APPLICATION OF ARTIFICIAL INTELLIGENCE (AI) FOR INFORMATION SERVICES DELIVERY: EXPLORING THE READINESS AND CHALLENGES IN SOME UNIVERSITY LIBRARIES IN KATSINA STATE

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Abstract
In recent years Artificial Intelligence (AI) has become increasingly common in various sectors, including the libraries. It is widely accepted that AI is capable to revolutionize information service delivery; improve automation and digitization of library's operations and subsequently improve working capabilities of library staff members in general. The major aim of this study is to explore the readiness and challenges of applying AI for information service delivery in some university libraries in Katsina state. These specific objectives were to evaluate the readiness of the libraries on the application of AI and finally to identify the challenges that libraries face towards the application of AI. The study employed quantitative and descriptive survey design. The population of the study comprises all the library staff members working in the three (3) university libraries in Katsina (i.e. UMYU, FUDMA & AL-QALAM) and 165 library staff members were proportionately sampled. The study used descriptive and inferential statistics to analyse and present the data using SPSS. The findings of the study reveal that library staff members are open and ready to apply AI if well provided; however, certain factors identified need to be fulfilled to ensure seamless application, which, among others, include specific AI policy document, AI support infrastructure, equipping library staff with AI skills. Consequently, the findings identify certain challenges that hinder application of AI such as inadequate financial or budgetary provision, lack of AI support infrastructure, AI policy document, plagiarism and intellectual freedom theft, and fear of job loss or polarization. The study recommends that that government, university managements and library management should make available AI support infrastructure, telecommunications facilities to facilitate easy transition to AI in libraries. Additionally, TET Fund and NITDA should collaborate with NLA and local library branches to formulate a comprehensive policy document that would guide

libraries and library staff towards responsible and ethical AI application into library operations and services. Libraries should seek increased support from government and funding agencies such as TETFund, UNESCO and IFLA to invest considerably in the provision of adequate budgetary provision, provision of AI support infrastructure and telecommunication facilities necessary for successful AI integration in the libraries.

Keywords: Application, Artificial Intelligence, University Library, Readiness, Information Services

Introduction

Libraries have been reoriented to reflect contemporary standards in information resources and services delivery across the globe. Through automation and digitisation of information services libraries are promoting and expanding many of their products and services. In modern day information service delivery, Artificial Intelligence (AI) is gaining grounds for it enables the library staff and management alike to render efficient and effective services to the maximum satisfaction of their users. AI has changed the narratives of modern technological advancements in all sectors and is popularised among all sectors of the society (Al-Khalidi, 2022). AI has the capabilities of giving upper hand and advantages to many modern technologies without the intervention and or operations of humans, thereby providing the advantage of round the clock services regardless of location or number of users at a time (multiple accesses).

AI could historically be traced back in 1955 when John MacCarthy postulated that all aspects of learning and human intelligence in performing tasks could be programmed through machine. He further expanded it to science and engineering through venturing into intelligent machines and computer software programs to ensure specificity, accuracy and efficiency in operations. His assertion triggered serious attention and attracted many scholars into defining and promoting the concept of AI. McGraw-Hill Encyclopaedia of Science and Technology (2007) defined AI as a subfield of computer science focusing on the understanding of our natural environment and innovatively creating intelligent gadgets and software that are able to handle intelligent operations often undertaken by humans. In addition, Merriam-Webster English Dictionary (2018) states that "AI is a part of computer science that deals with giving ability to the machines to look as if they have natural human intelligence". The advancement of these intelligent innovations is perfected through learning and

accumulation of experiences over time, their sophistication and areas of application are ever expanding.

According to Heath (2018), AI is the very useful technology that enables machines to have the abilities to plan, learn, reason, solve problems, move, and to some extent, be creative. Accordingly, Liu (2016) views AI as intelligent machines or intelligent systems that simulate human intelligence activities and extend the science of human intelligence. Similarly, Omame & Alex-Nmecha, (2020) are of the opinion that Artificial Intelligence is an aspect of computer science that focuses on how computers learn (Machine Learning), interpret information, vision: character recognition, picture analysis, 3D perception, modelling of the function of the eye. It also encapsulates speech recognition; speech production, understanding and use of natural language processing (NLP) and expert system which continues to gain more attention.

AI can be divided into three types: symbolism, connectionism, and behaviourism. Symbolism is an intelligent simulation method based on logical reasoning to simulate human intelligent behaviour. The main principle of connectionism is the connection mechanism and learning algorithm between neural network and neurons network. The theory of behaviourism is cybernetic and perceptual-action control system. At present, the popular technical fields involved in AI 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).

Although the notion has been used by libraries and librarians in the Western world for decades, it is relatively new to the Nigerian academic library system. AI and its relation to library services have been defined and discussed by a variety of academic experts from across the world. Having a single entity definition for AI will be difficult and time-consuming, as various authors have stated that its use implies a technological transition. However, for the purposes of this work, we will accept a few definitions from other authors. Artificial Intelligence (AI) is defined by Frankenfield (2021) as the simulations of human intelligence in computers that are trained to think and act like humans. The phrase can also refer to any machine that demonstrates human-like characteristics like learning and problem-solving. The sound of the term AI often conjures images of robots or computers that talk. AI is an aspect of computer science that focuses on how computers learn (Machine Learning), interpret information, vision: character

recognition, picture analysis, 3D perception, and modelling of the function of the eye. Furthermore, it encapsulates speech recognition, speech production, understanding and use of natural language (Natural Language Processing), and Expert System which continues to gain more attention. Furthermore, Artificial Intelligence is the programming and development of computers to perform human required-intelligence tasks, such as speech recognition, decision-making, visual perception, language translation, talking and emotional feelings (Irizarry-Nones, Palepu & Wallace, 2017). According to Heath (2018), AI is the technology that enables machines be to have the abilities to plan, learn, reason, solve problems, move, and be creative to some extent. Three main focus of Artificial Intelligence is perception, reasoning and action.

Furthermore, Asemi and Asemi (2018) assert that the field of AI deals with the study and development of computer systems or machines that exhibit some forms of human intelligence, such as learning new concepts and tasks, reasoning and drawing useful conclusions about a specific task, natural language processing or perception and comprehension of visual scene etc. The intelligence of computers can be measured using the 'Turing test', developed by Alan Turing in 1950s, although, there are controversies and objections over this method. Irizarry-Nones et al. (2017) however asserted that the AI of computers or machines could be strong or weak. A computer with strong AI is able to think and make decisions like human beings; it is also capable of learning from experience and re-programs itself to improve on past mistakes like in the movies. Weak artificial intelligence computers cannot think, learn or re-program themselves; rather, they are specifically designed to respond to specific situation.

Advancement in the field of AI include autonomous vehicles or self-driving cars, navigation systems, human versus computer games, fraud detection, robotics and machine learning – the application of AI which gives computers or machines the ability the learn from past experiences, re-programs and improves on itself without human intention (Irizarry-Nones et al. 2017). Machine learning simply implies the computer teaching itself through iteration and past experiences with data. In addition, AI encompasses the following general areas of research: automatic programming, computer vision, intelligent control systems, expert systems, and intelligent computer assisted instruction, image processing, natural language processing, planning and decision support, robotics, and speech recognition (Asemi & Asemi, 2018). The application of AI has gained usefulness in most fields of study and it is thriving fast with the development of smart

phones, smart homes, Internet of Things (IoT) and Internet of Vehicles (IoV). Interestingly, AI is being used to generate and evaluate content including artistic and creative work (LeFebvre, 2017).

According to Harris (2016), AI has made a significant inroad into education as IBM has come up with the Teacher Advisor an AI system which has been built to help teachers draw up personalized lesson plans by pointing them to best lessons in math and then customizing the lesson to fit their unique classroom needs. The Teacher Advisor has a database of open educational math resources that provides over 2,000 free lessons, teaching plans and videos that can quickly search and bring up relevant answers (Fine, 2017). Semantic Scholar uses machine learning and other AI systems to assist the academia search more effectively and efficiently through resources as more and more research gets published (Metz, 2016). AI systems have been broadly classified from two different perspectives as outlined by Liu (2011):

1. The degree of their intelligence. In this perspective, AI systems are classified into:
    a. Reflex agents able to respond to stimulus from sensors such as heat sensor, light sensor, motion detection etc;
    b. utility-based system;
    c. goal-oriented systems; and
    d. Learning system such as machine learning systems that can teach computer programming.
2. The nature of their functionality. In this view, artificial intelligence systems can be categorized into:
    a. Collaborative systems;
    b. Reactive systems;
    c. Internet-based systems; and
    d. Mobile systems that can autonomously travel from one place to another to perform a task.

According to the McGraw-Hill Encyclopaedia of Science and Technology (2007), AI is built upon four key foundations: representation, search, reasoning, and learning. These foundational elements are essential in all AI systems.

a. **Representation:** This pertains to the internal organization of knowledge within an intelligent system, such as the problem description or relevant information. For example, an expert system for medical diagnoses would contain information about symptoms and diseases, while a robot's representation could include a 3D map of its environment.

b. **Search:** Critical for problem-solving, search methods are utilized in AI systems to find solutions. Heuristic search, for example, can adapt its approach based on the problem at hand, such as searching a database for similar problems and solutions.
c. **Reasoning:** This aspect allows AI systems to use knowledge to generate solutions. Reasoning can involve deductive reasoning, where existing knowledge leads to possible solutions, or inductive reasoning, where hypotheses are developed based on available information. Expert systems are an example of reasoning-based solutions.
d. **Learning:** This feature enables intelligent systems to adapt and improve based on experience and knowledge. Learning methods in AI include statistical, neural networks, and reinforcement learning, all falling under the umbrella of machine learning and deep learning. These methods allow systems to adjust representations, searches, and reasoning based on new information.

AI is the programming and development of computers to perform human required-intelligence tasks, such as speech recognition, decision-making, visual perception, language translation, talking and emotional feelings (Asemi & Asemi, 2018; Heath, 2018). Thus, these make AI matters to libraries because it can be used for organizing and making available large collections of information (ALA, 2019). According to Sridevi and Shanmugam (2017), AI is the modern technology which is used to manage the digital library. The ultimate promise of AI is to develop computer systems or machines that think, behave and in fact rival human intelligence, and this clearly has major implications on librarianship. AI is not just an intelligent system or software program, it is a biologically motivated technology used to replicate human ways of perceiving and processing information (Sridevi & Shanmugam, 2017). Intelligent library automation systems rely on Artificial Intelligence technologies to provide knowledge-based services to library clientele and staff. AI in libraries should not be misconstrued with library automation. While the later implies the degree of mechanization to routine library operations, the former goes beyond just automating library activities, and create intelligent rational systems that behave and act like librarians and requires little or no human intervention. AI systems can replicate and thus replace a human being in the library, although Li, Huang, Kurniawan and Ho (2015) believed that this invention will never replace librarians, but will center on menial and time-consuming library operations such as shelf reading and leave the librarians to engage with the patrons. Corroborating this assertion, Murphy (2015) maintained that the application of robots in libraries will bring librarians and users closer

together, against the notion that robots will alienate librarians from their users. Some fields of AI that be use by librarians include: natural language processing (NLP), expert systems (ES), pattern recognition, robotics, speech recognition, chatbots, etc (Sridevi & Shanmugam, 2017).

Nugroho, Anna and Ismail (2023) conducted a study analyzing the correlation between AI and libraries and the shift in research trends during the COVID-19 pandemic. The researchers gathered secondary data from Scopus using keywords such as AI, library, and repository from 1993 to 2022. The findings revealed that keywords like human, deep-learning, machine learning, surveys and open-source software became popular in 2020 and closely related to digital libraries. The annual scientific production of papers also significantly increased in 2021. The study highlights the importance of AI implementation in libraries to support repositories during the pandemic. It suggests that librarians can maximize AI-based repository services and create policies using AI. The research identifies themes and knowledge gaps in AI in library repositories, providing insights for researchers, academicians, and practitioners to conduct further research in this area.

Another study by Afaf' (2010) for some Sudanese universities on the use of AI applications in university libraries: designing a model for an expert system in references for the published University of Khartoum library": the study aims at identifying the applications of AI technology, areas of its use, and the ways to benefit from it in Sudanese university libraries, with proposing an expert system in references using the experimental approach. The researcher adopts in her study, in addition to the experimental approach, the descriptive-analytical approach, the survey approach, and the case study approach, using the method of focus group and interview as tools to collect information and data from a sample consisting of 55 users of the automated system of libraries, 100 users of the reference service within libraries, and 25 librarians. They all represent 11 Sudanese universities. The most prominent results are as follows: The expert systems in Sudanese university libraries are still in the establishment stage, and they have not been adopted as a strategy for managing libraries, no importance is given to expert systems technology, Librarians' lack of familiarity with Artificial Intelligence techniques.

In a study by Moustapha and Yusuf (2023) on the adoption and utilization of AI in university libraries in Kwara state Nigeria. The study raised four research goals as well as four research questions. A descriptive survey method and random

sampling techniques with 450 randomly selected librarians from Kwara state Universities were used for the research. Five research assistants were employed and trained on how to contact respondents and secure their consent before distributing the structured questionnaire designed by the researcher, who assisted in the tool distribution process. The researcher was able to able to retrieve 410 copies of questionnaires, with a high response rate of 91%. Findings indicated a limited use of AI in the libraries, with security scanning devices being the most common AI technology present. However, advanced AI systems like chatbots, face recognition, and RFID technologies were found to be lacking. The study also highlighted barriers to AI adoption, such as the need for training and infrastructure. Recommendations included providing training for librarians and ensuring support from university administration and libraries should commit and provide necessary infrastructure to ensure successful and rapid AI implementation.

However, Tella (2020) identified various areas AI application in academic libraries in Nigeria which include shelving and locating library materials, security and answering users' queries. In addition, AI technologies are very relevant in automated storage and retrieval systems (ASRSs), and this has really helped in space management in library operations (Payne, 2007). From this, it can be said that the readiness of librarians to apply AI will laid the technical foundation for the establishment of smart academic libraries. Furthermore, Shivarama and Choukimath (2019) identified various factors that can promote the application of AI technologies in academic libraries to include awareness and positive perceptions among librarians, modular architecture, self-learning and vivid language.

Similarly, various professional bodies in librarianship such as International Federation of Library Associations and Institutions (IFLA), the American Library Association (ALA) and South African Library Association have acknowledged the role AI can play in library operations and librarianship. An IFLA Trend Report indicates the relevance of AI in libraries and librarianship in the sense that it can be used with semantic web and search, as well as improvements to translation and cloud-based computing (Wang, 2014).

However, the readiness of library staff on the application of AI in university libraries dependent on factors like sufficient amount of data, need for policy document, the need to deploy necessary algorithms and software, and

lastly, expert knowledge (Martinez-Plumed et al., 2021). To achieve librarians' readiness to apply AI, Qomariyah, Mursidah and Wahyun (2020) in a study on Indonesian university libraries, list necessary factors and facilities needed for effective AI use in university libraries. These include making librarians aware of the AI in the sense of fully understanding its relevance and limitations, equipping the librarians with needed necessary skills to operate the technology, policy and procedure documents and organizational resources. Decker (2015) argues that, for effective use of AI in university libraries, the library management needs to deploy enough technology facilities in the library which include very strong Wi-Fi connectivity zone. He goes further to mention that there must be policy documents in place. However, deployment of AI systems would in turn reduce the rate of human interactions in library operations. In addition, Adebayo et al. (2018) reports that librarians need to be adequately aware of the benefits that AI may bring into the library and will in turn change their perceptions toward the AI because majority of librarians are found to have fear that AI deployment will reduce human interactions in the library which will subsequently lead to loss of jobs.

Below are the areas in which Artificial Intelligence could be used and/or applied in Academic library services in Nigeria (Heath, 2018; Vijayakumar & Sheshadri, 2019).

6. **Applications of Expert Systems in Reference Services**: Expert systems are utilized in reference services to help clients find recommended sources for their questions and research, direct patrons to reference sources, provide online reference assistance (ORA), aid in answering questions on specific topics, and act as a referral tool such as pointer, answer man and PLEXUS (Heath,2018; Vijayakumar & Sheshadri,2019).
7. **Application of Expert System in cataloguing:** Expert systems focus on descriptive cataloguing and can automate the cataloguing process with minimal input from intermediaries.
8. **Application of Expert System In classification:** Expert systems such as Coal SORT, EP-X, and BIOSIS assist in organizing knowledge through semantic networks and hierarchical concepts (Asemi & Asemi, 2018; Heath, 2018).
9. **Application of Expert System in Indexing:** Indexing as stated by Asemi and Asemi (2018) involves identification of concepts to translate these concepts into verbal descriptions by selecting and assigning controlled vocabulary terms that are conceptually equivalent to verbal descriptions. The reason for automating the intellectual aspects of indexing is to improve the indexing consistency and quality. Based on the information provided by the indexer, the

systems can arrive at appropriate preferred terms to automatically assign relevant subdivisions.

10. **Application of Expert System in Acquisition:** Expert systems like Monograph Selection Advisor help in building library collections with user input (Heath, 2018; Vijayakumar & Sheshadri, 2019).
11. **Application of Natural Language Processing in Library Activities:** Natural language processing can be used in library activities to search databases like OPACs.
12. **Application of Pattern Recognition in Library Activities:** In this era of the Internet and distribution of information, multimedia computing, new and emerging classes of information systems' applications have swept into the lives of office workers. New applications ranging from digital libraries, multimedia systems, geography information system and collaborative computing to electronic commerce have created tremendous opportunities for information researchers and practitioners.
13. **Application of Robotics in the Library Activities**: A robot is a programmable, multi-functional manipulator that is automatically controlled and can be reprogrammed, operating in three or more axes and capable of being stationary or mobile for automation purposes. Robots have the ability to maneuver by scrambling, rolling, flying, and climbing independently. The increasing digital services and resources offered by libraries have resulted in libraries acquiring significant amounts of printed materials. The challenge of providing both electronic and print-based resources has led to space limitations, particularly in academic research libraries. The Comprehensive Access to Printed Material (CAPM) initiative aims to develop an on-demand robotic scanning system that enables real-time browsing of printed materials through a web interface. Users will interact with the CAPM system, which will activate a robot to retrieve the requested item. The robot will deliver the item to another robotic system that will open it and automatically turn the pages. By utilizing scanners, optical character recognition (OCR) software, and indexing tools from the Digital Knowledge Centre, the CAPM system will not only facilitate browsing of text images but also enable searching and analysis of full-text content derived from the images (Asemi, &Asemi, 2018; Heath, 2018).

In the same vein, librarians' readiness to apply AI can enable university libraries in Katsina state to provide AI driven library services and perform operations with the aid of AI. These AI driven library services and operation can includes the following:

a. Automatic cataloguing and classification using Optical Character Recognition (OCR)
b. Automatic translation of foreign language materials using Natural Language Processing (NLP)
c. Automatic indexing using Expert Systems
d. Retrieval of audio-visual materials Optical Character Recognition and Speech Recognition. Music and pictures in the library's collections can be called up as fast as printed records a new dimension to knowledge storage and management.
e. Interactive bibliographic instruction using various media
f. Intelligent gateways to online sources,
g. User-structured information environment
h. Portable computer reader services for the handicapped
i. Intelligent Document Delivery Services (DDS)

Korinek and Stiglitz (2017) maintain that advances in AI technologies could bring about job losses or job polarization. AI adoption has the potential for a high rise in inequality due to automation. World Bank (2016) maintains that developing countries may be more hinted at 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. Similarly, International Labour Organization (2018) also stresses that with the current trend in technological change based on the use of AI in different organizations that include libraries, AI use has created widespread fear of job losses and a high rise in inequality.

The study "Artificial Intelligence Investing in Academic Libraries: Reality and Challenges" by Farag, Mahfouz and Alhajri (2021) examines the implementation of AI in Saudi academic libraries. The study found a weak understanding of AI among most library workers, with 69% saying they do not use AI. The study also found that AI is currently being used in indexing, analysis, retrieval, storage, photography, and meeting the needs of library users. However, there is a lack of training for workers in the AI sector, which is attributed to the lack of training courses. The study concludes that AI should be used as an assistive technology for library specialists but not relied on entirely. The main challenges faced by academic libraries are a lack of physical equipment, limited local AI technology. Other challenges that may face by librarians on AI include the following:

1. **Financial Uncertainty and Cost of AI System**: When government funds are shrinking and political or economic changes are underway, cultural institutions

are often the first to suffer cuts. In many ways, the struggle for institutional or government funding is much like the chicken and egg problem. While the AI systems are very expensive and mostly in form of proprietary, system upgrade and maintenance requires payment to the proprietors, libraries cannot keep affording it. Libraries are expected to show value for money and demonstrate cost-effective practices, but they can't do that without integrating new technologies to upgrade their physical spaces, offer new services, and improve the user experience for today's patrons all of which requires additional funding (Tella, 2020). Thus, today's libraries often find themselves in a financial limbo- unable to show value without additional funding.

2. Lack of AI Skills: Lack of AI skills among librarians can negatively affect the libraries readiness to apply AI in both of their library operations and services. Today, equipping librarians with AI skills is just as important as provision of library resources and other physical infrastructures. These make it essential for libraries to organize workshops, seminars and to attend AI conferences in order to develop new skills not only to stay competent, but to better serve patrons in this AI age.

3. Lack of AI Infrastructure: The level of infrastructures needed to create and support AI in university libraries remain relatively low if not absent. At present, the level of investment needed to develop intelligent libraries requires skilled personnel with expensive development tools or techniques are lacking or costly.

4. Cultural and Religious Issues: Cultural affiliation and religion bigotry are the most critical barriers to development and deployment of AI in Nigeria. Language might not be a challenge to AI in university libraries in Nigeria, but people of the same tribal affiliation are usually biased in working cooperatively with other tribes especially in knowledge acquisition. Similarly, there is much religious intolerance that can seriously militate against AI technology in Nigerian university libraries.

5. Privacy Issue: Artificial intelligence when fed with large amounts of data, eventually learns to identify certain sets of data with the help of machine learning. Personal information has become a commodity that can be used for illegal purposes. Librarians need to ensure privacy by providing anonymous means of interacting with human information systems.

6. Bias: The transparency and accountability of library resources are services may be questioned, because algorithms can work according to the opinion of developers or commercial organizations which can lead to the provision of biased information. This may also lead to staff or users corrupting the AI thereby to play their bid.

7. Plagiarism and Intellectual Freedom Theft: Searching for information and receiving information from Artificial technology systems creates intellectual freedom in threats, as it gives room for users to search and use information without the permission of the authors or even users to personalized the information as if it's their property. Consequently, queries and search history are saved which can be used against people.

8. Fear of Unemployment, Redundancy and Job Loss: Another critical challenge that hinders application of AI in university libraries in Nigeria is the perceived fear of job losses that may cause large scale unemployment among librarians.

1. Motivation for the Study

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. 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) notes that using AI in academic libraries would help to analyze big data, create metadata, and improves 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) stresses the need for academic libraries to re-position themselves to take relative advantage of Artificial Intelligence's potentials by refining the quality of library services in this era of the information age. Talley (2016) also emphasizes the need for university librarians to embrace AI technologies to provide better services to researchers and other library users. Grant and Camp (2018) observe that many academic libraries particularly in developed countries have adopted AI for various library operations, such as circulation and reference services. Sagarjit, Sanghamitra and Paramita (2017) maintain that the application of AI has improved user engagement in many developed countries in the world. Access to timely information can only occur in a situation where AI is being used to guide and support, and at the same time user-friendly, particularly in information search. For instance, a friendly AI technology will help users search for information with ease, help retrieve information across various collections, and help with users' queries.

Moreover, Asemi 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. AI technology can also be used to assign metadata and to assist in the non-textual search. Fernandez (2016) notes the potential opportunities of AI in library operations, particularly in analysing big data, creating metadata, translating search items, and integrating search items across contents. Divayana, Ariawan, Sugiarta, and Artanayasa (2015) identified some of AI's advantages in library operations to include but not limited to the ability to perform library duties efficiently. 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.

Despite the advantages of applying AI in information services delivery many academic libraries in Nigeria and especially in the study area are not venturing into the huge benefit, to this background this research is triggered to understand the readiness and possible challenges hindering the application of AI in some University Libraries in Katsina State. And to do that the following objectives were set to guide the study to:

1. Ascertain the readiness of library staff on the application of Artificial Intelligence for information service delivery in the study area.
2. Identify the challenges that library staff may face on the application of Artificial Intelligence for information service delivery in the study area.

Methodology

This study is guided based on positivism research paradigm. Positivism perspective maintains and emphasizes on the importance of relying on evidence that can be physically observed and measured in order to comprehend the world. In social science research, the term "paradigm" is used to refer to the philosophical assumptions or set of core beliefs that guide the behaviour, actions and define the worldview of the researcher (Patton 2002). The study adopted quantitative research method based on its ability to capture quantitatively the attitudes and intention of librarians in determining the awareness and perception of librarians on AI. It will allow the researcher to determine the strengths and weaknesses of the divergent attitudes and approaches used by librarians on how ready they are and the challenges to application of AI technologies in shaping their daily library activities. Creswell (2013) and Williams (2011) described quantitative research method as a strategy of inquiry that includes experimentation, quasi-experimentation and surveys, and collects data on predetermined instruments (questionnaire) to general results quantitatively.

This study, therefore, employs survey research design from the three types of research design found in quantitative research methodology Creswell (2013). Cross-sectional Survey research design is a research design that provides a quantitative or statistical description of trends, attitude, or opinions of a population by studying a sample of that population and make analysis for the purpose of better understanding of the population (Sukamolson 2007 & Creswell 2013).

A structured questionnaire was prepared and developed using previously adapted scale used by Lund, Omame, Tijjani and Agbaji, (2020) on their study on perceptions toward AI among academic library employees. To ensure the reliability of the questionnaire, 30 copies of questionnaires (15 questionnaires each) were distributed to similar group of respondents in (Bayero University, Kano and Yusuf Maitama Sule University, Kano). The result was subjected to analysis using Cronbach alpha formula with the help of SPSS version 23 which give 0.723 reliability levels. To collect timely and relevant data using the questionnaire, the researcher physically administered the research instrument to the respondents in Katsina state university libraries with the help of two (2) research assistants.

The quantitative data collected in this study was organized for analysis by coding the raw data for easy manipulation using the appropriate descriptive statistical software. The Statistical Package for Social Sciences (SPSS IBM version 23) was used to present, analyse and describe the collected data using the questionnaire. SPSS is described as a powerful, comprehensive and flexible general-purpose data analysis package (Pickard, 2013). The researcher used frequency distribution tables, simple percentage, mean and standard deviation to represents the data. This allows representation of data in visually attractive forms thereby making the audience easily understand the data and research findings.
The target population for this study comprises all the 287-library staff working in the three selected university libraries in Katsina state.

2. Presentation of Tables

Table 1: Distribution of the Population

S/n	Name of University Library	No. of Library staff
1.	Umaru Musa Yar'adua University Library	49
2.	Federal University Dustin-Ma Library	218
3.	Al-Qalam University Library	20
	Total	**287**

(Preliminary Study, 2023)

The sample size of this study is one hundred and sixty-five (165) samples which is calculated and determined proportionally based on Krejcie and Morgan (1970) formula for determining sample size, with a margin of error of 0.05 and the level of confidence of 95%. The following formula is used: $S = \frac{N \times S}{TP}$.

Where, N = Population of Stratum S = Calculated Sample Size TP = Total Population

Table 2 Sample size of the study

S/N	Name of University Library	Population	Sample size
1.	Umaru Musa Yar'adua University Library	49	28
2.	Federal University Dustin-Ma Library	218	125
3.	Al-Qalam University Library	20	12
	Total	**287**	**165**

Table 3 Readiness of libraries on the application of AI for information services delivery

Readiness of library staff on the application of AI	Frequency	Percentage (%)
Yes	117	81.8
No	26	18.2
Total	143	100

Table 4 Factors that influence the readiness of libraries to apply AI for information services delivery

Items	SA		A		UD		D		SD		Mean	STD
	F	%	F	%	F	%	F	%	F	%		
High awareness of AI	46	32.2	64	44.8	6	4.2	19	13.3	8	5.6	2.15	1.18
Positive perceptions of AI	56	39.2	63	44.1	0	0	17	11.9	7	4.9	1.99	1.15
AI support infrastructure	56	39.2	63	44.1	0	0	19	13.3	5	3.5	1.98	1.12
AI algorithm and programming	64	44.8	50	35.0	0	0	24	16.8	5	3.5	1.99	1.20

skills among librarians												
AI policy framework	65	45.5	51	35.7	0	0	19	13.3	8	5.6	1.98	1.22
Availability of telecommunication facilities	58	40.6	60	42.0	0	0	20	14.0	5	3.5	1.98	1.14

Table 5 Challenges libraries face on the application of AI for Information Services Delivery

Challenges	Yes		No	
	F	%	F	%
Financial uncertainty in libraries	120	83.9	23	16.1
Lack of AI skilled librarians in the libraries	119	83.2	24	16.8
Absence of specific AI policy document in the libraries	119	83.2	24	16.8
Lack of awareness of librarians on the application of AI	106	74.1	37	25.9
Negative perceptions of librarians on AI	111	77.6	32	22.4
Plagiarism and Intellectual freedom theft	112	78.3	31	21.7
Lack of telecommunication facilities	102	71.3	41	28.7
Lack of AI support infrastructure	120	83.9	23	16.1
Fear of job lost or job polarization	115	80.4	28	19.6
Cost of AI technologies	119	83.2	24	16.8

Table 6 Solutions to the challenges that libraries face on the application of AI for Information Services Delivery

Items	Yes		No	
	F	%	F	%
Adequate budgetary provision	119	83.2	24	16.8
Good AI skilled librarians in the libraries	119	83.2	24	16.8
Provision of specific AI policy document in the libraries	110	76.9	33	24.1
High level of AI awareness among librarians	104	72.7	39	27.3
Positive perceptions on the application of AI among librarians	101	70.6	42	29.4
Provision of telecommunication facilities	109	76.2	34	23.8

Making available of AI support infrastructure	113	79.0	30	21.0
Adequate provision of security and anti-plagiarism gadgets	117	81.8	26	18.2

Results and Discussion

165 questionnaires were distributed to the respondents, out of which 143 questionnaires were duly filled and retrieved representing 86.7% while 22 questionnaires were not returned. This high response rate was achieved as a result of subsequent follow-ups by the researcher together with the research assistants employed for the study.

Table 3 presents the responses rate on the readiness of library staff members to apply AI in information services delivery. The data indicated that 117 (81.2%) of the total respondents are ready to apply AI for information services delivery, while 26 (18.2%) of the total respondents indicated that they are not ready to apply AI.

Table 4 presents the responses on the factors that influence the readiness of library staff members to apply AI for information service delivery. The data show that majority of the respondents indicated that availability of AI support infrastructures; AI policy document; and telecommunication facilities accounts the highest level of agreement with the mean and standard deviation of 1.98 and 1.12, 1.14 and 1.22 respectively. This is followed by positive perceptions of AI among librarians and AI algorithm and skills among librarians with each accounting to the mean score of 1.99 and standard deviation of 1.15 and 1.20 respectively. However, lack of awareness of AI accounts to lowest level of agreement with 64 (44.8%) of the respondents agreeing with the statement while 46(32.2%) strongly agreeing, the mean score for this item was 2.15 and standard deviation of 1.18 indicating a moderate level of awareness may be a factor that influence the readiness of library staff regarding the application of AI. On the other hand, 19 (13.3%) of them disagreed, while 8 (5.6%) strongly disagreed, whereas 6 respondents, corresponding to 4.2%, were undecided.

The data above made it clear that a significant majority of the library staff are open and ready to the acceptance of AI, which could potentially lead to improved information service delivery in the university libraries. While the least number of the respondents has shown that they are not ready for it. However, the data above made it clear that a significant majority of the library staff are open to the application of AI to deliver information retrieval service, reference service,

translation service teaching support service and other services that AI may be relevant to be useful. This which could potentially lead to improved information services delivery in the university libraries. This is contrary to the findings of a study by Odeyemi (2019) who reports that librarians working in academic institutions in Nigeria are partially ready to apply AI to provide information services.

However, to fully apply AI the data indicated certain requirements or factors like librarians' awareness, perceptions, AI algorithm and programming skills, AI support infrastructure, AI policy document and availability of telecommunication facilities of which the majority of the respondents believed will play a very significant role in making library staff ready to apply AI. Moreover, libraries should consider these factors when developing strategies to adopt AI technologies and ensure a smooth transition in the libraries. This is in line with the findings of Ocholla and Ocholla (2020) on their study on the readiness of academic libraries to research, teaching and learning support in the fourth industrial revolution, which reports that libraries in the US, UK and other developed countries have put in place sophisticated technologies as a show of readiness; the readiness is meant to apply AI systems into their operations and services. Therefore, the findings of this study affirm that for libraries and library staff members to apply AI in university libraries in Katsina state, certain facilities need to be put in place.

Table 5 presents data on the challenges to the application of AI for information services delivery, the data indicated that financial instability and cost of AI systems as well as fear of job lost or job polarization have the highest frequency and percentages with each to accounting to 120 (83.9%) respectively; this is reflected in the mean score of 1.82 and standard deviation of 1.21. it is followed by lack of AI skilled librarians, lack of AI specific policy document and cost of AI technologies accounting to frequencies and percentages of 119 (83.2%) of the total respondents respectively, reflecting the mean of 1.98 and standard deviation of 1.12. However, lack of telecommunication facilities accounts the lowest frequency and percentage of 102 (71.3%) and then followed by lack of awareness of AI accounting to 106 respondents corresponding to 74.1%.

The data indicate that several challenges that the library staff may face on the application of AI in libraries. The majority of respondents indicated that financial uncertainty and cost of AI systems, lack of AI-skilled librarians, absence

of specific AI policy documents, lack of awareness of AI, negative perceptions of AI, plagiarism and intellectual freedom theft, lack of telecommunication facilities, lack of AI support infrastructure, fear of job loss or job polarization, and the cost of AI systems are some of the major challenges that may hinder application of AI in libraries in the study area. This buttresses the findings of Obiano, Onuoha, Adeoye, Nwosu and Folarin (2022) on their study on aiding the exploration of AI in Nigerian academic libraries and another study by Mustapha and Yusuf (2023) on adoption of AI to improve library service delivery in academic libraries, all of which affirm that inadequate funding of the libraries affects AI application. Their findings also go contrary to other findings of this study which claims that epileptic power supply, poor internet connectivity and lack of expertise among librarians are the major challenges hindering librarians and libraries from applying AI in Nigeria.

In addition, the findings also align with a study conducted by Saibakumo (2021) on awareness and acceptance of emerging technologies for extended library services in academic libraries in Nigeria, which report inadequate technological infrastructure and lack of technical skilled librarians on AI as the major challenges facing the application of AI into library operations and services. However, the data also provide suggested solutions to the anticipated challenges identified of which the majority of the respondents agreed that adequate budgetary provision, training equipping librarians with AI programming skills, provision of AI support infrastructure, provision of telecommunication facilities, making available AI policy document and provision of security and anti-plagiarism gadgets to checkmate plagiarism and intellectual freedom theft. In addition, library staff the need to start developing a clear vision and strategy for the future, educating themselves about AI, engaging with stakeholders, and acquiring and updating relevant skills. Finally, the data provide valuable insights into the perceived challenges and opportunities associated with AI in libraries and putting emphasis on the proactive measures to address these challenges and leverage the potential benefits of AI in library services.

Table 6 presents data on the solutions to the challenges facing libraries on application of AI for information service delivery. The majority of the respondents perceived adequate budgetary provision equipping librarians with AI skills as the suggested solutions to the identified challenges, with the highest frequencies and percentages of 119 (83.2%) respectively; this is then followed by adequate provision of security and anti-plagiarism tools in libraries with 117

(88.1%) of the total respondents. However, the data reveal that having positive perceptions recorded the lowest frequency and percentage of 101 (70.6%) and then followed by attainment of high level of awareness among library staff with 104 respondents corresponding to 72.7% of the total respondents.

Summary, Conclusion and Recommendations

The findings establish that majority of the respondents believed that there are many anticipated challenges that library staff members may face on the application of AI. The findings reveal major challenges including financial uncertainty, lack of AI-skilled librarians, absence of specific AI policy documents, plagiarism and intellectual freedom theft, lack of telecommunication facilities, lack of AI support infrastructure, fear of job loss or job polarization, and the cost of AI systems, among others.

Furthermore, the findings of the study provide suggested solutions to the challenges identified some of which are that the majority of the respondents agreed that adequate budgetary provision, training and equipping librarians with AI programming skills, provision of AI support infrastructure, provision of telecommunication facilities, making available AI policy document and provision of security and anti-plagiarism gadgets to checkmate and prevent plagiarism and intellectual freedom theft.

However, despite AI potential to transform libraries and librarians, it is concluded that many library staff have expressed concerns and reservations towards AI which in turn affects their readiness to accept its eventual application in their respective libraries.

Consequently, it can be deduced from this study that for libraries and library staff to effectively and efficiently apply AI for information service delivery, certain processes and facilities are needed to be put in place; these are prerequisite for every library that wishes to apply and adopt AI to perform operations and provide seamless services. These may include attainment of certain level of automation, equipping librarians with AI requisite skills; specific library policy document to guide the AI acquisition of software and hardware, installation, operation, updating and replacement, AI support infrastructure and telecommunication facilities, among others.

It is pertinent to note and recommend that high awareness and positive perceptions of AI among library staff alone cannot influence their readiness to accept and adopt AI; hence the study suggests that government, university

managements and library management should make available AI support infrastructure, telecommunications facilities to facilitate easy transition to AI in libraries. In the same vein, TETFund and NITDA should collaborate with NLA and local library branches to formulate a comprehensive policy document that would guide libraries and library staff towards responsible and ethical AI application into library operations and services.

The challenges that may hinder libraries and library staff toward applying AI where identified which include lack of adequate budgetary provision, lack of AI support infrastructure and telecommunication facilities in the libraries, lack of security and anti-plagiarism gadgets to checkmate and prevent intellectual freedom theft as well as fear of privacy abuse and job loss. However, it has been identified that in order to solve or remedy these challenges, there is need for increased support from government and funding agencies for university libraries such as TETFund, UNESCO and IFLA to invest considerably in the provision of adequate budgetary provision, provision of AI support infrastructure and telecommunication facilities necessary for successful AI integration in the libraries.

This study hopefully maintains that by considering the proffered recommendations, library staff members in the study area could better understand and embrace AI and ultimately improve the overall awareness, perception and their readiness to apply and integrate AI to their operations for information service delivery in the university libraries in Katsina state.

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