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"ADOPTION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN ACADEMIC LIBRARIES IN NIGERIA: AN ANALYSIS OF NEED AND HINDRANCES."

ADOPTION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN ACADEMIC LIBRARIES IN NIGERIA: AN ANALYSIS OF NEED AND HINDRANCE

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Abstract

This study examines the prerequisites and challenges associated with implementing artificial intelligence (AI) in Nigerian academic libraries. Through an exploratory research approach and a comprehensive literature review, the study identifies key factors necessary for the adoption of AI, including policy frameworks, digital infrastructure, human capital development, and data security. The study reveals significant challenges, such as high implementation costs, technical skill gaps, and infrastructure deficiencies. Recommendations include government and university support for AI implementation and targeted training for librarians to ensure the successful integration of AI technology.

Keywords: AI in Academic Libraries, Adoption Challenges, Digital Infrastructure, Human Capital Development, Machine Learning Applications.

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Introduction.

The advent of Information and Communication Technology (ICT) and subsequent technological innovations have consistently driven transformative changes in library operations and services. As a vital component of academic institutions, libraries play a crucial role in supporting scholarly pursuits by providing seamless access to information. To remain relevant and effective in facilitating teaching, learning, and research, modern academic libraries must continually adapt to the rapidly evolving technological landscape. The increasing adoption of digital technologies in libraries has led to significant shifts in information service delivery, primarily through automation. According to Memela (2023), the evolution of academic library automation has progressed from traditional card systems to computerisation, digitisation, electronic resources, radio frequency identification (RFID), and most recently, artificial intelligence (AI). This technological progression has significantly enhanced the efficiency and effectiveness of library operations and services, setting a new standard for excellence in the field.

The integration of Artificial Intelligence (AI), the latest milestone in technological development, has revolutionised library operations and services. As a result, AI adoption has emerged as a strategic imperative for academic libraries worldwide, enabling enhanced efficiency and effectiveness in their functions (Eiriemiokhale & Sulyman, 2023). The rapid evolution of AI technologies necessitates that librarians remain abreast of these advancements and adapt library processes and services accordingly. To achieve this, librarians must demonstrate a high degree of dedication to service design and delivery while also embracing proactive and innovative approaches to their work. By doing so, libraries can harness the full potential of AI to drive transformative change and improve user experiences.

The adoption of Artificial Intelligence (AI) in Nigerian libraries is presently limited, with recent studies (Odeyemi, 2019; Ajani et al., 2022; Yusuf et al., 2022; Oyekale, 2023) highlighting the need for further investigation. The slow pace of adoption raises concerns about the ability of

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academic libraries to remain competitive and keep pace with global trends in information access initiatives. In response, this research aims to conduct a comprehensive examination of the requirements and challenges associated with the successful adoption of AI in academic library operations and services in Nigeria. Specifically, the study will focus on identifying the key issues that impact AI adoption in Nigerian libraries by exploring these issues.

Foundational Frameworks of Artificial Intelligence: Principles, Concepts, and Paradigms

Artificial Intelligence (AI) is a multifaceted and dynamic field that encompasses a wide range of technologies, including machine learning, natural language processing, computer vision, and robotics (Lowendal & Calhoun Williams, 2018). According to Bughin et al. (2018), AI capabilities comprise various components, such as machine learning, natural language text understanding, virtual agents, and autonomous vehicles. These descriptions underscore the broad scope of AI, which draws upon multidisciplinary concepts, theories, and practices from fields such as philosophy, mathematics, psychology, linguistics, and computer science (Amudha, 2022). At its core, AI involves the development of computer systems that can perform tasks that typically require human intelligence, such as decision-making, object detection, and complex problem-solving (Memela, 2023). This necessitates a high level of intelligence, akin to human capabilities, in areas such as thinking, reasoning, comprehension, learning, judgement, and inference.

By combining these attributes, AI systems can mimic human-like intelligence, enabling them to make informed decisions and solve complex problems. Though the use of AI has not gained much popularity in Nigeria, it is regarded as part of the 4th industrial revolution (Park, 2019) and originated from the assumption of John McCarthy in 1956, who stated that every aspect of learning and other forms of intelligence can be simulated through the use of machines (Wang, 2018). The originator further defines AI as the 'science and engineering of making intelligent machines, particularly intelligent ones' to use the computer to study the intelligence and associated decision-making skills of humans (Amudha, 2022). Theoretically, the emergence of the field of AI stems from the recognition that computers, initially designed for digital

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computing, can be leveraged to perform complex cognitive tasks such as theorem proving and strategic play, thus facilitating the exploration of human intelligence and decision-making processes through computational modelling (Amudha, 2022). Theoretical. This implies that the theory of artificial intelligence is centred on the mix between human intelligence and computer intelligence.

AI in Academic Libraries: Strategic Objectives, Potential Benefits, and Anticipated Impacts of AI Integration in Academic Libraries

The integration of Artificial Intelligence (AI) in academic libraries has been recognised as a transformative force, revolutionising library processes and services (Halburagi, Suryakanth, & Mukarambi, 2023). The strategic objectives of AI adoption in libraries include improved search and discovery of materials, personalised library services, digitisation and preservation of library materials, and enhanced accessibility of library resources. According to Cox (2022), AI plays a crucial role in mining published literature, enabling researchers to efficiently navigate vast amounts of literature. AI-powered machine learning algorithms facilitate seamless navigation of library collections, eliminating the need for manual searching (Cox, 2022).

The potential benefits of AI in academic libraries are multifaceted. Memela (2023) describes AI as a "new hope" for libraries, enabling the provision of automated services and playing a major role in the upcoming 5th industrial revolution. Studies have shown that AI can increase productivity, improve customer satisfaction, enhance information accessibility, and facilitate collaboration and knowledge sharing (Ogwo, Ibegbulem, & Nwachukwu, 2023). AI can also simplify library functions, enhance librarian efficiency, and promote quality service delivery (Olayode, 2023). Furthermore, AI can provide error-free operations, work around the clock without fatigue, and free librarians to focus on more demanding tasks (Omame & Alex-Nmecha, 2020).

The impact of artificial intelligence on library operations and services is profound. AI can analyse texts, create knowledge models, and make decisions using machine learning algorithms. AI chat

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bots, such as Chat GPT, can be integrated into daily library workflows, providing practical tools for specific tasks. The capabilities of AI include robotic process automation, computer vision, machine learning, natural language text understanding, and virtual agents/conversational interfaces (Bughin et al., 2018). According to Balsubramanian and Tamilselvan (2023), the impact of AI on library operations and services manifests in various ways, including:

Optimised Search and Discovery Capabilities: Artificial Intelligence (AI) powered search systems revolutionise the way users discover relevant resources by leveraging advanced algorithms and machine learning techniques. These systems analyse user search behaviour, identify patterns, and suggest pertinent resources, ensuring a more efficient and personalised experience.

Strategic Collection Development and Management: Artificial Intelligence (AI) can significantly enhance collection management in libraries by leveraging data-driven insights to inform selection and acquisition decisions. By analysing usage data, identifying popular items, and predicting future demand, AI can enable libraries to make more informed decisions about resource allocation and procurement.

Efficient Processing and Organisation of Library Resources: Artificial Intelligence (AI) revolutionises the processing and organisation of library resources by streamlining cataloguing and classification workflows. By leveraging AI-powered technologies, libraries can significantly reduce the time and effort required to handle and arrange collections, thereby enhancing operational efficiency and productivity.

Enhancing Inclusive Information Accessibility: Artificial Intelligence (AI) plays a pivotal role in promoting inclusive information accessibility, particularly for individuals with disabilities, by providing innovative solutions that bridge the accessibility gap. By leveraging AI-powered technologies, libraries can offer a range of assistive features that facilitate equal access to resources and services.

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Digital Preservation and Conservation of Library Resources: Artificial Intelligence (AI) plays a vital role in the preservation of library resources, enabling the digitisation and conservation of fragile, rare, or deteriorating materials. By leveraging AI-powered technologies, libraries can mitigate the risk of loss or damage to physical documents while also enhancing their accessibility and usability for future generations.

Data-Driven Insights and Decision Making: Artificial Intelligence (AI) empowers libraries to extract valuable insights from complex data sets, enabling data-driven decision making and service enhancement. By leveraging AI-powered analytics, libraries can evaluate circulation statistics, user activity, and resource utilisation to identify patterns, trends, and correlations.

In conclusion, recent research by Subaveerapandiyan (2023) underscores the transformative potential of Artificial Intelligence (AI) in library settings. The study reveals that AI can significantly enhance information retrieval, automate routine tasks, and personalise user interactions, thereby elevating the overall user experience. Furthermore, AI-powered chatbots, such as ChatGPT, demonstrate exceptional efficacy in addressing user queries and providing instant assistance, resulting in improved user satisfaction. These findings highlight the critical role that AI can play in modernising library services, streamlining operations, and fostering a more user-centric approach. By leveraging AI-driven solutions, libraries can optimise their services, improve user engagement, and remain relevant in an increasingly digital landscape.

Modes of Artificial Intelligence Application in Academic Library Services:

The integration of Artificial Intelligence (AI) in academic libraries can be achieved through various modes, as identified by multiple studies (Yu et al., 2019; Ali et al., 2020; Omame & Alex-Nmecha, 2020; Olayode, 2022). These modes encompass a range of technologies, including AI-powered robots for tasks such as book sorting and retrieval, chatbots like ChatGPT for rapid and accurate responses to user queries, expert systems for specialised knowledge and support, facial recognition for enhanced security and user authentication, cloud computing for large-scale data storage and analysis, big data analytics for insights into user behaviour, and RFID technology for

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streamlined inventory management. Notably, recent research by Adetayo (2023) underscores the potential of chatbots, particularly ChatGPT, as a valuable tool for library service delivery, offering advanced language processing capabilities and human-like responses to user queries. By harnessing these AI applications, libraries can significantly enhance user experiences, improve operational efficiency, and provide innovative services that support research and learning.

Recent studies have highlighted the diverse applications of Artificial Intelligence (AI) in library services and operations. According to Nawaz, Gomez, and Saldin (2020) and Moustapha and Yusuf (2023), AI can be utilised in various areas, including automation of library routines, user identification, monitoring user activity, reference services, library security, teaching, and online messaging. Additionally, AI-powered tutorials can keep users informed about the latest developments in their field. In technical services, AI can be applied to tasks such as assigning and creating subject headings, taxonomies, and metadata descriptions, with librarians playing a crucial role in moderating metadata ethics and privacy (Corrado, 2021). Furthermore, AI-powered expert systems can support research, indexing, online reference, and technical services, including acquisition, cataloguing, and classification (Mughalu, 2019). The strategic integration of Artificial Intelligence (AI) applications in libraries can significantly augment user experiences, optimise operational efficiency, and facilitate the development of innovative services, thereby redefining the contours of library services and user engagement.

Recent studies by Lie et al. (2019), Kaushal and Yadav (2022), Balsubramanian and Tamilselvan (2023), and Halburagi and Mukarambi (2023) have elucidated the multifaceted applications of Artificial Intelligence (AI) in library operations and services. These applications include the deployment of chatbots as virtual assistants, providing rapid support and referrals to users while minimising staff workload. AI-powered algorithms can analyse user behaviour and preferences, enable personalised recommendations, and enhance user satisfaction. Additionally, AI-assisted systems can automate tasks such as cataloguing, classification, and indexing, ensuring accurate and efficient processing of library materials. Furthermore, AI-driven analytics can provide valuable insights into user interactions with library resources, informing service improvements

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and tailored offerings. AI technology also plays a critical role in digital preservation, facilitating the detection and repair of faulty files, optimising storage, and ensuring the long-term conservation of digital materials. By leveraging these AI applications, libraries can significantly enhance user experiences, improve operational efficiency, and provide innovative services that support research and learning.

The successful implementation of Artificial Intelligence (AI) in academic libraries necessitates careful preparation and consideration of key factors. According to Weija (2022), as cited by Subaveerapandiyan (2023), leadership, expertise in AI applications, acceptance of AI, awareness of AI, and an innovative environment are essential elements that influence libraries' preparedness to adopt AI. To ensure a seamless integration, library management should remain abreast of the latest developments and regularly assess the library's readiness for AI adoption. Furthermore, library personnel require a high level of awareness, comprehensive training, and a supportive environment that fosters innovation, encouraging staff to explore the potential of AI integration. By prioritising these factors, libraries can effectively harness the benefits of AI, enhancing user experiences, improving operational efficiency, and driving innovation in academic libraries.

Requirements for AI Applications in the Library:

The integration of Artificial Intelligence (AI) in libraries necessitates careful consideration of several key requirements. Research by Martinez-Plumed et al. (2021), Qomariyah et al. (2020), Decker (2015), Odeyemi (2019), and Owolabi et al. (2022) highlights the essential elements for AI application in libraries, including a policy document or framework, robust digital infrastructure, strong internet connectivity, expertise and skills in operating technology, human capacity and training, and sufficient data generation and organisation. Notably, AI relies on human-generated data, underscoring the importance of librarians' role in data creation and organisation. Consequently, librarians must possess data literacy skills, including understanding data types, sources, quality, privacy concerns, and ethical considerations, as Neuman et al. (2022), Lund and

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Wang (2023), and Oyetola et al. (2023) have emphasised.Furthermore, librarians should be proficient in digital tools and technologies, including coding languages. Halburagi and Mukarambi (2023) provide additional insights into specific AI requirements for libraries, reinforcing the need for a comprehensive approach to AI adoption. By addressing these requirements, libraries can harness the potential of AI to enhance user experiences, improve operational efficiency, and drive innovation.

The successful implementation of Artificial Intelligence (AI) in libraries requires careful consideration of several key factors.

A well-organised and easily accessible database of collections and user information is essential to support AI applications, which can be achieved through digitisation of library resources and thorough data capture. A robust AI infrastructure, comprising computer hardware, software, and reliable internet connectivity, is also crucial. Furthermore, expertise in AI development is necessary to build and maintain the AI system, requiring professionals with knowledge of AI programming languages, data analytics, machine learning algorithms, and related tools. High-quality data sets are also vital for training AI models, and robust data privacy and security measures must be implemented to protect user data and ensure compliance with data protection regulations. Additionally, specific areas of AI application should be identified, and AI technology should be integrated with existing library systems to minimise operational disruption. Ultimately, user training is a critical necessity for successful AI implementation, requiring education and training for both library personnel and patrons to ensure proper deployment and utilisation of the technology.

The Imperative of Addressing Institutional Challenges in AI Adoption:

The integration of Artificial Intelligence (AI) technology in Nigerian libraries is beset by substantial challenges, as corroborated by recent empirical studies. Notably, research conducted by Rotimi et al. (2022), Owolabi et al. (2022), and Adeyeye et al. (2023) reveals a conspicuously low level of AI adoption in library operations and services, characterised by the predominance of

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manual processes and a marked lack of preparedness to integrate emerging technologies. This scenario highlights the limitations of AI adoption prospects in these libraries, which are likely attributable to institutional deficiencies.

Institutional Concerns as a Barrier to AI Adoption

The findings of Bawack and Nkolo (2018) and Tella (2020) further reinforce the notion that institutional concerns constitute a significant impediment to AI deployment in libraries, particularly in African countries. These concerns necessitate urgent attention to unlock the transformative potential of AI in enhancing library services and operations.

Key Implications

1. Addressing Institutional Inadequacies: Nigerian libraries must prioritise addressing institutional challenges to facilitate successful AI adoption.

2. Capacity Building: Librarians require training and development to integrate AI technologies into library services effectively.

3. Strategic Planning: Libraries need to develop strategic plans to harness the potential of AI, ensuring alignment with institutional goals and objectives.

By acknowledging and addressing these challenges, Nigerian libraries can navigate the complexities of AI adoption and harness its potential to enhance user experiences, improve operational efficiency, and drive innovation.

Several factors, including the lack of necessary facilities, inadequate policies, and ineffective library management, hinder the implementation of Artificial Intelligence (AI) technology in Nigerian libraries. Studies by Odeyemi reveal a low level of readiness for AI adoption, attributing it to financial uncertainties, incomplete automation, skill gaps, fear of job loss, inadequate technological infrastructure, and unreliable power supply. Additional challenges include ethical concerns, privacy issues, high system development and maintenance costs, and limited

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availability of AI experts. These factors underscore the importance of sufficient financial provision for successful AI implementation. Given the current economic realities and low financial allocation to education in Nigeria, the prospect of fully implementing AI in the education system appears to be challenging, highlighting the need for strategic planning and resource allocation to overcome these challenges.

Conclusion and Future Directions:

This study explores the feasibility of adopting Artificial Intelligence (AI) technology in Nigerian academic libraries, recognising the pervasive presence of AI in various aspects of modern life. As AI has become an integral part of personal devices, its potential applications in libraries warrant examination. This research focuses on identifying the key requirements for successful AI implementation in academic libraries, including policy frameworks, digital infrastructure, human capacity development, data for training, and data privacy and security. Additionally, the study highlights the challenges associated with AI adoption, primarily related to financial constraints, which are contingent upon institutional and political will. By understanding these requirements and challenges, libraries can better navigate the complexities of AI integration and harness its potential to enhance services and operations.

Recommendations

Based on the study's findings, the following recommendations are proposed to facilitate the successful adoption of Artificial Intelligence (AI) technology in Nigerian academic libraries:

1. Adequate Financial Provision: The government should allocate sufficient funds to institutions of higher learning to support the development and implementation of AI technology, particularly for providing AI-related infrastructural facilities in libraries and other relevant administrative functions.

2. Diversification of Funding Sources: University authorities and library administrations should explore additional funding opportunities beyond TETFUND, such as grants, philanthropic support, and partnerships with non-governmental organisations, to supplement financial resources for AI adoption.

3. Staff Training and Development: Library administrations should prioritise staff training and professional development to ensure a seamless transition to AI-enhanced operations and

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services. This should include technology literacy, hands-on experience with AI tools, and proficiency in digital tools and technologies.

4. Digital Literacy and AI Competence: Librarians should possess fundamental knowledge of AI, including its capabilities, limitations, and techniques such as machine learning, natural language processing, and data mining, as well as proficiency in coding languages.

5. Data Protection and Security: Libraries should implement robust data protection measures to safeguard user privacy, ensuring the security of patron data and biographical information.

By implementing these recommendations, Nigerian academic libraries can effectively harness the potential of AI technology to enhance services, improve efficiency, and support research and learning.

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(2) Dr. Muhammed Lawal Akanbi is a distinguished academic and library professional, currently serving as the University Librarian at Kwara State University of Education. With a strong background in library and information science, he is chartered with the Librarians Registration Council of Nigeria (LRCN) since 2005.

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(4) Basirat Raji is a dedicated professional librarian serving at Kwara State University Library, where she leverages her expertise in Library and Information Science to deliver exceptional services. Holding a bachelor's and master's degree in library and Information Science, Mrs Basirat has developed a strong foundation in the technical aspects of librarianship.