CHALLENGES AND OPPORTUNITIES OF IMPLEMENTING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN NIGERIAN LIBRARIES: AN OVERVIEW OF SELECTED CASE STUDIES

WHONG, F. M.
Kashim Ibrahim Library, Ahmadu Bello University, Zaria
fideliawhong@gmail.com +2348035927624

Abstract

Integrating artificial intelligence (AI) and machine learning (ML) technologies into services delivery in Nigerian libraries offers revolutionary possibilities as well as serious challenges. This paper examines six case studies and the challenges involved in integrating AI and ML into the Nigerian library system, highlighting the urgent need for technology development in this field. The paper found the following challenges exist: insufficient financial resources, a shortage of qualified workers, issues with data availability and quality, challenges related to legislation and regulation, and cultural and societal barriers, and knowledge and the skill set required for integrating AI and ML personnel shortage. Notwithstanding these challenges, AI and ML present several chances to improve library services by means of enhanced information retrieval, automated routine chores, optimum resource management, greater accessibility, and the promotion of research and innovation. Therefore, this paper attempts to direct the successful implementation of AI and ML in Nigerian libraries, making sure they stay relevant and able to satisfy the changing demands of their users in the digital era, by looking at successful case studies and offering strategic recommendations for successful implementation.

Keywords: Machine learning, Artificial intelligence, Nigerian libraries, Challenges, Opportunities

Introduction

Artificial intelligence (AI) and Machine learning (ML) are today essential technologies with a wide range of uses in the healthcare, education, and library institutions. The integration of AI and ML in Nigerian libraries offers an important avenue for investigating both the challenges and opportunities it faces.

A definition of the extent of AI and ML technologies is necessary before one can appreciate the need for adopting these technologies in Nigerian libraries.

AI encompasses computer systems that can perform tasks such as pattern recognition, natural language understanding, and problem-solving, which typically require human intelligence (Katiyar et al., 2024). Conversely, ML refers to algorithms that allow computers to learn from data and increase their performance without the need for explicit programming (Pratyasha et al., 2022).

Knowing these definitions prepares one to investigate how these technologies could completely transform Nigerian library services.
Nigeria, a nation rich in cultural heritage but increasingly in need of technological development, has libraries that serve as essential information and knowledge stores for its people.

These libraries' inability to stay current with technological advances, however, frequently makes it more challenging for them to offer patrons effective and current services (Enakrire, 2023). By modernizing with AI and ML, Nigerian libraries could overcome these challenges and improve their services to meet the changing demands of their users.

One cannot overstate the importance of technologically upgrading Nigerian libraries. Libraries must change to be effective in serving their communities in a time when knowledge is becoming more and more digitalized and easily available.

AI and ML can help Nigerian libraries optimize resource management, simplify operations, and enhance user experiences (Tolulope, 2024).

This modernization is not only a luxury but also a necessity to guarantee that libraries remain important hubs of knowledge sharing and learning in the digital age.

As a result, this paper aims to investigate the complexities of implementing AI and ML in Nigerian libraries, as well as to clarify the possible advantages and challenges associated with this technical development through the lens of six selected case studies.

Case Studies

In order to perform an exhaustive analysis of both Nigerian pilot projects and successful implementations in other countries, it is imperative to conduct a thorough examination of the use of AI and ML in Nigerian libraries.

By leveraging global best practices and insights from the following six selected cases studies, one can establish a beneficial framework for customizing these technologies to suit the Nigerian situation.

Bichu et al. (2021) conducted the initial case study on the application of Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) in the field of orthodontics. This study included a cohort of 1,000 orthodontic patients from various dental clinics. By utilizing ANNs and CNNs, the study made significant improvements in diagnostic accuracy and treatment planning. These tools enabled the meticulous examination of dental pictures and patient data, resulting in enhanced precision and customized treatment regimens.

Implementing these advancements in library services requires customizing algorithms to effectively process the varied and intricate data sets that are unique to library operations.

The primary challenge involves creating AI models capable of efficiently processing and analyzing the diverse range of data present in libraries, including text, photos, and multimedia.

Also, Yang et al. (2022) investigate the incorporation of AI with Google Earth Engine (GEE) in a variety of applications, with a particular emphasis on geographic analysis and remote sensing.

The methodology entailed a comparative analysis of remote sensing data processed with AI and GEE at 100 geographic sites worldwide.

The research illustrated substantial enhancements in the visualization, data analysis, and decision-making processes associated with environmental monitoring and resource management by employing AI algorithms to analyze extensive satellite imagery.

The integration of AI and GEE has demonstrated substantial potential for libraries, particularly in the areas of data analysis and visualization. Nevertheless, the necessity of addressing data privacy concerns, extensive staff training, and substantial infrastructure investment are among the obstacles.

Another study conducted by Bi et al. (2022) examines the integration of AI with Internet of Things (IoT) technologies in smart libraries. The focus of this investigation was to use AI to improve library services, with a sample size of 30 smart libraries from various countries.

By utilizing AI algorithms and IoT devices, smart libraries can optimize resource utilization, automate commonplace duties, and provide library users with personalized experiences. For example, Chabots powered by AI can offer immediate assistance to consumers, while IoT sensors can monitor environmental conditions to guarantee the preservation of library materials.

Nevertheless, the implementation of smart technologies in libraries requires a substantial financial investment and the capacity to surmount resistance to change among patrons and library staff. Successful integration of these technologies is contingent upon ongoing stakeholder engagement and the implementation of effective change management strategies.

Reis (2024) also explore the Nigerian financial sector's cybersecurity measures, emphasizing the necessity of technological advancements to defend against cyber threats.

The implementation of AI and ML technologies to detect and mitigate cyber threats was the primary focus of this study, which also included a survey of cybersecurity protocols across 50 Nigerian banks.

By continually monitoring network traffic and identifying potential threats in real time, AI and ML can enhance cybersecurity protocols, safeguard sensitive data, and guarantee the reliability of digital resources, according to the results.

Libraries face similar cybersecurity challenges that necessitate continuous updates and significant investments in AI-driven security systems to protect digital resources and user data from intrusions.

Furthermore, a study conducted by Bali (2024) investigates the effects of AI advancements on learning outcomes in the Nigerian education sector. The study examined the incorporation of AI in 25 educational institutions, including secondary schools and universities, with a sample size of 5,000 students and educators.

AI technologies are progressively improving the quality of learning, research, and knowledge sharing by automating administrative tasks, facilitating access to educational resources, and providing personalized learning experiences.

In order to guarantee the effective use of these technologies, libraries must collaborate with educational institutions and provide continuous user training. The challenge is to adapt AI-driven educational tools to support diverse academic requirements.

Finally, Mwangi (2024) conducted a case study that examined the use of AI applications to optimize supply chain processes in Kenya. This study investigated the use of AI and ML to improve operational efficiency, resource allocation, and inventory control in 200 supply chain operations from a variety of industries.

The results indicate that AI and ML can significantly improve supply chain management by predicting demand, optimizing routes, and reducing operational costs.

Some of the logistical challenges that come with putting similar solutions into libraries include adding AI to existing library management systems and making sure that all of the library's different functions work together without any problems.

A comprehensive approach to AI adoption, which includes staff training and system enhancements, is necessary to address these challenges.

Ultimately, by drawing insights from these six case studies, Nigerian libraries can gain a

thorough understanding of the potential advantages and challenges associated with the implementation of AI and ML technologies. In order to strategically plan and execute AI and ML initiatives, Nigerian libraries will be able to draw lessons from successful global implementations and pertinent local examples.

Hence, these technologies provide opportunities to promote the dissemination of knowledge and empower users in the digital age by optimizing resource management, fostering innovation within the library ecosystem, and enhancing service delivery.

Challenges of Implementing AI and ML in Nigerian Libraries

The effective integration and application of ML and AI in Nigerian libraries necessitates addressing several challenges. These challenges can be grouped into the following subsections.

Technological Infrastructure: Limited access to sophisticated computing resources is one of the main challenges Nigerian libraries face in using AI and ML technology. Without sufficient infrastructure in place, such as high-performance computer systems, libraries could find it difficult to use and apply AI and ML tools (Enakrire, 2023).

An inadequate internet connection exacerbates this issue, as the successful implementation of AI and ML applications in libraries relies on seamless data processing and online resource access, he further noted that some Nigerian libraries lack the necessary hardware and software to support AI and ML technologies.

This includes inadequate internet connectivity, outdated computers, and insufficient digital resources (Mahmud, 2024).

Financial Constraints: Implementing AI and ML technologies requires significant investment, which is often beyond the budgetary allocations of many Nigerian libraries. Tolulope (2024) added that funding is a major obstacle to the use of AI and ML in Nigerian libraries.

Many libraries, particularly those with tight budgets, may find the high expenses of obtaining and sustaining AI and ML technology to be unaffordable.

The general low funding available for libraries in Nigeria makes it more difficult for institutions to invest in the resources required to assist AI and ML projects (Blow, 2024).

Skilled Personnel: The dearth of qualified AI and ML experts in the Nigerian library sector is another major issue. A shortage of qualified staff members hinders the effective application and use of AI and ML technologies in library settings (Amzat, 2023).

Therefore, continuing education and professional development programmes are necessary to bridge this gap, equipping library employees with the necessary knowledge and skills to utilise AI and ML effectively (Barsha & Munshi, 2023).

Data Quality and Availability: Data quality and availability are major obstacles impeding the use of AI and ML in Nigerian libraries (Chika, 2024).

Notably, because so many library items are still in old formats, inadequate digitalization of library resources makes it challenging to use AI and ML technologies to their full potential (Ailakhu, 2024).

Also, because libraries lack defined procedures and infrastructure to manage massive amounts of data, maintaining and managing huge datasets can be challenging (Chika, 2024).

Policy and Regulatory Issues: Policy and regulatory concerns are also major obstacles to incorporating AI and ML into Nigerian libraries (Bali, 2024). The lack of encouraging government policies designed especially to direct the integration of these technologies impedes development in this field (Bi, et al, 2022).

Furthermore, libraries face major obstacles because they must follow strict rules to protect user data and provide moral data handling procedures (Olujobi et al., 2021).

Cultural and Social Barriers: Further complicating the use of AI and ML in Nigerian libraries are cultural and societal obstacles (Baro & Nwabueze-Echedom, 2022).

One typical problem is that people are reluctant to adopt new technology or procedures that go against established library procedures, both for staff members and customers (Iltis, 2023).

Applications based on AI and ML raise ethical questions, particularly with regard to maintaining moral principles and protecting user privacy (Oladeinde, 2024).

Opportunities for Implementing AI and ML in Nigerian Libraries

Artificial intelligence and machine learning provide Nigerian libraries with many new opportunities to improve user experiences and transform traditional library services.

AI-driven systems can greatly improve search skills in databases, archives, and library catalogues, providing an important prospect for improved information retrieval (Enakrire, 2023).

Libraries can provide customised user experiences by using ML algorithms to tailor search results and suggestions to specific preferences and actions (Tolulope, 2024). This enhances user satisfaction and encourages greater engagement with library resources.

Automating repetitive operations through AI and ML integration is another important prospect for Nigerian libraries. Libraries can improve productivity and reduce manual labour by streamlining cataloguing and categorization procedures using AI technologies (Mahmud, 2024).

AI chatbots and automated reference services can improve user interactions by answering questions quickly and allowing employees to concentrate on more difficult jobs (Enakrire, 2023). This automation saves time and ensures constant service delivery.

Among the many ways AI and ML may help Nigerian libraries is in resource management. Libraries can use predictive analytics to build collections by anticipating user demands and information consumption patterns (Tolulope, 2021).

ML models enable libraries to make well-informed decisions about resource purchases and distribution, maximising their holdings to efficiently satisfy user needs. AI can also help with the effective administration of digital resources by guaranteeing simple access to and retrieval of electronic materials (Enakrire, 2023).

For libraries, diversity and accessibility are critical factors, and AI provides the means to successfully address these concerns. AI technologies can help people with disabilities by offering text-to-speech, adaptive interfaces, and other accessible features (Enakrire, 2021).

Furthermore, AI can be critical in closing the digital gap by providing creative ways to increase the accessibility of library materials to marginalised groups (Tolulope, 2024). Using AI technologies, Nigerian libraries can ensure that

their offerings are inclusive and meet a variety of user demands.

Research and innovation are two areas where AI and ML can have a significant impact on Nigerian libraries. These technologies' data analytics can assist scholars in conducting sophisticated studies and gaining insightful knowledge from vast volumes of data (Tolulope, 2024).

The library use of ML algorithms can improve knowledge discovery, facilitate data-driven decision-making, and promote creativity in scholarly and scientific activities. Moreover, AI has the potential to foster research cooperation and knowledge exchange, advancing an open access and multidisciplinary cooperation culture (Enakrire, 2023).

AI-powered solutions can improve an important component of community involvement in Nigerian libraries. Libraries can use AI technologies to increase the reach of their outreach initiatives and interact more successfully with the community (Tolulope, 2024).

Personalized learning experiences, resource recommendations, and lifelong learning possibilities are just a few ways that AI-powered solutions might help educational endeavours (Enakrire, 2023). By means of community involvement programmes powered by AI, Nigerian libraries can enhance their function as centres of information sharing and cultural enrichment.

Integrating AI and ML into Nigerian libraries presents numerous opportunities across various aspects of library operations. The possibilities for AI technologies to revolutionize Nigerian libraries range from automating regular chores and boosting information retrieval to encouraging accessibility and resource management.

By seizing these opportunities, Nigerian libraries can improve their services, better serve their communities, and maintain their leadership in digital age innovation.

Recommendations for Successful Implementation

When introducing AI and ML into Nigerian libraries, it is critical to take into account a number of suggestions for a successful rollout. Making these suggestions will help to guarantee that the integration of these technologies is efficient, long-lasting, and advantageous to the library environment.

It is clear from a variety of academic works that important foundations for successful implementation are strategic planning and investment, capacity building and training, policy and advocacy, and community involvement (Huang, 2022; Harisanty et al., 2022; Subaveerapandiyan, 2023; Hussain, 2023; Mahmud, 2024).

Successful application of AI and ML in libraries is mostly dependent on strategic planning and funding. A thorough implementation strategy must outline the goals, objectives, and road map for integrating these technologies into library services (Hussain, 2023).

Libraries could find it difficult to fully use AI without a defined plan. Finding enough money and resources is also critical (Hussain, 2023; Subaveerapandiyan, 2023). Libraries need to make the investments in the equipment, technology, and infrastructure required to efficiently support AI applications. Insufficient infrastructure can make AI in library services more difficult to use successfully (Hussain, 2023).

Training and capacity development turn out to be essential elements of successful AI and ML integration in libraries. Building training

programmes for library employees is crucial to giving them the abilities and information they need to use AI technologies (Harisanty et al., 2022; Mahmud, 2024). Collaborations with academic institutions can help improve capacity-building initiatives by providing access to specialised training materials and knowledge (Harisanty et al., 2022). Libraries may guarantee that their employees are skilled at using AI tools to improve library services by making investments in ongoing education and skill development.

An enabling environment for the use of AI in libraries depends critically on policy and lobbying. It is crucial to advocate for favourable government policies to secure legislative and political support for AI projects in libraries (Huang, 2022).

Creating rules for the use of ethical AI is just as crucial to guaranteeing that AI applications in libraries follow data privacy laws and ethical principles (Huang, 2022). Libraries can negotiate the possible legal and ethical obstacles to AI implementation by promoting supportive laws and creating ethical standards.

Community involvement is another important suggestion for the effective use of AI and ML in libraries. Participating in the implementation process with library users promotes inclusivity and ownership (Subaveerapandiyan, 2023; Jha, 2023).

Libraries can tailor AI solutions to the specific needs and tastes of their communities by including users in decision-making processes and asking for their input. Additionally, increasing knowledge of the benefits of ML and AI is critical (Subaveerapandiyan, 2023; Mahmud, 2024).

Understanding the potential benefits of AI technology among library users can help build acceptance and trust for these developments.

In the end, a calculated approach including strategic planning, capacity building, policy advocacy, and community involvement is required for the effective application of AI and ML in Nigerian libraries. By implementing these suggestions, libraries can leverage the transforming potential of AI to improve user experiences and services while keeping up with digital-age technology developments.

Conclusion

The application of AI and ML in Nigerian libraries presents a complex landscape with numerous opportunities and significant challenges.

The major obstacles include insufficient financial resources, a shortage of qualified workers, issues with data availability and quality, challenges related to legislation and regulation, and cultural and societal barriers.

These challenges emphasize the need for all-encompassing plans to overcome constraints and create an environment that promotes technical progress.

On the other hand, the prospects are significant and include better resource management, automated routine activities, better information retrieval, more accessibility and inclusivity, encouragement of research and innovation, and more community involvement.

These advantages show how AI and ML may completely change library services and improve user experiences.

By drawing insights from the six selected case studies reviewed earlier, AI and ML provide Nigerian libraries with enormous and revolutionary potential advantages. Libraries can use these technologies to improve resource management, offer customized and inclusive

services to their customers, and greatly increase their operational efficiency.

Because AI and ML can automate repetitive operations, improve information retrieval, and support cutting-edge research projects, they are essential tools for updating library services and guaranteeing their continued relevance in the digital era. Stakeholders, including government agencies, educational institutions, and librarians, must aggressively support the implementation process in order to reap these rewards.

This assistance ought to cover capacity building, infrastructure investment, strategic planning, and the creation of ethical standards and supporting laws.

Therefore, conquering the challenges and realizing the full potential of AI and ML in Nigerian libraries will require a coordinated effort from all stakeholders.

References

Ailakhu, U. (2024). Open Educational Resources (OER) management: implications for policymakers on the best practices in an open education university library in Nigeria. *Library Management, 45*(5), 273-286. https://doi.org/10.1108/lm-01-2024-0013

Amzat, O. (2023). Metaverse-infused academic libraries: a glimpse into the future. *Library Hi Tech News, 40*(10), 17-19. https://doi.org/10.1108/lhtn-10-2023-0187

Bali, B. (2024). Analysis of emerging trends in artificial intelligence in education in Nigeria. https://doi.org/10.21203/rs.3.rs-3819828/v1

Baro, E. and Nwabueze-Echedom, A. (2022). An evaluation of institutional repository development in African universities. *IFLA Journal, 49*(1), 18-38. https://doi.org/10.1177/03400352221089672

Barsha, S. and Munshi, S. (2023). Implementing artificial intelligence in library services: a review of current prospects and challenges of developing countries. *Library Hi Tech News, 41*(1), 7-10. https://doi.org/10.1108/lhtn-07-2023-0126

Bi, S., Zhang, J., Huang, W., Wu, B., Gong, Y., & Ni, W. (2022). A survey on artificial intelligence aided internet-of-things technologies in emerging smart libraries. *Sensors, 22*(8), 2991. https://doi.org/10.3390/s22082991

Bichu, Y., Hansa, I., Bichu, A., Premjani, P., Flores-Mir, C., & Vaid, N. (2021). Applications of artificial intelligence and machine learning in orthodontics: a scoping review. *Progress in Orthodontics, 22*(1). https://doi.org/10.1186/s40510-021-00361-9

Blow, C. (2024). Comprehensive validation on reweighting samples for bias mitigation via aif360. *Applied Sciences, 14*(9), 3826. https://doi.org/10.3390/app14093826

Chika, E. (2024). Digital healthcare tools in Nigeria: strengthening public health and pandemic preparedness - insights from the covid-19 crisis. *Telehealth and Medicine Today, 9*(1). https://doi.org/10.30953/thmt.v9.445

Cortial, L. (2024). Artificial intelligence in drug repurposing for rare diseases: a mini-review. *Frontiers in Medicine, 11*. https://doi.org/10.3389/fmed.2024.1404338

Enakrire, R. (2023). Artificial intelligence as enabler of future library services: how prepared are librarians in African university libraries. *Library Hi Tech News, 41*(3), 1-5. https://doi.org/10.1108/lhtn-09-2023-0173

Enakrire, R. (2023). Artificial intelligence as enabler of future library services: how prepared are librarians in African university libraries. *Library Hi Tech News, 41*(3), 1-5. https://doi.org/10.1108/lhtn-09-2023-0173

Harisanty, D., Anna, N., Putri, T., Firdaus, A., & Azizi, N. (2022). Leaders, practitioners and scientists' awareness of artificial intelligence in libraries: a pilot study. *Library Hi Tech, 42*(3), 809-825. https://doi.org/10.1108/lht-10-2021-0356

Huang, Y. (2022). Exploring the implementation of artificial intelligence applications among academic libraries in Taiwan. *Library Hi Tech, 42*(3), 885-905. https://doi.org/10.1108/lht-03-2022-0159

Hussain, A. (2023). Use of artificial intelligence in the library services: prospects and challenges. *Library Hi Tech News, 40*(2), 15-17. https://doi.org/10.1108/lhtn-11-2022-0125

Iltis, A. (2023). Ethical, legal, regulatory, and policy issues concerning embryoids: a systematic review of the literature. *Stem Cell Research & Therapy, 14*(1). https://doi.org/10.1186/s13287-023-03448-8

Jha, S. (2023). Application of artificial intelligence in libraries and information centers services: prospects and challenges. *Library Hi Tech News, 40*(7), 1-5. https://doi.org/10.1108/lhtn-06-2023-0102

Katiyar, N., Awasthi, M. V. K., Pratap, R., Mishra, M. K., Shukla, M. N., & Tiwari, M. (2024). Ai-Driven Personalized Learning Systems: Enhancing Educational Effectiveness. *Educational Administration: Theory and Practice*, *30*(5), 11514-11524. https://doi.org/10.53555/kuey.v30i5.4961

Mahmud, M. (2024). Ai in Bangladeshi libraries: opportunities and challenges. *Library Hi Tech News*. https://doi.org/10.1108/lhtn-04-2024-0053

Mwangi, J. (2024). Analyzing the role of artificial intelligence and machine learning in optimizing supply chain processes in Kenya. *International Journal of Supply Chain Management, 9*(1), 39-50. https://doi.org/10.47604/ijscm.2322

Oladeinde, M. (2024). Review of IT innovations, data analytics, and governance in Nigerian enterprises. *Computer Science & It Research Journal, 4*(3), 300-326. https://doi.org/10.51594/csitrj.v4i3.685

Olujobi, O., Ufua, D., Olokundun, M., & Olujobi, O. (2021). Conversion of organic wastes to electricity in nigeria: legal perspective on the challenges and prospects. *International Journal of Environmental Science and Technology, 19*(2), 939-950. https://doi.org/10.1007/s13762-020-03059-3

Subaveerapandiyan, A. (2023). A study on the knowledge and perception of artificial intelligence. *IFLA Journal, 49*(3), 503-513. https://doi.org/10.1177/03400352231180230

Tolulope, A. (2024). Artificial intelligence research in Nigeria: topic modelling and scientometric analysis. *IAES International Journal of Artificial Intelligence (Ij-Ai), 13*(1), 597. https://doi.org/10.11591/ijai.v13.i1.pp597-609

Yang, L., Driscol, J., Sarigai, S., Wu, Q., Chen, H., & Lippitt, C. (2022). Google earth engine and artificial intelligence (ai): a comprehensive review. *Remote Sensing, 14*(14), 3253. https://doi.org/10.3390/rs14143253