

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPLICATIONS IN LIBRARY SERVICES: ENHANCING USER EXPERIENCE AND OPERATIONAL EFFICIENCY IN UNIVERSITY LIBRARIES IN NORTH CENTRAL NIGERIA

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ABSTRACT

This study examined the incorporation of artificial intelligence (AI) and machine learning (ML) technologies in six university libraries in North Central Nigeria (Benue, Niger, Kwara, Nasarawa, and Kogi States). AI is identified as smart systems and technologies and includes chatbots, recommendation systems, automated cataloging, predictive analytics, natural language processing, and intelligent library management systems. This study employed the Technology Acceptance Model (TAM), and a survey approach was adopted. This study surveyed 48,632 students, 2,154 academics, and 238 staff in the six university libraries in North Central Nigeria. The research basis was the 1,018 surveyed participants, selected as follows: 600 students (100 per university), 180 academics (30 per university), and 238 staff (census). The study used a sample of 827 questionnaires completed (81.28% response rate). Data were collected using structured questionnaires, accompanied by personal interviews and direct observation. All data were analyzed using descriptive statistics. The main findings of this study showed that library staff and lecturers had a moderate level of understanding of AI and ML technologies. The implementation and usage of AI-related tools at all six universities was critically low. The most evident use of AI at the three federal universities was the use of upgraded online public access catalogues, while other more advanced uses of AI were in their very early stages or non-existent. The lack of foundational infrastructure such as adequate and stable power and the Internet, lack of budget allocation, absence of AI staff,

the lack of AI policies in the institutions, vendor support challenges, and the presence of data privacy concerns were the most prevalent problems. The study recommended that along with staff capacity building, collaborative procurement, policy and legislation, partnerships with technology companies and development partners should focus on ethical AI to help libraries in planning for AI adoption.

KEYWORDS: Artificial Intelligence (AI), Machine Learning (ML), University Libraries, Technology Adoption and North Central Nigeria.

INTRODUCTION

Machine Learning and AI technologies are changing the shape of services in academic institutions, and libraries are the first to recognize this. Cox and Mazumdar (2022) suggest that the introduction of AI will automate repetitive tasks in libraries, personalize user experiences, facilitate resource discovery, assist librarians with information to better aid decision making, and allow libraries to use their resources better. AI can redefine how libraries manage, disseminate and provide access to digital information.

As defined by Mbambo-Thata (2020), the presence of an academic library within a higher learning institution is due to the library's need to assist the learning and teaching process and aid research. Academic libraries aid in the fulfillment of information access needs, assist in knowledge creation, aid in the elevation of scholarly status, and provide services toward the attainment of institutional goals. In the age of the Fourth Industrial Revolution and the digital revolution, academic libraries must use technology, including AI, in order to serve their patrons in the age of digital disruptions.

Breeding (2021) suggests that the use of AI and machine learning will provide libraries with innovative and improved ways of enhancing their services and operations. AI and machine learning can automate repetitive tasks, such as cataloging, metadata creation and data inputting, and provide intelligent search and discovery services that understand and provide results based on natural language queries. AI and machine learning can assist libraries in providing personalized reference services and recommendations. Additionally, AI and machine learning can assist libraries in improving their collection management services.

Digital transformations and adoption of technology by university libraries in Nigeria vary. Some libraries have been able to put in place simple automation systems. Incorporation of advanced technology like Artificial Intelligence (AI) and Machine Learning (ML) remain largely absent. According to Okiy (2019), Nigerian university libraries have many challenges

including underfunding, lack of basic infrastructure, low levels of IT skills and opposition to changes in technology. There is interest in AI among Nigerian library professionals because of the opportunities to use AI to remedy old and persistent problems in the provision of library services.

University libraries in the North Central region of Nigeria (Benue, Kogi, Kwara, Nasarawa, Niger, Plateau and the Federal Capital Territory) have a large and diverse student and academic population, who demand a lot of information. These libraries operate in environments with scarce resources and poor infrastructure. Knowledge of the current state of AI/ML, proposed cases, user and service impact, and some major challenges that still exist is needed to develop an effective strategy for AI integrated library services for this region. This study evaluates the status of AI/ML, proposed use cases, and required strategies in university libraries in the North Central region of Nigeria to provide informed recommendations for the incorporation of AI for library service administration at universities, and for institutional and policy decision-makers.

Statement of the problem

While many emerging artificial intelligence and machine learning technologies have the potential to transform library services and operations, most Nigerian university libraries have struggled to adopt and integrate these technologies. As a result, many libraries are unable to meet changing user needs and are unable to ensure the optimization and visibility of their services within a rapidly digitized and competitive environment. This study is driven by a number of major threats.

Knowledge gaps amongst library administrators and staff regarding the AI technologies, the library related contexts, the associated benefits, the implementation hurdles, and the strategic implications have adversely impacted the planning and the financing of strategies for the adoption of AI. These knowledge gaps have been exacerbated by the suboptimal and unstable internet connectivity, insufficient computers, obsolete library management systems, and the absence of digital repositories required to support AI.

AI, ML, data science and software integration skills in one personnel are virtually nonexistent. Oyewole and Alegbeleye (2020) have observed that most library staff in Nigerian universities do not have up to speed with technological trends and will require a significant amount of AI system capacity building. Lack of funding has further impacted the ability of libraries to adopt AI, purchase the necessary equipment and software, hire technical support, and provide the training to sustain implementation.

Lack of institutional policies and strategies along with governance frameworks for AI implementation in libraries generated uncertainty and apprehension toward AI. Concerns about the privacy of data, bias of algorithms, displacement of jobs and ethical implications of AI's role raised legitimate issues that merited focused attention. Further provoking this apprehension was the lack of contextual information on the effects of AI technologies on library services and the satisfaction of users as well as the operational efficiency of libraries in Nigeria which made it untenable for libraries to fund AI projects and implement them. This apprehension prompted this researcher to carry out a study on the use of AI and ML in the university libraries of North Central Nigeria and examine the use cases and effects of the technology while proposing reasons for the obstacles encountered in the implementation.

Objectives of the Study

The purpose of this research was to evaluate artificial intelligence (AI), and machine learning (ML) technologies in university libraries in North Central Nigeria and how these influence user experience and operational efficiencies in university libraries in North Central Nigeria. Specifically, this research evaluated:

- i. The existing level of AI and ML technologies adoption and implementation in university libraries in North Central Nigeria.
- ii. The existing and the possible AI and ML technologies in library services such as cataloguing, discovery, reference services, collection management, user engagement, and library management systems.
- iii. The effects of AI and ML technologies on library users' experience and levels of satisfaction with and engagement in library services and resources.
- iv. The impact of AI and ML on efficiency, staff productivity, and resource optimization and decision-making in library services.
- v. AI and ML impediments and difficulties in university libraries in North Central Nigeria; the needed infrastructure, new skills, financing, and related policies.

Research Questions

This study examines the following:

- i. Current status of awareness and use of AI and ML technologies in the university libraries in North Central Nigeria.
- ii. Current and projected use of AI and ML technologies in library systems and procedures.

- iii. Effect of AI and ML technologies on library patrons' experiences and the fulfilment of their expectations and needs while using library services.
- iv. Effect of AI and ML technologies on the procedures and activities of university libraries.
- v. The barriers and enablers of the use of AI and ML technologies on university libraries.

Scope of the Study

Herein, we present a report on six university libraries found in North Central Nigeria. These libraries include three owned by the Federal Government and three by state governments, spanned across five states. They include University of Agriculture, Makurdi (Benue State); Federal University of Technology, Minna (Niger State); University of Ilorin (Kwara State); Nasarawa State University, Keffi (Nasarawa State); Kogi State University, Anyigba (Kogi State); and Niger State University, Minna (Niger State). The staff of the libraries, students, and lecturers were the subjects of the survey.

Significance of the Study

University service and operational changes based on AI and ML have begun due to published research findings. Upper management and administrators were involved in research and were shown how end-of-shelf life fund investments increase operation efficiency and give institutions an edge.

Analysis for AI in the Nigerian context suggested pros and cons of AI. Library staff's skills to adopt and implement AI technologies was developed. Additionally, with a staged implementation approach, staff development, and added resources, suggestions for infrastructure were made. The research provided a justification for the TETFund and other CSR technology companies, as well as international development aid, to aid AI for Nigerian libraries. AI was shown to improve the resource discovery for library materials and shorten the time it takes library staff to pull requested materials for the library users: students, teachers, and researchers. The research filled the existing scholarly gap for technology and digitization integration and provided insight on the digital resources available in academic libraries of Africa.

Literature Review

2.1 Theoretical Framework: Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) by Fred Davis (1989) is the starting point for this research. TAM describes how people incorporate novel technologies into their day-to-day activities. TAM describes technology acceptance as having two components, perceived

usefulness (PU) and perceived ease of use (PEOU). TAM argues that perceived usefulness and ease of use jointly impact the attitude toward using a certain technology, which subsequently aids in determining the intention to use a particular system and actual system usage (Davis, 1989).

TAM is popular and has been employed exhaustively in the library and information science field to study the adoption of different technologies in various situations. Such technologies may be integrated library systems, digital repositories, mobile libraries, or social media. Venkatesh and Davis (2000) extended the original TAM and presented that, within the overall social and cognitive elements, PU and PEOU are the most replications and strongest predictors of technology acceptance. The flexibility and ease of embracing theories and the robustness of TAM make it the most widely used technology acceptance model within the library context.

Application of TAM to AI/ML in University Libraries

Regarding AI and ML adoption in university libraries in North Central Nigeria, TAM can be used to understand how librarians, lecturers and students will perceive and interact with AI-embedded library tools and services. The model is applicable in this research context since AI adoption is not merely a technical choice. A great deal in the usability of AI tools depends on the users' decision as to whether the AI tools support their information needs in the context of their work.

1. Perceived Usefulness in AI Library Contexts: How library personnel, lecturers and students will view the utility of AI technologies in their contexts is what we are referring to as PU. This is the case with library staff in that PU involves assessing the extent to which the adoption of AI technologies like automated cataloging, intelligent search systems and chatbots reduces workload, raises the quality of services, and enhances professional effectiveness. On the other hand, PU will be realized by academic users when AI-based technologies for discovery and virtual reference services that combine personalized recommendations and smart services have been shown to enhance productivity in research and facilitate the accessibility of professional information. According to Hussain and Naeem (2023), staff evaluations noted a positive correlation between perceived usefulness and tool adoption, concentrated in AI-based services that were expected to save time and improve service quality.

2. Perceived Ease of Use in AI Library Contexts: This PEOU refers to how user friendly AI library technologies are. There are Nigerian university library staff who have rarely if ever encountered AI systems, who will perceive the deployment, management, and resolution of AI tool issues as highly complex. AI-based interfaces perceived as relatively complex will remain unused even by those who can recognize their utility. Oyewole and Alegbeleye (2020) report that Nigerian university libraries have formal ICT training of a very limited nature. In such environments, the perception of the ease of use of a technology is critical for technology acceptance.

3. Behavioural Intention and Actual Use: In regard to the Technology Acceptance Model (TAM), PU and PEOU jointly affect user attitude formation toward a technology, as well as their behavioral intention to use a technology and their eventual use. In the case of university libraries in North Central Nigeria, insight into the relationships between perceived awareness, perceived benefits, perceived usability, and the real intention to adopt AI helped shed light on the disparity between potential AI and real AI-based library services. By employing TAM on three different respondent groups, this study showed the distinction in the perception of various groups of stakeholders and what can be done to alter their attitudes and intentions toward positive interaction with AI.

2.2 Conceptual Framework

For the purposes of this study, artificial intelligence includes machine learning, natural language processing, computer vision, virtual assistants and chatbots, recommendation systems, analytics and predictions, robotic process automation and search engines. In the context of libraries, it includes software to automate and improve cataloging and classifying, systems to intelligently discover and broaden information, tools for personalized and adaptive learning, and automated tools to manage intelligent collections and improve library services. As a subset of AI, machine learning makes systems capable of getting better at performing specific tasks and predicting outcomes without giving instructions; therefore, it is very useful for predictive collection analysis, recommendation systems, and user behavior analysis in libraries (Cox and Mazumdar, 2022). When used in combination, AI and ML technologies offer libraries the ability to move away from providing rigid, rule-based services and provide more personalized data-based services.

AI and ML Applications in Academic Libraries

Breeding (2021) surveyed a number of potential AI applications in academic libraries. These include systems for intelligent search and discovery that understand user intent and context; chatbots and other virtual assistants that enable libraries to offer round-the-clock reference

services; automated cataloguing, which uses image recognition and Natural Language Processing; recommender systems; predictive analytics for better collection management and space utilization; and robotics for automating tedious but necessary tasks.

AI technologies will almost certainly play a substantial and positive role in future cataloging and metadata generation tasks. Zapounidou, Sfakakis and Papatheodorou (2023) examined machine learning in library cataloging and argue that AI technologies have the potential to generate metadata, classify and organize materials, suggest subject headings, and uncover duplicates at a level of sophistication that rivals human coding. Automation of these tedious coding tasks will drastically diminish backlogs in a library's catalog and allow staff to focus on higher-value work.

AI-based search systems have the potential to greatly enhance information retrieval through the use of natural language processing and semantic systems. Lund and Wang (2023) posit that with these systems, users will be able to formulate search queries in plain, natural language and be presented with contextually relevant and related resources. Novice users, who comprise much of the clientele of university libraries in Nigeria, will greatly benefit from these systems.

Implementations of AI in the form of chatbots have become prominent within libraries. Naik and Padma (2024) assessed AI implementations of chatbots in academic libraries and noted that they answer reference questions, assist with navigational barriers of library services, and can operate 24/7 while freeing up staff to address more difficult questions. Though most users reported positive experiences with the service, they noted the inability of the service to handle more complicated or sensitive queries and preferred the service of a human worker.

Many of the service gaps AI can fill can use adaptive algorithms to recommend resources while personalizing the user's experience. Popoola (2021) analyzed recommendation systems in digital libraries and noted that both collaborative filtering and content-based algorithms can provide appropriate resource recommendations based on a user's profile and borrowing history, with higher levels of resource use and engagement observed in the institutions studied. With respect to collection management, White and Schmidt (2020) illustrated that through the application of predictive models, the demand for resources can be anticipated, ideas for removal of resources proposed, and budgetary considerations addressed, all resulting in more appropriate collections and better use of resources.

AI Adoption in African Library Contexts

Awareness of AI in libraries is growing in the African context, even if adoption is still very low. Ekwelem and Okafor (2019) examined Nigerian university libraries and documented

almost zero AI adoption, attributing that to poor infrastructure, no budget, and no skills. Nevertheless, they remarked that there was interest and a growing awareness, especially among younger librarians. Mbambo-Thata (2020) has documented that sub-Saharan African academic libraries have made progress in some basic level library automation but that shifting to AI-based services will require more infrastructure.

There are numerous and complex barriers to using AI in developing country libraries. Poor infrastructure, especially power and Internet, and obsolete computing equipment, along with no support from tech vendors and lack of funding, constrain adoption. Hussain and Naeem (2023) suggest that library staff must be taught how to use AI with the understanding of its ethical implications, and that professional education must come first for successful AI adoption. Ethical issues for library AI have emerged in the literature. Whittaker et al. (2019) indicate AI systems carry risks and issues pertaining to bias, privacy, and transparency in how decisions are made. Libraries must analyze the ethical issues associated with AI systems and create policies that ensure responsible AI deployment. Burton, Howard and Oname (2022) conducted cost-benefit analyses on the implementation of library AI systems and indicated that measurable benefits were not clear until two or three years post-implementation, as automation systems require a long-term institutional commitment.

3.0 RESEARCH METHODOLOGY

Research Design

The descriptive survey design for this study captures the current situation regarding the perception and relationships associated with AI and ML adoption in university libraries. The survey design facilitates the collection of structured data from stakeholders including library staff, students, and teachers, to gauge the levels of awareness, methods, means, outcomes, and barriers of adoption in six universities spread across different geographical zones.

Population of the Study

The study population included students, lecturers, and staff of libraries within six university libraries in North Central Nigeria during the 2024/2025 academic session. The six universities were purposely selected to ensure a balance of federal and state universities located in the different North Central zone states, with diversity in institutional type, size, funding level and geographic location. Table 3.1 has the full population breakdown.

Table 3.1: Population of the Study.

S/N	University Library	Students	Lecturers	Library Staff
1	University of Agriculture, Makurdi (Benue State)	12,487	531	68
2	Federal University of Technology, Minna (Niger State)	9,718	471	56
3	University of Ilorin (Kwara State)	16,342	784	72
4	Nasarawa State University, Keffi (Nasarawa State)	6,254	178	22
5	Kogi State University, Anyigba (Kogi State)	2,087	112	12
6	Niger State University, Minna (Niger State)	1,744	78	8
	TOTAL	48,632	2,154	238

Source: Internal Records of the Institutions, 2025

Sample and Sampling Techniques

Federal and state universities within five North Central states were selected by purposive sampling based on institutional ownership. For students, stratified random sampling was employed, where 100 students were selected from each university using the institutional student register as the sampling frame, giving a student sample of 600. For faculty, 30 observations were selected from each university. A census was employed for staff at the library, and therefore all 238 library personnel were included. A total of 1,018 respondents was the goal for this study.

Respondent Groups

There were three major participant categories in this study:

- a) Library Staff: The 238 librarians and library officers of the six institutions. Library staff were included as respondent category because they are the ones that implement and manage information and communication technology (ICT) interfaces and are best-positioned to evaluate the status of AI, the applications, and the hindrances that define the implementation.
- b) Students: 600 students of the 100 students per institution chosen through stratified sampling. Students were selected as the main users of library services and the primary users for whom the impact of the use of AI-enabled services will have the greatest significance.
- c) Lecturers: 180 lecturers of the 30 lecturers per institution also selected through stratified random sampling. Lecturers as academic users of library services have intensive use and a great deal of specialized need and expectation of satisfaction whose research productivity will be impacted by library services.

Data Collection Instruments

The research instruments for this study included structured questionnaires and observation tools. A closed-ended questionnaire called "Artificial Intelligence and Machine Learning Applications in Library Services" (AIMLALS) was designed for library personnel, students and lecturers. The library staff questionnaire was used to collect data on staff's adoption of AI tools, existing and used AI tools, implementation of AI tools and the impacts of AI implementation on service delivery. The student and lecturer questionnaires were used to collect data on AI tools used, the ways AI tools were used and the satisfaction of service users with AI-enhanced library services. In-depth interviews with chief librarians at each site were used to obtain information on strategic plans and implementation challenges. Direct observation protocols assessed the visible AI technology and the physical infrastructure at each of the libraries.

Validity and Reliability of the Instruments

All three survey instruments were validated by five experts in Library and Information Science and Information Technology Management, and content validity was established at that stage. Changes based on the validation of the drafts were made prior to piloting. To establish reliability, twenty (20) copies of each questionnaire were administered to staff members and users of the Federal University of Agriculture, Abeokuta library. The Cronbach's Alpha reliability for the library staff, student and lecturer surveys, respectively, was found to be 0.83, 0.80 and 0.82. These values are satisfactory for this study.

Data Collection Procedure

The Federal College of Education, Okene supplied the researcher with an introductory letter and sent photocopies of questionnaires and the letter to the heads of libraries of the six institutions. The researcher, assisted by two other researchers, went to the six institutions to administer the questionnaires. Data collection took eight weeks to complete. When a researcher visited an institution, data were collected by administering the questionnaires and by observing the library. For the questionnaires which were still outstanding, the researcher went back to the institutions and called them.

Method of Data Analysis

A wide array of analysis was performed on research data using descriptive statistics such as counts, percentages and means. Data were sorted, grouped, and presented using tables with a narrative for each of the research questions. Content analysis of the data from interviews and observation was conducted as a means of contextualizing the findings. The analysis was

performed using IBM SPSS Statistics and the results were framed according to the study's goals and the Technology Acceptance Model.

Presentation and Analysis of Data

Response Rate

1,018 questionnaires were sent to staff and faculty members of the six university libraries, and students at those libraries. 827 of them, or 81%, were completed and ready for analysis as shown in Table 4. The remaining 191, or 19%, were left blank, filled out by staff and faculty members on training, study or sabbatical leaves, as well as students on internships. Overall, 81% of responses was determined to be an adequate representation for the purposes of analysis and generalization of the data.

Table 4: Response Rate of Respondents.

University Library	Staff Admin.	Students Admin.	Lecturers Admin.	Staff Returned	Stud. No	Stud. %	Lect. No	Total	%
Univ. of Agriculture, Makurdi	68	100	30	58	82	82	25	165	83
Fed. Univ. of Tech., Minna	56	100	30	48	80	80	24	152	81
University of Ilorin	72	100	30	61	84	84	25	170	85
Nasarawa State Univ., Keffi	22	100	30	19	78	78	23	120	79
Kogi State Univ., Anyigba	12	100	30	10	78	78	23	111	73
Niger State Univ., Minna	8	100	30	7	78	78	24	109	73
TOTAL	238	600	180	203	480	80	144	827	81

Source: Field Survey, 2026

Research Question 1: Current Level of AI/ML Awareness and Adoption**Table 5: AI and ML Applications Currently Implemented in University Libraries in North Central Nigeria.**

AI/ML Application	Uniagric Makurdi	FUT Minna	Unilorin	NSU Keffi	KSU Anyigba	Niger State Univ.
AI-enhanced OPAC/Discovery system	√	√	√	-	-	-
Semantic/Natural language processing search	-	√	√	-	-	-
Chatbot/Virtual reference assistant	-	-	√	-	-	-
Automated cataloguing/metadata generation	-	√	-	-	-	-
Personalised recommendation system	-	-	-	-	-	-
Predictive analytics for collection management	-	-	-	-	-	-
Robotic process automation	-	-	-	-	-	-
AI-powered reference/research support	-	-	-	-	-	-

Source: Field Survey, 2026

Table 5 shows that all 6 university libraries in North Central Nigeria use AI/ML in the early stages. All 3 federal libraries have AI-integrated OPACs and discovery systems. The Federal University of Technology Minna and the University of Ilorin have search systems that use natural language processing. The only artifact that uses text and communication technology at Unilorin is a chatbot or virtual reference assistant. An automated cataloging system exists but is still in the research phase at FUT Minna. No other advanced systems for personalized recommendations, predictive management of library resources, or benefit and support systems for research are available. None of the three State Universities reported any type of AI system currently operational. This finding corroborates Ekwelem and Okafor (2019) in which the authors found that AI integrated systems in Nigerian university libraries were few and far between, mainly attributable to lack of resources and inadequate facilities.

Table 5b: Level of AI/ML Awareness Among Library Staff and Lecturers.

Awareness/Adoption Indicator	Staff VH Freq(%)	Staff H Freq(%)	Staff MH Freq(%)	Staff L Freq(%)	Lect. VH Freq(%)	Lect. H Freq(%)	Lect. MH Freq(%)	Lect. L Freq(%)
Awareness of AI/ML concepts	8(4)	43(21)	88(43)	64(32)	14(10)	36(25)	57(40)	37(26)
Understanding of AI library applications	4(2)	28(14)	72(35)	99(49)	8(6)	28(19)	62(43)	46(32)
Actual use of any AI tool in library work	2(1)	18(9)	42(21)	141(69)	5(3)	16(11)	38(26)	85(59)
Institutional readiness for AI adoption	0(0)	12(6)	45(22)	146(72)	0(0)	10(7)	40(28)	94(65)

Source: Field Survey, 2026 Key: VH=Very High, H=High, MH=Moderately High, L=Low
Library Staff n=203; Lecturers n=144

Table 5b notes that 43% of library staff consider their AI conceptual awareness to be moderate. However, among responding library staff, only 31% have used AI tools in their library work, and only 28% perceive their libraries to be prepared for AI adoption. Lecturers also predominantly reported low AI tool implementation (59% reported low) and low institutional readiness (65% reported low). This supports the finding that staff have a strong conceptual awareness of AI, but its operational usage is lagging, consistent with the studies of emerging technology in Nigerian academic libraries by Oyewole and Alegbeleye (2020).

Research Question 2: AI/ML Applications in Library Services

Table 6: Extent of Implementation of AI/ML Applications in Library Services. (Library Staff Respondents, n=203)

AI/ML Service Application	VH Freq(%)	H Freq(%)	MH Freq(%)	L Freq(%)	NR Freq(%)
AI-powered catalogue and resource discovery	4(2)	38(19)	72(35)	82(40)	7(3)
Chatbot-based reference and user support	2(1)	8(4)	20(10)	165(81)	8(4)
Automated metadata and cataloguing	2(1)	10(5)	28(14)	155(76)	8(4)
Personalised resource recommendation	0(0)	4(2)	12(6)	178(88)	9(4)
AI analytics for collection management	0(0)	4(2)	10(5)	180(89)	9(4)
Intelligent user behaviour analytics	0(0)	3(1)	8(4)	183(90)	9(4)
AI-assisted acquisition and deselection	0(0)	2(1)	6(3)	186(92)	9(4)

Source: Field Survey, 2026 Key: VH=Very High, H=High, MH=Moderately High, L=Low, NR=No Response

Table 6 illustrates that the creation of catalogs and discovery systems was the most advanced use case for AI in libraries. Twenty-one percent of library staff rated that use case in the high

or very high category, indicating that improved OPAC systems were at a relatively early stage of implementation in federal universities. In contrast, all staff surveyed regarded the other use cases of AI in libraries as predominantly low, including 81% regarding chatbot-based services, 76% regarding automated cataloging, 88% regarding personalized recommendations, 89% regarding analytics for collection management, 90% regarding analytics for user behavior, and 92% regarding AI for intelligent acquisitions. This result supports the assumption that in North Central Nigeria, the use cases for AI in libraries are at the beginner level, with no advanced use cases for AI present. This supports Breeding (2021) who indicated that intelligent discovery was the most popular use case of AI in libraries globally.

Research Question 3: Impact on User Experience and Satisfaction

Table 7: Impact of AI/ML Technologies on User Experience and Satisfaction (Student and Lecturer Respondents)

User Experience Indicator	Stud. VH Freq(%)	Stud. H Freq(%)	Stud. MH Freq(%)	Stud. L Freq(%)	Lect. VH Freq(%)	Lect. H Freq(%)	Lect. MH Freq(%)	Lect. L Freq(%)
Quality of library resource search/discovery	24(5)	115(24)	218(45)	123(26)	12(8)	48(33)	52(36)	32(22)
Ease of accessing library services and resources	19(4)	106(22)	216(45)	139(29)	10(7)	45(31)	55(38)	34(24)
Availability of personalised recommendations	5(1)	22(5)	68(14)	385(80)	2(1)	8(6)	28(19)	106(74)
Quality of virtual/online reference support	5(1)	28(6)	95(20)	352(73)	3(2)	12(8)	42(29)	87(60)
Overall satisfaction with library technology services	22(5)	120(25)	228(48)	110(23)	14(10)	52(36)	50(35)	28(19)

Source: Field Survey, 2026 Key: VH=Very High, H=High, MH=Moderately High, L=Low
Students n=480; Lecturers n=144

Table 7 shows that most students and lecturers at all six universities have a moderate level of satisfaction regarding library technology services. Only 30% of students and 46% of lecturers rated overall satisfaction as high or very high. The particularly positive ratings for resource discovery and accessibility show an advantage of improved federated search systems at the

three federal universities, where AI-like discovery features are provided. Moreover, personalised recommendations and virtual reference services were rated overall low with 80% and 73% of students respectively, reflecting the near absence of these AI functions at the studied libraries. Expectations of lecturers were largely higher than that of students and may be attributed to greater expertise of and purposeful interactions with library systems. This strain of the findings was attributed to the work of Popoola (2021), who found that recommendation systems, when tailored, greatly enhance user satisfaction and engagement.

Research Question 4: Effects on Operational Efficiency

Table 8: Effects of AI/ML Technologies on Operational Efficiency and Library Staff Productivity. (Library Staff Respondents, n=203)

Operational Efficiency Indicator	VH Freq(%)	H Freq(%)	MH Freq(%)	L Freq(%)	NR Freq(%)
Reduction in routine cataloguing workload	2(1)	18(9)	45(22)	128(63)	10(5)
Improvement in reference service response time	3(1)	22(11)	55(27)	115(57)	8(4)
Enhancement of data-driven collection decisions	2(1)	10(5)	28(14)	154(76)	9(4)
Improvement in staff time allocation and productivity	2(1)	15(7)	48(24)	130(64)	8(4)
Automation of repetitive administrative tasks	0(0)	8(4)	22(11)	165(81)	8(4)
Improvement in reporting and library analytics	0(0)	6(3)	18(9)	170(84)	9(4)

Source: Field Survey, 2026 Key: VH=Very High, H=High, MH=Moderately High, L=Low, NR=No Response

According to Table 8, the impact of AI and ML technologies on operational efficiencies of the sampled libraries has been negligible. A clear preference for lower ratings on operational efficiencies was demonstrated by most library staff. Sixty-three percent, fifty-seven percent, seventy-six percent, and eighty-one percent respectively, rated the reduction of cataloging workload, improvement of the reference services, improvement of data-driven collection decisions, and automation of administrative tasks as low. The highest positive ratings were recorded for improvement of the reference services (thirty-eight percent rated moderately and higher), indicating that members of staff assumed that the enhanced OPACs at the three federal universities have reduced the number of routine searches directed to the reference services. The lowest positive ratings (eighty-four percent) were based on the absence of AI-powered analytics. The result mirrors the finding by Burton, Howard and Oname (2022) that

unless there are large implementations of AI, there are no experiences of operational AI benefits.

Research Question 5: Challenges and Success Factors for AI/ML Implementation

Table 9: Challenges to AI/ML Implementation in University Libraries.

Challenge	Library Staff Freq (n=203)	%	Lecturers Freq (n=144)	%	Students Freq (n=480)	%
Inadequate infrastructure/hardware ICT	203	100	144	100	480	100
Unreliable power supply	203	100	144	100	480	100
Poor internet connectivity and bandwidth	199	98	141	98	470	98
Insufficient funding for AI tools and systems	203	100	138	96	420	88
Shortage of AI-skilled library personnel	196	97	130	90	345	72
Absence of institutional AI policy/strategy	193	95	128	89	312	65
Lack of vendor support and local AI expertise	188	93	115	80	290	60
Data privacy and security concerns	142	70	108	75	240	50
Staff resistance to technology change	128	63	88	61	205	43
Concerns about algorithmic bias and fairness	87	43	78	54	165	34

Source: Field Survey, 2026

Table 9 captures general level implementation challenges for the three stakeholder groups. The six institutions lack the digital foundation for the use of AI, according to the library staff. In addition, library staff noted inadequate ICT as well as poor electricity and Internet as a challenge to the adoption of AI. This was noted by 100% of library staff and 96% of lecturers. The absence of AI-skilled staff was noted by 97% of library staff, indicating the inability of staff to adopt AI, as noted by Hussain and Naeem (2023). The lack of AI policy was noted by 95% of library staff and 89% of lecturers, as was the absence of AI governance. Concern for data privacy was noted by 70% of library staff and 75% of lecturers, indicating ethical AI concerns, as noted by Whittaker et al. (2019). Staff resistance to change was noted by 63% of library staff, confirming cultural and attitude barriers to adoption and compounding existing structural challenges.

Summary of Findings

Below are the key findings of this study:

1. University libraries in the North Central region of Nigeria are at the initial exploratory phase of AI and ML. The only advanced system level implementation of AI and ML in this region is the use of AI in OPAC (Online Public Access Catalog) systems in the three federal universities. Beyond the federal universities, state university libraries do not have any advanced systems, such as chatbots, recommendation systems, predictive analytics, automated cataloging, or AI-based reference services.
2. AI and ML awareness amongst library professionals was low to moderate. Operational use of AI and library toolkits was practically non-existent. Low adoption was indicated in the low AI readiness score of 72% of staff and 65% of academics, illustrating a vast disparity between perception and actual implementation.
3. Satisfaction with library technology services was moderately high, with a higher satisfaction score in the federal universities where AI-based systems for discovery and search were implemented. Personalized recommendations and virtual reference services were some of the lowest rated services.
4. There was a minimal impact of AI and ML on efficiency for all the libraries studied. Most of the library staff rated the impact on efficiency as low. The limited use of AI tools directly impacted the extent of efficiency in library operations, confirming that substantial and continued implementation is needed to positively impact operational efficiency.
5. The primary obstruction to the adoption of AI was the combination of inadequate ICT infrastructure, insufficient power, poor internet, low funding, inadequate personnel, absence of institutional policies, lack of local vendors, focus on privacy, and bias of algorithms.

CONCLUSION

University libraries in North Central Nigeria are at the beginning stage of integrating AI. Research has shown that libraries in North Central Nigeria have a growing gap between transformative AI capabilities shown in global literature on libraries, and the current state of North Central Nigeria libraries. Although some library professionals have begun to develop an understanding of AI, barriers like structure, funds, and people, block meaningful AI implementation. The Technology Acceptance Model confirmed that both perceived usefulness and perceived ease of integration are limited and that the lack of real AI tools has impeded the formation of positive attitudes towards adoption.

Breaking this cycle requires multiple interventions aimed at developing the necessary resources, people, policies and partnerships. These interventions would move the awareness-to-adoption gap for AI in North Central Nigerian university libraries. In the absence of these interventions, the awareness-to-adoption gap for AI in North Central Nigerian university libraries will continue to widen as AI is further adopted worldwide. Based on the results of the current study, we can say that investing in AI has great potential for improving the quality of education, research, and enhancing competitiveness at Nigerian universities.

RECOMMENDATIONS

1. University management and library administrators must create measurable strategies to incorporate artificial intelligence (AI) in library services. Strategies must include data governance, algorithms, explanations of ethical AI, and the allocation of resources for planned implementation of AI.
2. TETFund and other national funding bodies should create a dedicated grant window for the development of AI infrastructure in university libraries, including the provision of reliable internet connection, modern computing hardware, and server infrastructure and software.
3. Library administrators can begin AI competency programs for library staff with training for AI literacy. This should be followed by more advanced online and vendor specific training for deploying, managing, and developing staff and user training and education regarding AI tools.
4. University libraries should collaborate with other libraries to reduce the price of AI software licensing and implementation. To this end, library administrators should reach out to the large technology companies (Microsoft, Google, and IBM) for the CSR pricing of AI tools for libraries.
5. Library administrators should plan for the use of AI within their libraries in planned steps, beginning with enhanced AI systems to improve discovery and search functions, and building toward more complicated AI systems such as chatbots and recommendation systems when budget availability allows.
6. All six sampled libraries should engage with the ethical implications of AI use. This should include the development of data privacy and consent policies in addition to frameworks for transparency with regard to algorithms prior to the deployment of AI systems designed for the collection of user data.

Contributions to Knowledge

- This is the first empirical study on the AI and ML adoption at six universities in North Central Nigeria as reported across their libraries. This provides a baseline that aids in measuring and benchmarking further adoption in the region.
- This study understands the AI adoption context in Nigerian university libraries within the Technology Acceptance Model. This model is intended to serve resource poor developing countries and therefore contributes another dimension to African academic libraries AI acceptance theory.
- This study captures the multistakeholder dimension of challenges pertaining to AI adoption in North Central Nigerian university libraries, pivoting the perspectives of library staff, lecturers, and students. A multistakeholder approach is able to elaborate on and provide more complexity to the challenges faced.
- This study begins to capture the user emotions and assessment of satisfaction with and without AI tools, offering a first step toward understanding the impact of AI on the library within the context of emerging and advanced technologies in Nigeria.
- The study presents a contextual and phased implementation approach in conjunction with collaborative purchasing and policy formulation to realize AI adoption within the bounds of practicality within the resource constraints of university libraries in Nigeria.

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