the sample size of the study which is 313 academic staff from the 1430 academic staff members.

Table 2: Sample size of the Nine Tertiary Institutions of the State

S/N	Tertiary Education Institutions (Selected Study Areas)	Sample size
1	Federal University, Birnin Kebbi	69
2	Kebbi State University of Science and Technology, Aliero	61
3	Waziri Umaru Federal Polytechnic, Birni Kebbi	45
4	Kebbi State Polytechnic, Dakingari	10
5	Adamu Augie College of Education, Argungu	31
6	College of Agriculture and Animal Husbandry, Zuru	49
7	College of Basic and Advanced Studies, Yawuri	13
8	School of Nursing, Birnin Kebbi	14
9	Jega Health Technology	21
	Total	**313**

Research Instrument
This study considered the use of semi-structured questionnaire, which flexibly contained both close-ended and open-ended questions. The semi-structured questionnaire was specially developed for the purpose of the current research and it contained eight (8) sections and twenty (20) questions. There were three (3) open-ended questions in the questionnaire, while seventeen (17) were close-ended questions.
Section A of the questionnaire contained five (5) items that solicited data on the demographic characteristics of the respondents. However, each of the five (5) questions had a few number of response options and allowed the respondents to tick only one (1) answer out of the alternative answers provided under each questions.

Section B had six (6) questions that tapped information from the academic staff on their awareness about internet resources and availability of internet resources.

Section C consisted of two (2) items that sought for information on the types of search strategies used by the respondents.

Section D of the instrument had only one item that tapped information on the knowledge and skills of search strategies employed by the academic staff, but the items were eight closed-ended and one open-ended item. This section provided opportunities to the respondents to tick as many as eight (8) response options, if applicable to them.

Section E dealt with information about the academic staff use of search engines for internet resources and it had only two (2) items. Its first question contained eight (8) closed-ended items which were made available to the respondents to choose all, if applicable to them and one (1) opened-ended item, while the second question was completely an opened-ended question which requested respondents to give reasons why they selected the search engine(s) that they mostly used.

Section F interrogated academic staff on their purposes for using internet resources and the section provided opportunities to the academic staff as respondents to tick as many as seven (7) items, if applicable to them and the eighth item was in the form of opened-ended item.

While section G sought data relating to the challenges facing academics when using internet resources and it had only one (1) question with eleven response options made available for the respondents to tick as many as they could, if they were applicable to them. But the eleventh item was an opened-ended response option. lastly,

Section H was primarily based on tapping data related to the possible measures to overcome the challenges associated with the use of internet resources and Internet search strategies by the academic staff and it had six (6) response options and five of the options could be ticked, if the respondents felt they are applicable to them, while one of the option was opened-ended in nature.

7. Results

Table 3: Types of Internet Resource Available to Academic Staff of the Institutions

S/N	Types of internet resources available	Frequency	%
1	E-books	93	12.1
	E-journals	71	9.2
2	E-theses and e-dissertations	41	5.2
3	Online databases	71	9.2
4	E-newspapers & e-magazines	48	6.2
5	E-data archives	21	2.3
6	Digital libraries/archives	33	4.9
7	E-audio visual resources	30	3.9
8	E-images	43	5.6
9	E-mail	266	34.5
10	Institutional repository	53	6.9
11	**Total**	**770**	**100**

As can be seen on table 3 list of internet resources was presented to the respondents with instruction to tick all that was applicable to them. A staff can be featured in more than one internet resources, thus, the seven hundred and seventy (770) was not out of place because of multiple counting. Twelve types of internet resources were available to the staff of the tertiary institutions of Kebbi State. Specifically, more than half of the respondents, 266 (34.5%) indicated the availability of email. This is followed by E-books with 93 (12.1%). E-journals and Online databases came third with 71 (9.2%). The least indicated by the respondents is E-data Archive with 21 or 2.1%.

Table 4: Types of Search Engines used by Academic Staff

Item	Search engines	Frequency	%
	Ask.com	87	14.9%
	Yahoo	55	9.4%
	MSN search	26	4.5%
	Bing	86	14.7%
	Excite	18	3.1%
	Alta vista	16	2.7%
	Google	285	48.9%
	Others (Lycos, DuckDuckgo)	9	1.5%
	Total	**N=582**	**100**

The table 4 shows commonly used search engines in institutions of higher learning not only in Nigeria but globally. For multiple choices available to the staff, a staff can use as many as possible search engines, thus, the total, five hundred and eighty-two (582) was justified. These choices were presented to the academic staff members to tick all those they used when searching for internet resources. Frequencies of the responses showed that Google Search engine has the highest frequencies with nearly three-quarters or 285 representing 48.9%. More than one-quarters are users of Ask.com (14.9%) and Bing (14.7%) respectively. The least used search engines were others represented by Lycos and DuckDuckgo with only 9 or 1.5% responses.

Table 5: Challenges to Associated with the use of Internet Search Strategies

Item	Challenges	Freq	%
	Erratic/epileptic power Supply	285	93.4
	Inadequate ICT facilities	95	31.1
	Slow access speed	37	12.1
	Inadequate search skills	165	54.1
	Problems in formulating search queries	137	44.9
	Inappropriate use of search engines	27	8.9
	Lack of adequately developed search strategies	30	9.8
	Inadequate knowledge of information retrieval system	31	10.1
	Information overload	52	17.0
	Restriction of access by library staff	25	8.2
		225	**100**

Many constraints are captured, analyzed and discussed empirically in the section below. The section also deals with possible measures identified by academic staff for tackling the challenges facing them in the use of internet resources in Kebbi State.

Ten challenges gleaned from the literature were presented to the respondents with instructions to select all the challenges that were affecting their use of the internet resources, in their respective tertiary institutions, if applicable. This information is presented on table 5. As can be seen on the table, the results showed that all the 225 respondents representing 100% indicated erratic/epileptic power supply as their main challenge that hampered their use of the internet resources in their tertiary institutions. More than half (73.3%) of the 225 respondents indicated inadequate search skills. The least were those the indicated restriction of access by library staff. This means that poor provision of electricity; and inadequate search skills were the most disturbing challenges that hampered the use of internet resources among the academic staff members in the tertiary institutions of Kebbi State. This findings supports the works of Ishola (2016), Omosekjimi, Ijiekhuamhen and Emuejevoke (2016), including Salaam (2008) who discovered that poor telecommunication system, unreliable electricity supply, lack of internet service providers, inadequate information, knowledge and skills for retrieval, high cost of ICTs, lack of updated ICT strategy, slow internet service, internet connection failures, shortage of funds for internet services and lack of support for maintaining internet facilities are the constraints against the use of the internet resources by academic staff in Nigeria.

8. Summary of the Major Findings

The findings are presented according to the research questions and the hypotheses:

1. The study found that e-journals, e-books, online databases, e-theses and e-dissertations, e-conference proceedings, e-technical reports, e-reference documents and e-mail as the commonly available internet resources, available and use by the academic staff of the tertiary institutions in Kebbi state.
2. The study found that the academic staff used one or more internet search strategies when looking for internet resources. However, Boolean operators, phrase searching and proximity search were the most widely used internet search strategies by academic staff in tertiary institutions of Kebbi state.
3. The study found that the internet search strategies have enhances the academic staff use of the internet resources in the tertiary institutions.
4. The study found that the purpose for using the internet resources was for research and communication, teaching/notes taking.
5. The study found that the major challenges associated with the use of Internet Search Strategies was erratic/epileptic power supply, in adequate search skills, problems in formulating search queries etc.
6. The study found that there was a relationship between the level of Internet search strategies and the use of Internet resources

9. Conclusion

It is concluded based on the findings of this study that federal tertiary institutions have the potentials to enjoy more funds with which to provide internet resources to academic staff and many academic staff across the tertiary institutions in Kebbi State are higher degree-holders, active and productive. Through the enlightenment services of the ICT/MIS officials, libraries and archives' staff as well as teaching staff in the State many academic staff become aware and knowledgeable about internet resources. Obtaining internet resources is mostly done through the use of library equipments, personal computers, smart-phones and tablets and these electronic devices are the most available, accessible, user friendly and familiar among academic staff in Kebbi State tertiary institutions. It is in order to conclude that internet resources are multi-purpose in nature, because they are majorly used by academic staff for teaching, notes-making, research, communication, community service, reading and listening to online news, watching events, uploading and downloading

documents. The most serious challenges faced by academic staff in Kebbi State tertiary institutions are associated with epileptic power supply, low level search skills, difficulty in formulating search queries, inadequate ICT facilities and organized trainings on how to formulate search queries. Given the above, knowledge of Internet searching by academic staff are vital to the effective use of internet resources and healthy discharge of their professional academic responsibilities that centre on teaching, research and community service in Kebbi State.

10. Recommendations

Based on the findings of the study, the following recommendations were proffered with a view to ensuring improvement on the current situation found in the tertiary institutions in Kebbi State.

i. It is highly recommended that the Kebbi State Government in collaboration with TETFund, NCC as well as internet providers to synergize in an effort to provide efficient internet resources for academic staff in the tertiary institutions in Kebbi State.

ii. Academic staff should be properly oriented on the appropriate search strategies to be employed in search for information resources and services over the internet Capacity buildings, Trainings, Workshops and Conferences should be prioritized as measures to overcomes the identified challenges confronting academic in the all-tertiary institutions in Kebbi State. Relevant stakeholders should intensify efforts towards addressing epileptic power supply, ICT Facilities Deficit and ensure routine Training for academic to address the lingering challenges associated Utilization of Internet Resources and Search Strategies among Academic Staff in Tertiary Institutions Kebbi State.

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