



ARTIFICIAL INTELLIGENCE IN SMART ACADEMIC LIBRARIES: ENHANCING USER EXPERIENCE AND OPERATIONAL EFFICIENCY

¹ Fatima Zubairu Digma*

Department Of Library and Information Science

University Of Maiduguri

fatimadigma@gmail.com

² Umar Abba

Ramat Library University Of Maiduguri

Uabba771@unimaid.edu.ng

³ Fatima Umar Faruq

Department Of Library and Information Science

University Of Maiduguri

Fatimaumarfaruq00@unimaid.edu.ng

Abstract

Artificial Intelligence (AI) is transforming the landscape of academic library services by enhancing user experience, streamlining administrative functions, and increasing overall operational efficiency. In smart academic libraries, key functions such as digital resource management, personalized content recommendations, and advanced information retrieval are being reshaped through AI technologies, including automation, machine learning, and natural language processing. Despite the global momentum, implementing AI solutions in Nigerian academic libraries is significantly hindered by factors such as limited AI literacy, inadequate digital infrastructure, and insufficient funding. This study adopts a secondary research methodology, analyzing existing literature, reports, and case studies to evaluate the role of AI in academic libraries, particularly within the Nigerian context. The paper identifies significant challenges and benefits associated with AI integration and outlines practical recommendations for successful implementation. These include the development of AI policies, investment in infrastructure, and capacity-building initiatives for library professionals. By embracing AI technologies such as intelligent chatbots, automated cataloguing systems, predictive analytics, and robotic process automation, Nigerian academic libraries can bridge the digital divide, expand information access, and enhance research and learning outcomes for students and staff alike.

Keywords: Artificial Intelligence, Smart Libraries, Academic Libraries, Operational Efficiency, Digital Transformation, Nigerian Libraries, AI Applications in Libraries.

Introduction

Artificial Intelligence (AI) is among the most transformative technologies of the twenty-first century, significantly reshaping industries, institutions, and societal operations. Originally conceptualized in the mid-twentieth century, AI emerged from the ambition to design systems capable of replicating or surpassing human cognitive functions such as learning, reasoning, and decision-making. Since the 1950s, it has evolved from theoretical foundations to practical applications, powering innovations like autonomous vehicles, intelligent chatbots, and generative AI tools. The term "artificial intelligence" was first introduced in 1956 to describe a new area of computer science focused on developing machines that think and act like humans. Over the decades, landmark developments such as the Turing Test, the creation of LISP (the first AI programming language), the ELIZA chatbot, IBM's Deep Blue, Siri, and OpenAI have marked key turning points in the field. Today, AI encompasses a broad spectrum of technologies that simulate human intelligence using algorithms and data, enabling machines to interpret language, make decisions, and engage in adaptive learning.

In academic environments, especially libraries, AI promises to improve information access, streamline administrative processes, and deliver personalized user experiences. However, in Nigeria, the adoption of AI in academic libraries remains limited due to persistent challenges such as inadequate digital infrastructure, insufficient funding, and low AI literacy among library staff. This study employed a secondary research methodology, drawing on peer-reviewed journal articles, institutional reports, books, and relevant publications to examine the current state of AI in academic libraries, focusing on the Nigerian context. The findings reveal that while Nigerian academic libraries are in the early stages of AI exploration, there is substantial potential for AI-driven tools such as automated cataloguing, chatbots, and predictive analytics to enhance service delivery, resource management, and user engagement.

Purpose of the study

The paper reviewed the need for targeted investment in digital infrastructure, comprehensive capacity-building programs for library personnel, and the development of national policies to guide ethical and

practical AI implementation. If these foundational challenges are addressed, AI could transform Nigerian academic libraries into intelligent, responsive, and user-centered information hubs.

Literature Review

Artificial Intelligence (AI) in Smart Libraries and Academic Libraries

By streamlining management systems, increasing operational efficiency, and boosting user experiences, artificial intelligence (AI) is transforming academic libraries (Akinade Adebawale Adewojo & A. Dunmade, 2024; Chakala Mallikarjuna, 2024). AI-driven technologies like machine learning and natural language processing are included to automate operations, customize services, and simplify resource management (Mrs. K. Aparna Preethi, 2024). These developments include chatbots that provide real-time assistance and tailored recommendations, virtual assistants, and intelligent search and recommendation systems. Additionally, AI reduces human labour and operating expenses by automating administrative procedures, improving security, and optimizing inventory management (Akinade Adebawale Adewojo & A. Dunmade, 2024). However, for implementation to be successful, issues including privacy concerns, ethical considerations, and the requirement for staff training must be resolved (Chakala Mallikarjuna, 2024; Pankaj Kumar & Jyoti, 2024). Academic libraries must adopt these developments as AI develops to stay current and offer their patrons state-of-the-art services.

AI Use in Smart Academic Libraries in Nigeria

By improving service delivery, research support, and user experience, artificial intelligence is revolutionizing academic libraries in Nigeria. To meet the changing needs of academic communities, these libraries are integrating AI, which is revolutionizing traditional information management systems and service delivery. The use and possible effects of artificial intelligence in academic libraries were described by Gupta et al. (2020). They determined that artificial intelligence might be used in four areas: educational, informing, assistive, and social

networking. The application of artificial intelligence (AI) in Nigerian academic libraries is altering how resources are accessed and handled. Artificial intelligence (AI)-powered technologies, such as machine learning, data analytics, and natural language processing, have the potential to fundamentally change a variety of library operations. However, researchers may now access and analyse millions of peer-reviewed papers in seconds due to the development of AI-powered search engines (Baviskar et al, 2021). Service delivery effectiveness and efficiency are elevated when academic libraries employ artificial intelligence technologies. AI can potentially significantly influence Nigerian academic libraries by boosting output, improving user experiences, and offering robust support for research projects. notes that, among other things, AI can be used successfully in the fields of subject indexing, shelf reading, reference services, descriptive cataloguing, collection creation, and information retrieval systems Olayode (2022) investigated the types of artificial intelligence that could be used in university libraries as well as technological advancements in the delivery of library services. The University of Calabar already uses chatbots and robots to meet some of its service needs. The study's findings suggested that Chabot could be a valuable tool for library reference services. Artificial intelligence (AI) chatbots, such as ChatGPT, are emerging as valuable tools for academic libraries, claims Adetayo (2023). After regular library hours, they give patrons easily accessible services and answer their inquiries promptly and accurately. Chatbots and virtual assistants with AI capabilities can also help users with research citations and connect them to pertinent resources. These chatbots are always here to assist. There are numerous technical service domains where artificial intelligence can be used, including creating and assigning nine subject headings, taxonomies, and metadata descriptions. Nigerian university libraries are at a turning point in the digital era, where using artificial intelligence (AI) could improve their relevance and effectiveness. By integrating AI technologies, these libraries could offer more responsive, dynamic services that satisfy evolving user demands and global standards. By leveraging AI to automate monotonous tasks, optimize resource management,

and streamline operations, librarians can focus on more strategic initiatives and personalized user experiences. Adejo and Misau (2021) investigated the potential applications of artificial intelligence in academic libraries in Nigeria. According to the study, in addition to robotics, natural language processing, pattern recognition, and robotics in library operations, artificial intelligence (AI) could be utilized in Nigerian academic libraries to provide expert systems for reference, technical, indexing, and acquisition. As a result, the study recommended that Nigerian university libraries integrate artificial intelligence (AI) into their daily operations and train staff to use it to deliver library services. AI should be included in every library department and introduced into the national curriculum to reach every corner of the country.

Enhancing User Experience and Operational Efficiency in Smart Academic Libraries

Libraries are transforming thanks to artificial intelligence (AI), which improves user experiences and operational effectiveness. Routine jobs like cataloguing and resource arrangement are automated by AI-driven technologies, allowing librarians to engage in more cognitively challenging activities (Aparna Preethi, 2024; Kumar & Jyoti, 2024). Virtual assistants and personalized recommendations enhance user engagement and information retrieval. Additionally, AI improves decision-making in the construction of collections and the distribution of resources (Kumar & Jyoti, 2024). Even though integrating AI has many advantages, issues still need to be resolved, like privacy issues, moral dilemmas, and implementation expenses. IoT, big data analytics, augmented reality, and deeper AI integration are upcoming developments (Adewojo & Dunmade, 2024). A balanced strategy emphasizing ethical issues and responsible implementation is required to optimize AI's potential in libraries. AI is turning libraries into smart, user-focused centres that meet changing information demands (Gajbhiye, 2024; Adewojo & Dunmade, 2024).

AI in Enhancing User Experience in Smart Academic Libraries

Academic libraries are transforming thanks to artificial intelligence (AI), which is improving user experiences and simplifying services. Personalized resource recommendations, enhanced information retrieval, and real-time support via chatbots and virtual assistants are made possible by AI-powered solutions, such as recommender systems, machine learning, and natural language processing (Ikwuanusi et al., 2023; Mala, 2024). By enabling automated summarization, translation services, and semantic search, these technologies reduce language barriers and increase accessibility for people with disabilities. Additionally, AI streamlines repetitive processes like cataloguing, freeing librarians to engage in more intellectually challenging work (Preethi, 2024). Even though AI has many advantages, issues including algorithmic bias, data privacy, and ethical concerns must be addressed (Ikwuanusi et al., 2023; Mallikarjuna, 2024). A user-centered strategy, continual staff training, and professional teamwork are necessary to successfully integrate AI in libraries (Mallikarjuna, 2024). Libraries can ensure their continued relevance in the digital age by utilizing AI to provide more efficient, personalized, and entertaining experiences.

AI in Improving Operational Efficiency in Smart Academic Libraries

Academic libraries are transforming thanks to artificial intelligence (AI), which is improving service delivery and operational efficiency. African libraries' information services are being transformed by AI technologies, such as robotics and expert systems, which provide machine learning and natural language processing capabilities (Echedom & Okuonghae, 2021). AI and machine learning enhance energy efficiency in library infrastructure, develop individualized learning experiences, and optimize resource management through predictive analytics (Ramachandran, 2024). While AI-based solutions simplify library administration, resource use, and research experiences, they also bring drawbacks, including staff training requirements and ethical issues (Mallikarjuna, 2024; Chakala, 2024). Collaboration with experts, researchers,

and legislators is necessary for a successful AI integration, as is continual training and employee involvement (Mallikarjuna, 2024). Libraries can increase their function as dynamic learning environments by utilizing AI to concentrate more on strategic growth and user engagement (Chakala, 2024).

Application of AI in Growing Academic Libraries in Nigeria

By improving information retrieval, automating processes, and customizing user experiences, the use of artificial intelligence (AI) in Nigerian academic libraries has the potential to completely transform services (Ibrahim & Okpala, 2024). Although librarians are aware of the widespread usage of AI, obstacles like finance, infrastructure, and competence prevent its widespread use in Nigeria (Ajani et al., 2022). Chatbots, barcodes, and RFID systems are AI applications that could enhance service quality and re-establish connections with distant users (Oyetola et al., 2023). The advantages are improved information retrieval, tailored suggestions, and expedited administrative procedures. However, obstacles, including inadequate infrastructure, budgetary limitations, and data protection issues, must be resolved for integration to be successful. Libraries should create ethical standards, work with stakeholders, and engage in staff training to overcome these obstacles. Adopting AI is generally considered essential for Nigerian universities to improve research and academic support in the digital age (Suleiman, 2024).

Challenges for the Incorporation of AI in Smart Academic Libraries in Nigeria

Infrastructure Limitations: In Nigeria, many academic libraries continue to function on outdated, underpowered PCs and servers. Moreover, traditional library systems may not be compatible with AI technologies. Integrating AI solutions with the present library management systems could be challenging, which could result in inefficiencies. Modern CPUs and GPUs are essential for artificial intelligence applications like natural language processing, yet many libraries do not have these hardware components. Many academic institutions in Nigeria

require a strong IT infrastructure, including processing power and broadband internet, for AI systems to function well. According to Farag et al. (2021), the first significant obstacle to integrating AI in libraries is a lack of physical equipment, which is followed by a lack of local suppliers of AI technology. The benefits and drawbacks of using artificial intelligence (AI) in African academic libraries are examined by Echedom and Okuonghae (2021). The investigation identified several problems, such as insufficient training and infrastructure. To promote the use of AI in African libraries and create suitable legislation to monitor its implementation, the authors advise government and library administration to collaborate. However, the sometimes-expensive process of putting AI concepts into practice is something that libraries need to budget for. Because AI requires powerful and up-to-date technological tools to function correctly, libraries frequently lack the infrastructure to support AI in their services. (Ajani, 2022).

Funding Constraints: Many libraries cannot fully invest in new technologies due to financial restrictions. As a result, the library might not be able to afford memberships to online AI platforms or buy sophisticated AI tools. Sufficient funds are essential for employing employees, purchasing AI technologies, and sustaining infrastructure. Businesses find it challenging to implement these new technologies due to the significant cost of errors (Ahmad et al., 2021). Inadequate funding may make it more difficult for libraries to implement and maintain AI projects.

Resistance to Change: When implementing AI technologies, navigating several levels of bureaucracy may hinder adoption and innovation. Librarians may be concerned that their expertise will be displaced by AI-powered information search systems, leading to employment instability. Academic library employees and patrons may be reluctant to embrace new technology because they are unfamiliar with it, fear losing their jobs, or prefer using more conventional approaches. Abayomi et al. (2021) investigate the knowledge and attitudes of

academic librarians in Nigeria on applying artificial intelligence (AI) in university library administration. The results showed that academic librarians understood how AI was used in library operations. However, they were concerned that their employment might be lost if it were adopted.

Data Privacy Concerns: The possibility that AI-based recommendation systems may collect and examine users' search and borrowing histories raises concerns over the misuse of personal data. Inadequate data encryption and access controls that leave private information vulnerable to online threats may jeopardize user confidentiality. Adopting new technologies that handle sensitive user data can be more difficult for academic libraries due to their stringent data security and privacy laws. Outlining the legal and regulatory guidelines that oversee data management and control is crucial. In 2021, Parasuraman.

User Training Needs: Training and skill development of users, both patrons and library employees, are essential to using artificial intelligence (AI) effectively in academic libraries. To manage and operate AI systems, workers must possess technical expertise. Without internal AI specialists or IT personnel trained in AI, many university libraries lack specialized IT support for AI technologies, which can lead to extended system failures and subpar user experiences. Patrons and staff may need assistance and training to properly use new technology, which makes deployment more difficult (Ajani et al., 2022). The paper claims that although academic libraries in Nigeria know that libraries worldwide are utilizing artificial intelligence (AI), they do not have the resources to fully integrate the technology into their everyday operations.

Suggestions for Effectively Incorporating AI into Nigerian Academic Libraries

Evaluation of Goals and Needs: Recognize the unique objectives and difficulties faced by university libraries in Nigeria. Determine which important problems, such as enhancing user experience, information retrieval, or resource management, AI can help with.

Training and Capacity Building: Provide library employees with comprehensive training so they may become knowledgeable about AI technology, its uses, and best practices for deployment. Additionally, Weijia (2022) recommends educating library employees about artificial intelligence, creating a culture open to new ideas, and motivating employees to research the possibilities of integrating AI.

Cooperation and Joint Ventures: Collaborate with universities, research centres, and other institutions in Nigeria or elsewhere to exchange resources, knowledge, and experiences implementing AI.

Privacy and Data Management: Establishing strong data governance policies and processes to guarantee the moral and responsible application of AI technology, especially regarding user data and privacy. Libraries must implement stringent data security procedures and treat user data carefully. Strong data governance regulations are necessary to guarantee moral and responsible use of AI in various industries, especially regarding user privacy and data security (Sistla, 2024). To address issues like algorithmic prejudice and advance inclusive policies, effective AI governance necessitates a focus on justice, transparency, and privacy preservation (Saxena, 2024).

Promote Acceptance and Conscience: Inform the public about the advantages of artificial intelligence (AI) in libraries by holding conferences, seminars, and demos that showcase measurable enhancements to user experience and service delivery. Ajani et al. (2022) investigated librarians' assessments of academic libraries in Nigeria's awareness and readiness to integrate artificial intelligence (AI) into their operations and services. The poll indicates that while academic libraries in Nigeria know that libraries worldwide utilize artificial intelligence, they do not have the resources to fully integrate the technology into their everyday operations.

Organizing for Sustainability and Finances: Create a long-term budget to fund the advancement and upkeep of AI technology. Think about allocating funds for AI upkeep, training, and future advancement. Organizations can use artificial intelligence (AI) to improve

the quality of their services, encourage top-notch research, and promote creative knowledge exchange by following the recommendations for successfully integrating AI into academic libraries in Nigeria and the difficulties faced.

Conclusion

Artificial Intelligence (AI) presents a transformative opportunity for Nigerian academic libraries to enhance user experience, streamline operations, and expand access to information. Tools like intelligent search engines, chatbots, and predictive analytics improve service delivery and resource management while supporting personalized and efficient user interactions. AI also aids in digitizing traditional knowledge, making local content globally accessible. However, successful adoption requires strategic investments in infrastructure, staff training, and clear policy frameworks to address challenges such as limited funding, digital literacy gaps, and data security. Embracing AI can position Nigerian libraries as dynamic knowledge hubs that drive research, innovation, and academic excellence in the digital era.

Recommendations

I. Investment in AI Infrastructure, Capacity Building, and Digital Connectivity

To successfully integrate Artificial Intelligence (AI) into Nigerian academic libraries, universities should prioritize strategic investments in digital infrastructure, consistent power supply, and librarian training. Clear institutional policies must be developed to guide ethical AI use and address data privacy concerns. Addressing budgetary and knowledge gaps is essential. AI adoption is critical for modernizing library services and meeting evolving user needs in the digital era.

II. Development of AI Policies, Ethical Guidelines, and Strategic Collaborations

While AI offers significant benefits for Nigerian university libraries, such as improved information access, personalized services, and operational efficiency, its integration must be approached responsibly. Institutions should establish clear ethical guidelines, address data privacy concerns, and ensure transparency in AI decision-making. Collaboration with AI research bodies and global partners is essential to develop context-specific, best-practice solutions. Libraries must engage in continuous staff training, stakeholder consultation, and

active participation in national AI policy development to support sustainable implementation and governance.

III. **Continuous Evaluation and Adaptive AI Implementation**

To harness AI's full potential in Nigerian university libraries, institutions should adopt a phased implementation strategy supported by targeted capacity building and collaborative partnerships. Key technologies such as machine learning and natural language processing can enhance user engagement and streamline operations. However, outdated systems, limited resources, and ethical concerns must be addressed. Libraries should involve staff in the transition process, prioritize user-centered design, and provide continuous training to manage change effectively. By doing so, they can position themselves as leaders in innovative knowledge services.

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