

Use of Artificial Intelligence Technologies in Rendering Library Services: Empirical Evidence from University Libraries in Africa

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Article Info

Article type:
Research Article

Article history:
Received October 19, 2023
Received in revised form November 28, 2023
Accepted December 22, 2023
Published online December 25, 2023

Keywords:
Artificial intelligence, Robotics, Chatbots, RFID, Librarians, Nigeria, South Africa

ABSTRACT

Objective: The main objective of this paper is to investigate the level of adoption of Artificial Intelligence to support library services delivery in university libraries in Africa.

Methods: Qualitative research method was adopted to collect data using online. A preliminary survey of 102 university libraries in English speaking countries in Africa was conducted to identify the university libraries that have adopted Artificial Intelligence in their libraries. Content analysis was used to analyze the responses.

Results: The study found that the only few university libraries in Africa have adopted AI technologies such as Chatbot, ChatGPT, LibKey from ThirdIron, robots, RFID technology and Grammarly. These AI technologies are used to render different library services like answering of directional and ready reference questions posed by library users, serving as a knowledge base for cataloguing information of library materials, self-check-out machine for books, used as a marketing tool for the library, tool for statistics evaluation and recommendations, assisting in the charging and discharging of library materials, and so on. Lack of fund to acquire the AI tools, training of librarians, and lack of full knowledge of AI were the most mentioned challenges associated with adoption of AI in the libraries.

Conclusion: The study concludes that formulation of policy to guide the adoption of new technologies such as AI, and training and re-training for librarians through workshops is required to equip librarians with skills needed to effectively use the AI technologies.

Cite this article: Abba, T. (2023). Use of Artificial Intelligence Technologies in Rendering Library Services: Empirical Evidence from University Libraries in Africa. *Informology*, 2(2), 23-40.



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Publisher: Informology Center.

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Introduction

Artificial intelligence (AI) technologies have strongly influenced the world of work in the 21st century. Nwakunor (2021) defined Artificial Intelligence as computer-controlled robots that think intelligently like human beings. These robots are controlled electronically with the aid of the computer by mimicking the competences of the human mind. Artificial Intelligence keeps records and analyses every action being made by the user (Nwakunor, 2021). The origin of AI can be traced to John McCarthy's research in 1955, with the assumption that every aspect of learning and other forms of intelligence can be stimulated through the use of a machine (Wang, 2018). Merriam-Webster English Dictionary (2018) stated that artificial intelligence is "a part of computer science that deals with giving ability to the machines to look as if they have natural human intelligence." These human capabilities of AI are improved through learning from experience and adaptation over time. As an aspect of computer science, AI comprises an expert system, fuzzy logic, artificial neural network, evolutionary algorithms, case-based reasoning, image processing, natural language processing, speech recognition, and robotics (Kusumanchi, 2019).

In the library setting, AI technologies are now being used in libraries to support and render library services. The adoption of AI can improve library services and provide access to accurate information that can drive growth and development in this information age. In the library, AI can be used to develop programs for effective reference services, scanning of textbooks, and the identification of appropriate subject categories (Tella, 2020). Furthermore, AI technologies can assist library users on how they can locate library materials through intelligent tutoring system and automated library services (Tella, 2020). Therefore, AI adoption and use in libraries will allow better information processing, and at the same time, better information search that will excite both library personnel and users giving easier and faster access to information. AI technologies are being adopted in libraries throughout the world for a wide array of purposes such as everyday service delivery (IFLA-FAIFE, 2020).

Artificial intelligence has made it possible to provide solutions to pressing challenges facing libraries, such as shelving of books and other library materials, cataloguing and acquisition of library materials, among others (Ajakaye, 2022). Consequently, library services can be done in more effective and efficient ways for improved user satisfaction. Therefore, library users can access timely and accurate information quickly and promptly. Fernandez (2016) noted that using AI in academic libraries will help to analyze big data, create metadata, and improve search translation. This means that using AI in academic libraries will make library materials more accessible and available, and allow the staff to answer users' queries on AI use. Tella (2020) stressed the need for academic libraries to re-position themselves to take relative advantage of artificial intelligence potentials by refining the quality of library services in this era of the

information age. According to Ajakaye, (2022) “Librarians need to be innovative in their thinking to stay relevant in their jobs because AI has found numerous applications in libraries ranging from book filing to book delivery.”

The IFLA Statement has outlined the key roles libraries can take on in a society that employs AI; and reported that throughout the world, some libraries and library organizations are already engaged in raising awareness and AI literacy, developing and working with AI, and taking part in debates around its impact on the library sector and beyond (IFLA-FAIFE, 2020). Artificial Intelligence in library service delivery has aided in the improvement of many librarians' job responsibilities, including cataloging, indexing, information retrieval, reference services, and other tasks. It can be used in a variety of applications, including speech recognition, machine translation, and library robots (Tella 2020). Kusumanchi (2019) noted that AI is transforming day by day with different features such as quantum computing, artificial neural networks, facial recognition, deep learning and chatbots.

Libraries, particularly those in universities in developing countries, have had difficulty adopting digital technology, and they also show resistance to change when using new technologies for a variety of library functions in developing nations like Nigeria (Wheatley & Hervieux, 2019). Tella (2020) stressed that libraries in the developed countries have accepted and used AI technologies virtually in all spheres of life whereas those in developing countries are still struggling to find their feet. Librarians mostly in Africa have begun to incorporate artificial technologies in the library system so as to meet up with the current trends in the worldwide. Despite efforts to meet with the current trends, no documentation on the incorporation of Artificial Intelligent in academic libraries in African educational institutions is seen. Evidently, the available literature on Artificial Intelligent in libraries were mostly carried out in institutions in the developed countries. Little or no documents were found on the application of artificial Intelligent in libraries in developing countries mostly in Africa. Therefore, the present study aims to fill the gap by investigating the extend university libraries in Africa have adopted artificial intelligence in rendering library services. To achieve this, three research questions were raised to guide the study.

Research Questions

RQ1: What type of AI is being adopted for use in the university libraries in Africa?

RQ2: What library services are the AI deployed to render?

RQ3: What are the challenges encountered in adopting AI in university libraries in Africa?

Literature review

The use of AI in university libraries

Artificial intelligence is the programming and development of computers to perform human required-intelligence task, such as speech recognition, decision-making, visual perception, language translation, talking and emotional feelings (Irizarry-Nones, Palepu & Wallace, 2017). Oracle (2022) defined Artificial intelligence as software or hardware that can carry out tasks by simulating human intellect and then interactively improves itself using the data it gathers. AI encompasses a wide range of fields which is not limited to computer science alone, but also philosophy, linguistics, psychology as well as other fields of life (Deloitte, 2018). Several libraries have recently found compelling use of AI, such as to support library systems for the benefit of library patrons and employees in Iran (Asemi & Asemi, 2018), as well as the use of AI in assisted information literacy instruction (Talley, 2016).

The AI revolution in libraries is projected to have a significant impact on a number of areas, including data processing, literacy, and online and virtual services (Winkler & Kiszl, 2021). Omame and Alex-Nmecha (2020) posited that AI has the potential to revolutionize the way libraries are managed, from the way library materials are catalogued and organized to the way librarians and patrons interact. Scholars have argued that AI can be used in the area of library security, as university libraries are now deploying AI-based facial recognition technology to track and monitor users, particularly service areas (American Library Association, 2022; Datagen, 2022). With AI, tasks such as the answering of directional questions, giving library tours, welcoming library users and locating an information source in the library can be done automatically (Karsten & West, 2015)

Artificial intelligence can be divided into three types: symbolism, connectionism, and behaviorism (Adejo & Misau, 2021). Symbolism is an intelligent simulation method based on logical reasoning to simulate human intelligent behavior. The main principle of connectionism is the connection mechanism and learning algorithm between neural network and neurons network. The theory of behaviorism is cybernetic and perceptual-action control system (Adejo & Misau, 2021). Presently, the popular technical fields involved in artificial intelligence research are: problem solving, natural language processing, artificial neural networks, genetic algorithms, expert systems, knowledge engineering, artificial life, deep learning, intelligent control etc (Liu, 2016). Natural Language Processing is another area where artificial intelligence technology could help the academic library gain traction. This technique allows a computer to understand the main linguistic concepts within a query or solution, with the goal of designing and building computers that can analyze, understand, and generate language in the way that humans do (Kumar, 2004). Natural Language Processing (NLP), according to Zulaikha (2020), is the study of extracting

information from natural human language in order to communicate with robots and grow enterprises. When applied to academic libraries, some of the methods employed in natural language processing that boost artificial intelligence include: voice text messaging, spell checker, autocomplete, spam filters. Omame and Alex-Nmecha (2020) reported that NLP may be utilized in libraries to create intelligent expert information retrieval systems that users can engage with directly using natural language. The computer receives natural language as input, analyzes and processes it, and then responds with the information required.

Given the wide range of services provided by academic libraries around the world, the incorporation of robotic services into the circulation unit of an academic library has become essential. Robotics is defined as a mechanical device that uses artificial intelligence techniques to perform automation tasks under direct human supervision, a pre-defined program, or a set of general guidelines (Vysakh & Rajendra 2020). Robots are multi-purpose manipulators that are automatically controlled, reprogrammable, and programmable in three or more axes. They can be fixed in place or transportable for use in automation applications. Vysakh and Rajendra (2020) reported that library such as Temasek Polytechnic Library, University of Chicago Library, Shanghai Library have begun to use robots instead of humans in a variety of procedures, particularly those that are hazardous and time-consuming. For instance, a robot at the PESIST central library assists in filing, classifying, and replacing volumes on the shelf, and libraries with large collections are now adopting robots for inventory purposes (Vysakh & Rajendra, 2020). The use of robots to perform this duty improves the efficiency of the library's operations.

The use of AI in library services in the African continent is very much in its infancy (Hervieux & Wheatley, 2021). Yusuf et al. (2022) assessed the application of artificial intelligence for efficacy in library service delivery in university libraries in Nigeria. The study revealed that the adoption of artificial intelligence by librarians in university libraries in Nigeria is relatively low as a result of a wide variety of challenges specific to developing nations. A recent study by Emiri (2023) investigated how librarians working in the various university libraries in Southern Nigeria adopted and use artificial intelligence and found that AI technologies have not been truly adopted in university libraries in Southern Nigeria. The AI technologies like robots, chatbots, face recognition, touch recognition, RFID technologies, humanoids, AI classification tools, machine-readable catalogue, and AI smart features are still lacking in Southern Nigeria's university libraries. Yakubu, Yagana, and Umar (2023) investigated librarians' intention to use artificial intelligence for effective library service delivery in university libraries in Nigeria and found that the librarians under study have shown great intention to use artificial intelligence (AI) in their libraries. In Nigeria, Yusuf, et al. (2022) reported that only University of Lagos has adopted the use of artificial intelligence in some library services and operations, and also added that library professionals' awareness of the use of artificial intelligence in library services and operations is

still low. Adejo and Misau (2021) studied how the application of Artificial Intelligence could be used in Nigerian Academic Libraries. The study showed that AI could be applied in Academic library services in Nigeria like Expert Systems in Reference Services, Technical, Indexing, Acquisition and its application in Natural Language Processing, Pattern Recognition and Robotics in library activities. Therefore, the study recommended that academic libraries in Nigeria should embrace the use of Artificial Intelligence in the library operations, library staff be trained on its use in the library service delivery in addition to its institution in all library units.

The study by Grant and Camp (2018) reported that many academic libraries, mostly in wealthier nations, have adopted AI to meet the many services demands of their customers, including reference and circulation services. Some AI use cases as reported in IFLA-FAIFE (2020) includes: The National Library of Norway, for example, has experimented with applying Machine Learning to automate Dewey Decimal classification. Also, The Stanford University Library AI studio is developing projects exploring AI application in libraries for internal information processing and library collection discovery and analysis, the Helsinki Central Library Oodi has introduced an AI-powered mobile application for library users, designed to make reading suggestions and assist with library collection discovery. Manjunatha and Patil (2020) looked at the use of smart technology in engineering college libraries in Karnataka. The data suggests that most engineering university libraries are already familiar with smart technologies and have adopted blockchain, augmented reality, artificial intelligence, and other cutting-edge systems. Yu, et al. (2019) investigated the application of artificial intelligence in smart library. The study cites a few artificial intelligence applications that can be employed in smart libraries, including face recognition, chatbots, and self-service AIs.

Nawaz, Gomes, and Saldeen (2020) studied artificial intelligence methods for library resources and services during the COVID-19 epidemic. The study demonstrates that a number of library services such as user identification in speech recognition or typing, monitoring of users as they use library resources and services, chatbots for reference services, robot assistants, drone surveillance for library security, AI alarms for reminding users when it's time for their scheduled appointment with a librarian, and AI-based tutorials for keeping users up to date with the most recent findings and discoveries in their field can benefit from the use of AI. Asefeh and Asemi (2018) list various ways in which AI technologies can be used to improve library services to include the followings: circulation services, shelving of books, cataloguing of library materials, among others. Mogali (2019) conducted a study on how artificial intelligence is used in libraries and found that expert systems in libraries, such as Refsearch, pointers, online reference help, Amswerman, and Plexus can assist in rendering library services. Expert systems have also proven beneficial for carrying out tasks related to acquisition, cataloguing, classification, indexing, and other library procedures.

Lund et al. (2020) studied the perceptions toward artificial intelligence among academic library employees and asked the role within libraries that librarians indicate they would most likely to see AI introduced. The study found that support/improvement of the library discovery search is the overwhelmingly favorite selection, followed by reference services and cataloging assistance. Studies have shown that AI such as humanoid robots can be used in libraries for a variety of tasks, including instruction, community building, chat services for online messaging, automation of library procedures, and improving the effectiveness of service delivery (Nguyen, 2020; Nawaz & Saldeen, 2020; Igbinovia & Okuonghae, 2021).

Yao et al. (2015) conducted research on intelligent talking robots to improve library services and found that the Xiaotu robot, which can interact with users and provide assistance, is effective in enhancing library reference services. Similarly, the study by Corrado (2021) pointed out that AI can be applied in several technical service areas, such as assigning and creating subject headings, classification, and metadata description.

Challenges associated with deployment of AI in academic libraries

Regarding the challenges of AI adoption in academic libraries, the study by Yusuf et al. (2022) primarily focused on librarians' low awareness of how to use AI to meet their service needs and the high disruption that AI has caused to traditional library services, which continues to shock most library professionals. According to Tait and Pierson (2022) the adoption of AI and robots in libraries may be hampered by a lack of skills and the need for training before implementation. In line with the above viewpoint, Hervieux & Wheatley (2021) in their study argued that the low adoption rate of AI and Robots in libraries is due to a lack of knowledge of these technologies. The study by Emiri (2023) reported that adoption of AI challenges includes considerable disruption brought by AI to conventional library services, a lack of skills and the need for training prior to adoption, erratic power supply, and a lack of suitable infrastructure for adoption.

The use of AI in libraries poses a number of ethical issues also (Cox, 2022) and there is a recurrent fear that AI may in some way replace human librarians' work. For example, the study by Korinek and Stiglitz (2017) reported that the use of AI poses a threat to librarians' work and that caution should be exercised before widespread implementation in libraries. Similarly, World Bank (2016) maintained that developing countries may be more affected by the adoption of AI because it will lead to a high job loss rate. The report further states that 69% of job loss will be experienced in India through AI adoption; 72% in Thailand; 77% in China and 85% in Ethiopia. All these studies indicate that AI can lead to job losses and the potential for gross job destruction.

Liau (2019) conducted research on the benefits of robots for library operations. The researcher highlighted a few obstacles that might prevent libraries from adopting robots. These include the high skill requirements to work with robots, the need to redesign workflow, the fact that robots

are only designed to perform one or two tasks and cannot be used for all library activities, also robots occasionally have temper tantrums that could disrupt library services, and others. Oghenetega, Umeji, and Obue (2014) identified a number of factors that work against the adoption of AI in library operations especially in developing countries. They are: poor maintenance ethics, inadequately trained staff, high costs, networking issues, a lack of adequate facilities, an epileptic power supply, and technological issues. Yusuf, et al. (2022) reported that the adoption of AI in academic libraries is setting a new level of efficient and effective library service delivery but the adoption in developing countries such as Nigeria is low due to some of the identified challenges which includes financial uncertainty, job loss, technological disadvantages among others. Echedom and Okuonghae (2021) reported that technologies like the AI expert system always require large amounts of data in order to function effectively. This becomes a major limitation where there is insufficient data or low data volumes.

While the enormous amount of data generated every day would require a long time to be processed, AI technologies that use machine learning can swiftly transform that data into useful knowledge (Ajani et al., 2022). The cost of processing the enormous amounts of data that AI programming demands is now the main drawback of employing AI. Nevertheless, researchers testified that the benefits of AI to its users significantly outweigh its cost (Ali et al., 2020). For instance, Hayani et al. (2021) acknowledged that when properly utilized, AI can enhance its users' productivity, economy, and decision-making process, as well as solving complex problems and manage repetitive task accurately than ever before. Emezaiwakpor, Idiodi and Urhiewhu (2023) reported that in planning to deploy artificial intelligence in Nigerian academic libraries, technical issues will be the major impediments that Nigerian academic libraries will be confronted in their ability to construct smart systems. The library must have up-to-date technology, such as computers and other devices. The study also reported the shortage of librarians who have been trained in artificial intelligence technologies (Emezaiwakpor, Idiodi, & Urhiewhu, 2023).

Materials and Methods

Qualitative research method was adopted to collect data from librarians in-charge of the artificial intelligence unit. Qualitative method is when a researcher collects data from interview or open-ended question that gives respondents time to mention responses. A preliminary study was carried out by sending e-mails to librarians working in university libraries in English speaking countries in Africa. The aim was to identify university libraries that have actually deployed AI to render library services in Africa. The e-mail addresses of the respondents were collected from the various university library websites in Africa. The question asked was "whether that particular university library has adopted AI technologies" sent as e-mail message to librarians working in university libraries in English speaking countries. In total, 389 e-mail messages were sent to

librarians in 102 university libraries in Africa. At the end of that preliminary survey, 8 university libraries were identified to have adopted AI in rendering library services. Among the number, one in Nigeria, 7 in South Africa.

The second phase was to send message containing the three open-ended questions through e-mail to the identified 8 university libraries. Data collection started in March 2023 and ended in May 30, 2023. The three open-ended questions sent through e-mail to the librarians in-charge of AI in the 8 university libraries in Africa are:

1. What type of artificial intelligence technologies are being used in your library?
2. What library services are the artificial intelligence technologies deployed to render in your library?
3. What are the challenges encountered in adopting artificial intelligence technologies in your library?

Thematic content analysis technique was used to analyse the qualitative data. Berg (2007) suggests one way of handling information analysis is by content analysis or qualitative analysis. Berg further stressed that content should be coded under certain themes or questions being asked. In this study, content analysis was used to categorize information obtained from the e-mail responses according to the questions and presented in table and chart. Responses from the respondents were also incorporated in the discussion section.

Results and Discussion

Out of the 102 university libraries contacted in English Speaking countries in Africa, only 8 university libraries were identified to have adopted artificial intelligence in rendering library services. The universities are: University of Lagos, Nigeria, University of Pretoria, South Africa, North West University, South Africa, University of Johannesburg, South Africa, University of the Free State, South Africa, University of the Witwatersrand, South Africa, Vaal University of Technology, South Africa, and Rhodes University, South Africa.

Table 1. Type of Artificial intelligence adopted in the responding university libraries.

#	Name of university	Country	Type of AI adopted
1	University of Lagos	Nigeria	Robot
2	University of Johannesburg	South Africa	Chatbot, ChatGPT, Online plagiarism game.
3	Vaal University of Technology	South Africa	RFID
4	Rhodes University	South Africa	Chatbot, LibKey from ThirdIron
5	North West University	South Africa	Robot and Chatbot
6	University of the Free State	South Africa	RFID technology and Grammarly
7	University of Witwatersrand	South Africa	Chatbot and RFID
8	University of Pretoria	South Africa	Robot

In Table 1, results revealed that the few university libraries in Africa have adopted different AI technologies such as Chatbot, ChatGPT, LibKey from ThirdIron, robots, RFID (radio frequency identification) technology and Grammarly. In addition, one librarian wrote - we are now busy investigating other AI tools such as ChatGPT. This we are doing in collaboration with various other divisions at the university, and there is a task group assigned to look at the bigger impact. According to Tella (2020), academic libraries must reposition themselves to make use of the potentials of artificial intelligence to improve the quality of library services in this information age. With AI operation, libraries can carry out tasks very fast, compared to when being done by human beings. AI is handy in discovering unexplored concepts, such as outer space and reduces human errors in library operations. Liu (2011) argued that academic libraries can develop artificial intelligence in libraries using expert systems in the reference section to recommend to users the library materials to meet their queries. The potential merits of chatbots have been reported in some studies, based on their 24/7 availability to respond to user inquiries and ability to deal with scale or requests (McNeal & Newyear, 2013; Vincze, 2017). Chatbots have a wide range of potential uses in libraries: the most obvious being to respond to routine information requests or even handle the early stages of complex reference enquiries.

The library services AI technologies are deployed to render

AI is not one technology but a bundle of technologies with general applications across many sectors of activity. Some are suitable for reference services, cataloguing activities, collection development services, readers services, and so on. In this question, respondents were asked the various library services the AI technologies are deployed to render in the library. The various responses were quoted directly as reported from the various libraries that have adopted AI technologies.

At the University of Johannesburg, South Africa, they use AI technologies to give students information and answer questions. In the words of the librarian –We have a library app, a chatbot. We also use Online plagiarism game that works on AI in the background. We also teach students how to use ChatGPT in their assignments when we teach Info Literacy courses.

At the Vaal University of Technology, South Africa, AI technology such as RFID (Radio Frequency Identification) is used to render library services. In the words of the librarian - we are using RFID self-check-out machine for books. This machine assist user to check the books in and out for themselves.

At the Rhodes University, South Africa, they use AI technologies in assisting the user services section to answer queries relating to the library services. The responding librarian wrote - we do have a chatbot on our library website as a tool to answer services-related information and is from LibApps. LibKey from ThirdIron is also another service we have that has some AI capabilities

of linking technology that lets scholars to access both open access publications from the public web and full-text academic journal articles to which the library subscribes.

Response from North West University, South Africa revealed that the NWU Library has adopted Artificial intelligence technologies in library service delivery. The responding librarian reported that the physical robot and chatbot is under construction which will be used as library assistant in the library. In the words of the Librarian - The physical robot will be used as library assistant. It will provide support and respond to basic questions to the patrons. It will also be used as a marketing tool for the library and the institution as a whole. The chatbot will be used to provide online support to the patrons 24/7.

Response from University of the Free State, South Africa revealed that they have adopted AI for tagging books in all the branch libraries, and AI language tool such as Grammarly. According to the responding librarian - We are currently implementing RFID technology, the first phase was tagging books in all our libraries, that is done and we are now in the process of rolling out RFID technology fully.

Response from University of the Witwatersrand, South Africa revealed that they have adopted Chatbot to answer general library queries, and AI tool for statistics evaluation and recommendations. In the words of the responding librarian - We have acquired a tool for statistics evaluation and recommendations. Others are in the pipeline like RFID (radio frequency identification) material coding and the change in the security system.

At the University of Pretoria, South Africa, responses revealed that the library uses robot for several services. According to the responding librarian - The robot, named Libby, has over 60 sensors, cameras and software integration which it uses to receive commands or request. The robot is able to perform a range of services which include repetitive task like answering of users' query, assisting in the charging and discharging of library materials as well as entertainment of library users. Beyond carrying out repetitive tasks, the robot is able to process survey data since it's able to connect to online cloud through WIFI.

At the University of Lagos Library, Nigeria, the study found that the library has adopted AI technology like robots for client services. In the words of the responding librarian - The client services robots were acquired with the aim to assist librarians in library operations such as answering of directional and ready reference questions posed by library users. The library users are able to interact with the robots using the voice recognition feature of the robot. Beyond answering of reference queries, the robot also serves as a knowledge base for cataloguing information of library materials, as such, library users are able to query the robot to determine the availability or otherwise of a particular information resource in the library. In addition, the robot at the University of Lagos Library has the capability to take user statistics thus, providing library

management with accurate or near accurate user data for planning and decision making. The robot also possesses other unique features which include research data management, research assistance, surveillance abilities and entry validation intelligence. The robot is able to render user specific services and consequently adding value to the library services.

Responses from the various university libraries showed that they have adopted AI technologies to support rendering different library services. Although, the adoption level is still at a very slow in Africa. For university libraries to fully deploy AI for meeting their various service needs, they need to first adopt and implement these tools. According to Ajani, et al. (2022) implementing artificial intelligence (AI) in university libraries can increase the effectiveness of library operations in general and reference services in particular. Several studies have argued that AI can be used in the area of library security, as university libraries are now deploying AI-based facial recognition technology to track and monitor users, particularly service areas (American Library Association, 2022; Datagen, 2022).

The findings from the present study on the use of AI to support rendering library services agrees with Al-Aamri and Osman (2022) who studied the potential of artificial intelligence to enhance library operations and services and that robots will assist in providing library services. Similarly, Vysakh and Babu (2020) studied the use of robots in libraries and found that most jobs carried out in libraries can be done by robots. It has become imperative to note that the use of AI in academic libraries mostly in Africa as it is adopted in developed countries will aid in the delivery of information services as well as better search, which will thrill both library staff and users due to the faster access to information.

Challenges encountered in adopting AI in university libraries in Africa

Regarding challenges associated with the adoption of AI in university libraries in Africa. Respondents were asked to mention the challenges they encountered. The responses were sorted according to similar themes and grouped together. Results presented in the Figure 1.

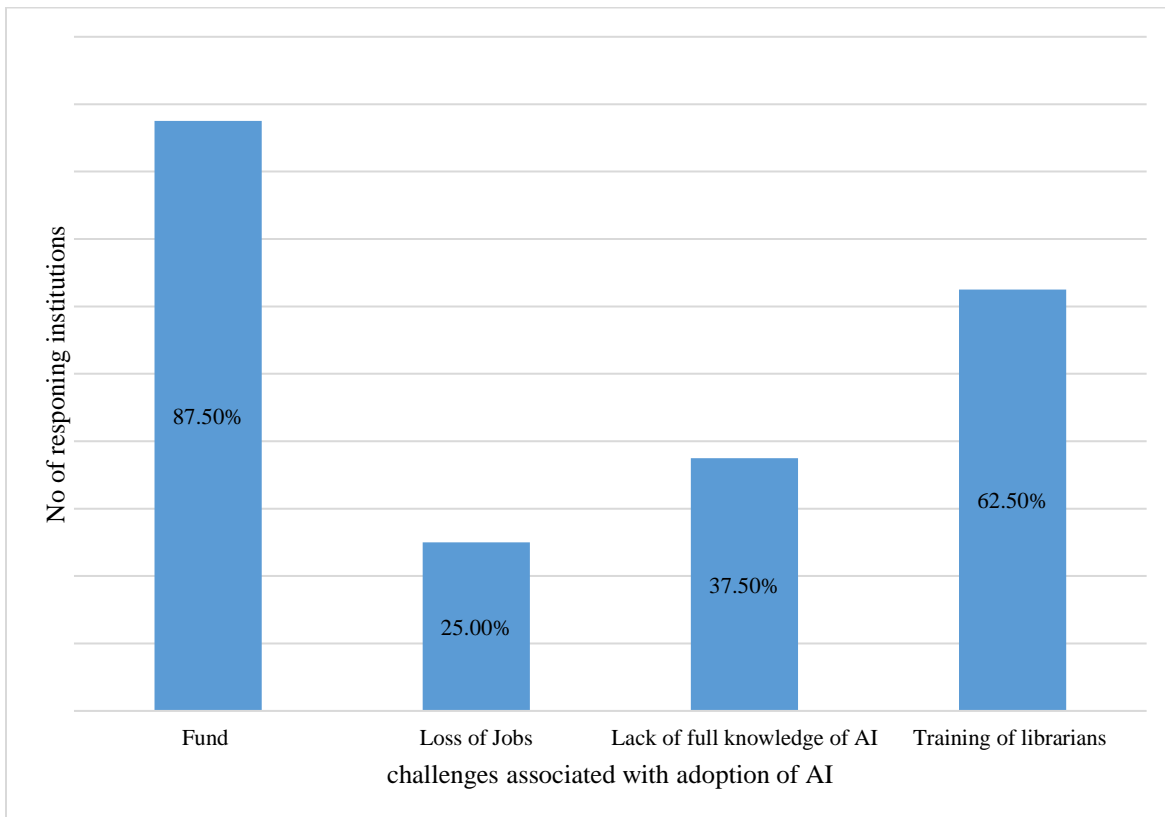


Figure 1. Challenges associated with adoption of AI

Out of the responding 8 institutions, 7 (87.5%) mentioned fund to acquire the AI tools as a challenge. This was followed by 5 (62.5%) responding institutions who mentioned training needs of librarians. This shows that availability of fund and the training and re-training is needed before adoption and implementation of AI technologies in university libraries in Africa. One of the respondents wrote - The cost of designing these different things has been the biggest challenge. The second challenge is getting librarians to understand how to use the technology so that they can teach students. Another mentioned -The challenge was to choose between procuring a robot or in-house building of the robot. Both options come with huge risks however we chose the latter due to financial constraints and also the support and maintenance we hoped we will get internally. The third most mentioned challenge was lack of full knowledge of AI. This was mentioned by 3 (37.5%) out of the 8 responding institutions. Reflecting on the role of libraries in an AI world, IFLA-FAIFE (2020) statement emphasized on the importance of equipping library staff and Library and Information Science students with a basic understanding of AI, and pointed out the role libraries can play in educating the general public about AI. It is interesting to see conferences and workshops coming up concerning AI in the libraries. This will no doubt equip librarians with the knowledge and skills needed to use AI technologies in libraries in Africa. One of such conference in Africa was “*Artificial Intelligence Symposium: 3rd IFLA Symposium on*

Artificial Intelligence, North West University, Potchefstroom, South Africa, 5-7 September, 2023”. Another coming up is “*Transforming LIS Education through Digital Technologies and Collaborative strategies, with emphasis on Artificial Intelligence*, organized by the Nigerian Association of Library and Information Science Educators (NALISE), at the University of Uyo, Nigeria, Nov. 6-10, 2023.” The need to attend conferences and workshops on Artificial Intelligence was emphasized by one of the respondents when he wrote - We are still doing some research and attending workshops to guide us in what best approaches to follow when adopting AI.

Conclusion

The qualitative study revealed that only few university libraries in Africa adopt AI technologies such as Chatbot, ChatGPT, LibKey from ThirdIron, robots, RFID technology and Grammarly. These AI technologies are used to render different library services like answering of directional and ready reference questions posed by library users, serving as a knowledge base for cataloging information of library materials, self-check-out machine for books, used as a marketing tool for the library, tool for statistics evaluation and recommendations, assisting in the charging and discharging of library materials, and so on. Challenges such as fund to acquire the AI tools, training of librarians, and lack of full knowledge of AI were the most mentioned by the responding institutions in Africa as challenges associated with adoption of AI in the library.

The intensive pressure on librarians to provide high quality services to library users due to information explosion in our present society have led to incorporation of modern technologies. The adoption of AI technology in academic libraries is setting a new level of efficient and effective library services delivery. Artificial intelligence is arguably the next frontier in an evolution of computing technology that has seen the development of mobile computing and ultra-fast processors (Lund et al., 2020). Librarians in Africa have begun to adopt artificial technology in some specific areas of their respective libraries to meet with current global trends.

Recommendations

Based on the findings, the following recommendation are made:

- Librarians should be exposed to training and retraining in the use of artificial intelligence in delivering library services;
- Artificial Intelligence should be introduced in all the sections of academic libraries to ease efficient and faster library operation and service delivery; and
- There must be proper policy formulation and implementation prior to, during and after the adoption of AI in African academic libraries.

Author Contributions

T.A.: conceived and designed the study, reviewed the literature, collected the data, analysis and graphs, contributed to interpretation and manuscript preparation, literature review, writing manuscript, and proofreading. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Not applicable.

Acknowledgements

The authors would like to thank two reviewers of the present study.

Ethical considerations

Not applicable.

Funding

Not applicable.

Conflict of interest

The authors declare no conflict of interest.

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