Received: 23.07.2026| Accepted: 30.09.2026 |Published: 09.10.2026
Citation: USORO, B.N, .AKOR, P.U., & BENSON, J.A. (2026) Evaluative Study of Digital Technologies and Artificial Intelligence in University Libraries in Nigeria. Gaijlis vol.3.1. Pp.81-98 https://globreshub.org/index.php/gaijlis/article
DOI: https://doi.org/10.5281/zenodo.23594369

EVALUATIVE STUDY OF DIGITAL TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE IN UNIVERSITY LIBRARIES IN NIGERIA

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Abstract
University libraries are increasingly expected to adopt advanced digital technologies to improve information access, service delivery, and user engagement. However, the extent to which these technologies are adopted and utilized in Nigerian university libraries remains unclear. This study investigated the level of adoption, perceived use, influence on users' patronage, and challenges associated with digital technologies in Nigerian university libraries. A cross-sectional survey design was employed. Data were collected from 854 undergraduate students and electronic librarians across four Nigerian universities using a structured questionnaire. Descriptive statistics and simple linear regression were used for data analysis. Findings revealed that commonly adopted and used technologies included artificial intelligence search tools, mobile technologies, e-learning applications, online databases, and social media platforms, while advanced technologies such as robotics, RFID, and big data systems were minimally adopted. Digital technologies enhanced user engagement, learning experiences, remote access to librarians, and resource sharing; however, the level of adoption did not significantly predict users' patronage. Major challenges identified were inadequate funding, limited infrastructure, lack of skilled personnel, irregular staff training, behavioral resistance, and fear of job displacement. The study concludes that Nigerian university libraries are experiencing gradual digital transformation but remain constrained by financial, infrastructural, and human capacity challenges.

Keywords: Digital technologies, artificial intelligence, university libraries, technology adoption, Nigeria

Introduction
Libraries exist in order to provide various information for users with a view of satisfying their information needs. The university libraries are expected to provide timely access to relevant information in order to meet the needs of the users.

In contemporary society, advanced digital technologies constitute powerful forces reshaping various fields, education being a foremost domain of transformation. Within Nigerian universities, the library remains a crucial academic resource center, traditionally serving as a repository of

knowledge and a hub for research support. However, the rapid evolution of digital technologies presents new opportunities to enhance the functionality, reach, and effectiveness of university libraries far beyond their conventional roles. University libraries, central to academic institutions, are pivotal in this digital shift. In Nigeria, as in other parts of the world, there is a growing movement towards integrating advanced digital technologies and especially Artificial Intelligence to enhance library services. The adoption of advanced digital technologies in Nigerian university libraries has transform traditional library services by improving information access, streamlining operations, and enhancing user experiences. Also provides solutions to assist in cataloging, indexing, reference services, information retrieval, and personalized interactions, making library services more efficient, accurate, and user-friendly.

Digital technologies according to Nwakunor (2021) are the computer controlled robots that think intelligently like human beings. These robots are controlled electronically with the aid of the computer by mimicking the competences of the human mind. Artificial Intelligence keeps records and analyses every action being made by the user.

Advanced digital technologies are a suitable attempt to replace human power with the machine. The adoption of digital technologies in the library will influence connectivity of information technology and actively support information usage as well as easing clients' search and immediately address their needs. The impact of artificial intelligence and advanced computer technology on the nature of future libraries will be enormous and the quality difference varies from experts (Vijayakumar & Sheshadri, 2019).

In Nigeria, the academic librarians have seen advanced digital technologies as a new driving force for the development of intelligent library. In order to meet up with the current global trends in librarianship, Librarians have begun to incorporate Advanced Digital Technologies in the library system so as to meet up with the current trends in the country.

Moreover, Kristin (2016) reveals that AI applications give libraries the opportunity to change the emphasis and attention. The way we navigate the information is kept altering. Digital technology gives a very useful shortcut to apply this knowledge and produce better outcomes. Libraries are positioning themselves to take advantage of the application of cognitive computing in general and artificial intelligence in particular for their potential utility as a tool for refining the quality of library services.

However, evidence suggests that Nigerian academic libraries exhibit low levels of preparedness and adoption of these technologies, primarily due to infrastructural gaps, inadequate funding, and the absence of enabling policies (Abayomi et al., 2021; Owolabli et al., 2022).

Therefore, for effective library services and use of libraries to be achieved and facilitated there is need for the provision and installation of advanced digital technologies facilities in Nigerian university libraries. This would in no small measure enhance students' academic pursuits and faculty member scholarly activities. These digital technologies are trending in various industries and the library, especially university libraries should take advantage of these opportunities to improve on their services, these among others attribute no doubt make them determinants of use of library. In view of the forgoing research, this study seeks to evaluate the adoption and usage of advanced digital technologies in Nigerian university libraries.

Statement of the problem

Globally, libraries have adopted the use of these technologies in order to serve their clients better. Given the global context, AI and digital technologies have been deployed to handle repetitive and labour-intensive tasks such as shelving, circulation, inventory management, and user assistance, thereby improving service efficiency and enabling librarians to focus on higher-level

professional roles (Bangani, 2025; Subaveerapandiyan et al., 2023; Yoon et al., 2022).

In most Nigerian universities, literature has shown that digital technologies are not provided in their libraries, and the key problems among them are inadequate infrastructural facilities, limited funding, lack of skilled technical personnel, and weak policy support (Ajani et al., 2024; Owolabi et al., 2022). Librarians often lack the required training to operate or maintain AI technologies, while financial constraints limit the procurement and deployment of such advanced technologies. In addition, the absence of enabling policies and organizational support further exacerbates resistance to change, leaving Nigerian libraries lagging behind their global counterparts (Akullo and Nsibirwa, 2023; Rahman et al., 2025). The integration of emerging technologies is noticeably absent in university libraries, despite their emphasis on technology-enhanced learning and research.

In addition, personal observation of the researchers also indicated that there is a low level of adoption and use of these advanced technologies in Nigerian university libraries. This development further necessitated the need to investigate the level of adoption in the universities under study. Therefore the study seeks to evaluate the adoption of advanced digital technologies in Nigerian university libraries. This is the gap in which this present research intends to bridge. Without understanding these conditions, efforts to modernize library services and align them with the innovative goals of the universities may remain unachieved.

Research Objectives

Specifically the study was design to:

1. determine the level of adoption of digital technologies in university libraries in Nigeria.
2. ascertain the perceived use of digital technologies in university libraries in Nigeria.
3. determine the influence of digital technologies on users' patronage in Nigerian university libraries.
4. examine the challenges associated with the adoption of digital technologies in university libraries in Nigeria.

Hypothesis

H1: The level of adoption of digital technologies does not significantly predict users' patronage in Nigerian university libraries; the hypothesis was tested at the 0.05 level of significance.

Literature Review

Level of adoption of digital technologies in libraries

Studies have indicated varying levels of adoption of advanced digital technologies in educational institutions, especially in the context of library service delivery. In a particular study, Serholt et at. (2018) investigated the adoption of technology development in public libraries and found that the design and implementation of new digital services in public libraries are growing in two folds. This implies that design and implementation of emerging technologies in the context of public librarianship are perceived to be growing at different levels. Shahzad and Khan (2023) also reviewed that there is a level of adoption of integrated semantic technologies in the digital libraries. The author further revealed that semantic digital technologies are highly significant as they offered context-based information resources.

In India, the adoption of digital technologies in libraries according to Meena (2024), reveal a substantial increase in government funding, driving a 40% rise in digitization projects across universities. Notable success stories include Radio Frequency Identification (RFID) implementations, yielding efficiency gains and reduced book losses. Agbetuyi and Olorunyomi (2024) found out that the adoption of digital technologies in the university libraries has

upgraded their information services by leveraging massive technological advancements of the present technology-driven age for sustainable development. The Author further confirmed that the adoption of these technologies improve sustainable development in an evolving technological age in Nigeria. He also revealed that digital technologies provided platforms for informed citizens, and limitless access to relevant information resources and services. In addition, for effective utilization of these technologies, the management of must support the adoption of digital technologies through provision of technological tools and training of librarians on core competencies and academic librarians must be open to innovation and changes. Anna and Mannan (2020) revealed that the adoption of advance technologies such as Big Data in the libraries is still in its early stage. The author also shown that limited numbers of practical implementation of big data analysis in libraries do not support innovation and services due to lack of librarian skills in big data analytic. This further creates many gaps that need to be researched on. Similarly, Owolabli et al. (2022) found out that librarians' readiness to adopt digital technologies was "nothing to write home about," with most institutions lacking concrete plans to adopt digital technologies. The institutions appear to lack specific, measurable implementation plans for the adoption of digital technologies, which could hinder the systematic incorporation of these tools into routine library operation. However, evidence suggests that Nigerian academic libraries exhibit low levels of preparedness and adoption of these technologies, primarily due to infrastructural gaps, inadequate funding, and the absence of enabling policies (Abayomi et al., 2021; Owolabli et al., 2022). In addition, personal observation of the researchers also indicated that there is a low level of adoption and use of these advanced technologies in Nigerian university libraries. This development further necessitated the need to investigate the level of adoption in the researchers' institution. Therefore, the study seeks to evaluate the study of digital technologies in Nigerian university libraries, thereby bridging the existing gap.

Use of digital technologies in libraries

Advanced digital technologies are already recognized as an important trend in the university libraries which create an important impact on information service delivery. Therefore, libraries are positioning themselves to take advantage of the application of cognitive computing in general and artificial intelligence in particular for their potential utility as a tool for refining the quality of library services. Agbetuyi and Olorunyomi (2024) acknowledge the use of digital technologies by libraries for essential growth in an evolving technological era. The authors further found that mobile technology-based services, institutional repositories, web Opac, QR codes were highly used in the university libraries. Isiaka et al. (2024) noted the integration and the usage of artificial intelligence technology in the libraries such as Robots, chatbots, face recognition technology, virtual references among others has immensely elevated the image of their operations and services to users. In addition, artificial intelligence technologies in the libraries provide efficiency in library operation such as reference services, cataloguing and classification of library materials, AI drone surveillance for security, AI expert search tools for information search and also for automation of library routine. Fernandez (2016) identifies potential impacts in terms of analyzing big corpuses of data, creating metadata, translation of search and integrating search across content. Completely new ways of interacting with information, e.g. location-based search will also be part of the picture, he suggests. The 2017 NMC library trend report sees the time to adoption horizon for AI as four to five years (Adams Becker et al., 2017). Yet in recognizing AI as an umbrella term, some aspects of AI have already touched academic libraries in addition to the impact on search and discovery, two stand out,

namely chatbots and Text and Data Mining. Chathots (also known as digital assistants, virtual agents or intelligent agents) are computer programs that can simulate an intelligent conversation, through text, speech or potentially through an embodied representation. Raza et at. (2019) indicated that the development of linked-data technologies and the Semantic Web has reshaped the conventional functions of libraries. While traditional libraries are transitioning into digital libraries and digital libraries are in a struggle to publish their resources on the Web using XML-based metadata standards. It has made capable the digital collections to be viewed by machines on the Web just like human. On the emergence of linked data applications in digital libraries, Web visibility of the libraries has been enhanced to provide the opportunities for the users to find their required quality information of libraries round-the-clock on the Web. National Library of France, National Library of Spain, European, Digital Public Library of Americana, Library of Congress and The British Library have taken the initiatives to publish their resources on the Web using linked data technologies. The study could also help facilitate Web users who are eager to access high-quality, authentic library resources online round the clock. Additionally, it would support search engines in finally tapping into the libraries' rich, reliable content, thereby enhancing the credibility and trustworthiness of their Web presence for users.

In Greece, Adamou and Ntoka (2017) observed that digital technologies have created an impact on both the librarians and the users' of academic libraries. The author further examines the experiences, benefits,. However, it was also noticed that librarians were less satisfied with the digital library system, the limited personnel, and the financial and challenges of both library users and librarians regarding the implementation of digital technologies in academic libraries. Additionally, it was indicated that the general perception of both library users and librarians towards digital material and E-resources and services of the institutions were satisfactory. Users were satisfied with the convenience of digital material, the availability of E-resources provided by both academic libraries such as World Wide Web, WIFI, and online databasesfunds for academic libraries in general. Uzoigwe and Eze (2018) perceived that librarians and library users made use of information communication technologies ICT facilities for different reference purposes especially to obtain information they need using the internet. The review found that other reference needs for which patrons used the ICT facilities included: - access to current e-books and e-journals, user education and access to global information in other libraries. Further findings showed that the librarians and library users derive a lot of benefits from their use of ICT facilities in reference services. The author further indicated that easy retrieval and dissemination of information to patrons were ranked highest by the librarians amongst others.

Influence of digital technologies on users' patronage in libraries

Michael and Olayemi (2023) investigated the influence of librarians' attitudes on users' patronage in private university libraries in Lagos State. The author also found that the librarians' attitudes significantly influenced library patronage of undergraduates in the university. Okon et al. (2024) examined the influence of information technology on users' patronage of polytechnic libraries in south-south Nigeria. The author further revealed that, the variables examined significant influence on users' patronage of polytechnic libraries in south-south Nigeria. The study therefore concluded that there is significant influence of information technology on users' patronage of polytechnic libraries in south south Nigeria. Similarly, Malik et at. (2024) investigated that library image, users' trust; library service effect and personal control significantly influence user satisfaction. However, Oviri and Adesina (2025) found that library resources such as books,

journals, and card catalogs were somewhat accessible, whereas encyclopedias and indexes were relatively hard to access, leading to moderate patronage focused on assignments and digital resources over print materials. Odunola and Tella (2019) reviewed the influence of information technology skills on library patronage by undergraduate students in south west Nigerian university. The study revealed that information technology skills had influence on library patronage by undergraduate student in the university.

Challenges associated with the adoption of digital technologies in libraries

Multiple studies identified significant challenges hindering the adoption of digital technologies in libraries. Shahzad and Khan (2023) identifies factors affecting the adoption of integrated semantic digital libraries to include, ontologies and interoperability, development of a suitable model, diversity in language, lack of skilled human resources, and other technical issues. Rahman et al. 2025 identified organizational conditions such as leadership advocacy, alignment of initiatives with institutional goals, and support structures as key facilitators of adoption. Similarly, Rahman et al., 2025 also found that social conditions such as peer influence, organizational norms, and cultural contexts shaped adoption attitudes in Bangladesh. Furthermore, Rahman et al. (2024) extended this by revealing that personal factors including confidence in technology (self-efficacy) and willingness to adapt, also facilitated adoption, even though fears of job loss persisted. The author further explores the impact of personal resistance to technology adoption in university libraries in Bangladesh, particularly among library and information science professionals. Similarly, Shahzad et al. (2024b) documented barriers such as financial hurdles, shortage of skilled man power, ethical concerns, fear of job loss, technical issues, and lack of organizational planning. Also, Awais and Ameen (2021), through interviews with Pakistani academic library leaders, identified barriers including behavioral resistance, lack of training, insufficient funding, and weak leadership as major impediments to the adoption of advanced digital technologies. Enweani (2018) also revealed that new skills, cost/funding, managing of new generation of learners, lack of skilled manpower, lack of confidence in the face of increasingly information technology, lack of maintenance culture, resistances to changes etc. to be challenges managing university libraries in digital era. In addition, the researchers' observed that insufficient funding, limited infrastructure, inadequate staff training, accessibility issues are major challenges that hinder the adoption of advanced digital technologies in the researchers' institutions.

Research Gap

Existing scholars has highlighted that adoption of digital technologies possess potential impact in transforming library operations through automation, efficiency, and enhanced user engagement. While global research on digital technologies in libraries is increasing, there is a notable lack of studies focusing particularly in Nigerian university libraries. Existing research on evaluating study on digital technologies in Nigerian university libraries has mainly addressed with little or no empirical attention given to university libraries. Even fewer studies have attempted to systematically investigate the facilitating conditions that are critical for adoption.

However, no study has explicitly examined these issues within the unique context of the researchers' universities, where one would expect the emerging and adoption of advanced technologies to be actively embraced. This gap shows that while the potential of advanced technologies in libraries is recognized globally, there's a limited understanding of how contextual conditions in Nigerian research universities specifically affect their adoption, either enabling or constraining it. To bridge this gap, this study provides new empirical insights and a framework to guide policy,

investment, and capacity-building efforts toward integrating advanced digital technologies into university libraries in developing contexts.

Methodology

This study adopted cross-sectional research design. The cross-sectional design was justified used for this study because it allows data to be collected from respondents at a single point in time, thereby providing a snapshot of perceptions, attitudes, and conditions related to the adoption of advanced technologies in university libraries in Nigeria. This design is particularly suitable for studies involving large populations spread across different locations, as it enables the researchers to capture variations across diverse institutions without the need for longitudinal tracking (Creswell et al., 2016; Cummings, 2018). In addition, the kind of research design enables the collection of quantitative data from respondents to make general and valid inferences.

The population of the study comprised 1117 undergraduate students, and 4 electronic librarians from conveniently selected universities in Nigeria, totaling 1121. These include Federal University of Technology Ikot Abasi, University of Uyo, University of Nigeria Nsuka, University of Abuja (Table 1). These universities were conveniently selected as a result of the researchers' access and reach to the universities. Based on this, a convenience sampling technique was used for this study. This implies that only respondents who made themselves available during the survey were eligible to participate in the study.

Table 1: Population of the Study

S/n	Institution	Students	E-librarians	Total
1.	Federal University of Technology Ikot Abasi	97	1	98
2.	University of Abuja	379	1	380
3.	University of Nigeria Nsuka	534	1	535
4.	University of Uyo	107	1	108
	Total	1117	4	1121

In addition, structured questionnaire was used for data collection. The questionnaire comprised of two sections. Section A contained the demographic information of respondents while Section B consisted of items answering Research Questions 1, 2, 3, and 4. A five (5) Likert Scale was used for the design of the research questions 1 to 4, ranging from Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). The questionnaire was validated by two experts in the field of library and information science. They provided comments and inputs which strengthened the structure and design of the questionnaire. A pre-test was conducted on 15 undergraduate students and 2 electronic librarians at two universities outside the study area. Cronbach Alpha co-efficient was used to ascertain the reliability level of the pre-test investigation. At the end of the investigation, an overall index value of 0.86 was determined, which indicated that the instrument was reliable.

The researchers administered the questionnaire in person to the respondents under study. The survey started between 19th January and 18th February, 2026 which lasted for 3 weeks. At the end of the survey, 927 responded and completed the questionnaire items. Furthermore, descriptive and inferential statistics were used for data analysis. Descriptive statistics such as frequency, percentage counts, mean and standard deviation were used to answer the research questions; while a simple linear regression analysis was used to test the hypothesis at a 0.05 level of significance.

The study strictly complied with ethical standards throughout the investigation. Respondents were duly briefly of the objectives of the study and their right to participate. As a result, informed consent was obtained from the respondents, and they were assured of the confidentiality of responses during the survey as these validate global ethical practices for social science research.

Results

This section covers the results from the data collected. Tables 2 to 5 comprised data generated from the research questions while Tables 6 and 7 indicated the hypothesis. Out of 927 administered questionnaires, only 854 were successfully completed, representing 92.1% return rate.

Table 2: Level of Adoption of Digital Technologies in University Libraries in Nigeria

S/N	Item	SA	A	U	D	SD	N	Mean (x̄)	Std. Dev.	Decision
1	Artificial Intelligence	278	291	90	188	7	854	3.76	1.15	Accept
2	Radio Frequency Identification (RFID)	159	199	77	243	176	854	2.91	1.44	Reject
3	Robotics Technology	177	152	72	273	180	854	2.85	1.47	Reject
4	Big Data	161	183	61	259	190	854	2.84	1.46	Reject
5	Mobile Technologies	245	311	28	180	90	854	3.52	1.37	Accept
6	Chatbots	196	208	63	201	186	854	3.03	1.51	Accept
7	Barcode / QR Codes	201	219	79	197	158	854	3.13	1.47	Accept
8	Virtual Reality	217	291	35	144	167	854	3.29	1.49	Accept
9	Augmented Reality	185	259	69	180	161	854	3.15	1.45	Accept
10	Social Media Technology	237	299	35	173	110	854	3.44	1.41	Accept
11	E-learning Applications	251	310	18	156	119	854	3.49	1.43	Accept

Keys: Strongly Agree = SA, Agree = A, U = Undecided, D=Disagree, SD= Strongly Disagree, N=sampled population, x̄ = Mean, SD = Standard Deviation

Table 2 presents the mean scores for the level of adoption of selected digital technologies in Nigerian university libraries. The findings show that artificial intelligence recorded the highest mean score (x̄ = 3.76), indicating a relatively high level of adoption among the libraries studied. Mobile technologies (x̄ = 3.52), e-learning applications (x̄ = 3.49), and social media technologies (x̄ = 3.44) also recorded high mean values, suggesting that these technologies are commonly adopted to support library services. Virtual reality (x̄ = 3.29), augmented reality (x̄ = 3.15), barcode/QR code systems (x̄ = 3.13), and chatbots (x̄ = 3.03) showed moderate levels of adoption. In contrast, RFID (x̄ = 2.91), robotics technology (x̄ = 2.85), and big data technologies (x̄ = 2.84) recorded mean values below the benchmark, indicating relatively low levels of adoption. Generally, the results in Table 2 suggest uneven adoption of digital technologies, with greater emphasis on more established and user-facing technologies.

Table 3: Perceived Use of Digital Technologies in University Libraries in Nigeria

S/N	Item	SA	A	U	D	SD	N	Mean (x̄)	**Std. Dev.**	Decision
1	AI expert search tools for information search	326	231	74	112	111	854	3.64	1.43	Accept
2	AI drone surveillance for security	121	98	112	336	187	854	2.57	1.33	Reject
3	Face recognition technology	96	87	189	228	254	854	2.46	1.31	Reject
4	OPAC for information retrieval	221	196	210	104	123	854	3.35	1.29	Accept
5	QR codes for book security	156	121	115	285	177	854	2.73	1.36	Reject
6	Big data corpuses for creating metadata and translation	67	43	110	375	259	854	2.35	1.24	Reject
7	Chatbot for answering users' queries	128	72	71	231	352	854	2.48	1.42	Reject
8	Online databases provide access to all kinds of electronic resources	247	187	83	225	112	854	3.40	1.38	Accept

Keys: Strongly Agree = SA, Agree = A, U = Undecided, D=Disagree, SD= Strongly Disagree, N=sampled population, x̄ = Mean, SD = Standard Deviation

Table 3 shows the mean scores of respondents' perceptions regarding the use of digital technologies in Nigerian university libraries. The table indicates that AI expert search tools (x̄ = 3.64), online databases (x̄ = 3.40), and OPAC for information retrieval (x̄ = 3.35) recorded mean values above the criterion mean, implying that these technologies are actively used to facilitate information access and retrieval. Conversely, technologies such as AI drone surveillance for security (x̄ = 2.57), face recognition technology (x̄ = 2.46), QR codes for book security (x̄ = 2.73), chatbots for answering users' queries (x̄ = 2.48), and big data corpuses for metadata creation and translation (x̄ = 2.35) recorded lower mean values, indicating limited use in library operations. These findings suggest that university libraries prioritize conventional digital systems that directly support academic information services over more advanced or emerging technologies.

Table 4: Influence of Digital Technologies on Users' Patronage in Nigerian University Libraries

S/N	Item	SA	A	U	D	SD	N	Mean (x̄)	**Std. Dev.**	Decision
1	The availability of digital technologies makes me to visit the library every day	321	198	80	188	67	854	3.63	1.42	Accept

2	I visit the library to read and study because there are sufficient advanced technologies	124	148	83	225	274	854	2.54	1.38	Reject
3	The technologies in the library makes reading and learning interesting for me	300	241	60	113	140	854	3.59	1.36	Accept
4	Resource sharing is made easier through digital technologies	223	239	99	107	186	854	3.43	1.39	Accept
5	I communicate and contact the librarian when the need arises at the comfort of my home without having to visit the library.	317	235	79	116	107	854	3.63	1.41	Accept
6	There is adequate funding allocated for maintaining digital technologies in the library	268	299	58	120	109	854	3.58	1.39	Accept
7	Internet connectivity is provided to support advanced technology tools	219	301	81	147	106	854	3.44	1.36	Accept
8	The organizational culture of my library supports innovation and new technology adoption	277	291	57	131	98	854	3.61	1.37	Accept
9	There is effective collaboration with ICT departments and external experts to facilitate integration of advanced digital technologies in the library	293	255	59	138	109	854	3.57	1.42	Accept

Keys: Strongly Agree = SA, Agree = A, U = Undecided, D=Disagree, SD= Strongly Disagree, N=sampled population, $\bar{x}$ = Mean, SD = Standard Deviation

Table 4 presents the mean scores on the influence of digital technologies on users' patronage of Nigerian university libraries. The results reveal that most items recorded mean values above the benchmark, indicating a generally positive influence of digital technologies on library use. Notably, the availability of digital technologies encouraging daily library visits ($\bar{x}$ = 3.63), making reading and learning interesting ($\bar{x}$ = 3.59), facilitating remote communication with librarians ($\bar{x}$ = 3.63), supporting organizational culture for innovation ($\bar{x}$ = 3.61), and enabling collaboration with ICT experts ($\bar{x}$ = 3.57) were positively perceived. Internet connectivity ($\bar{x}$ = 3.44), resource sharing ($\bar{x}$ = 3.43), and adequate funding for technology maintenance ($\bar{x}$ = 3.58) also recorded high mean values. However, the item relating to visiting the library due to the presence of sufficient advanced technologies recorded a lower mean score ($\bar{x}$ = 2.54), suggesting that technology alone may not strongly motivate physical library visitation. Generally, Table 4 indicates that digital technologies enhance user engagement and service delivery, thereby supporting sustained patronage.

Table 5: Challenges Associated with the Adoption of Digital Technologies in University Libraries in Nigeria

S/N	Item	SA	A	U	D	SD	N	Mean (x̄)	**Std. Dev.**	Decision
1	Lack of skilled IT personnel	217	281	40	181	135	854	3.31	1.45	Accept
2	Inadequate funding	301	287	47	118	101	854	3.67	1.38	Accept
3	Fear of job loss or replacement	291	286	60	137	80	854	3.67	1.34	Accept
4	Limited digital infrastructure	274	284	80	103	113	854	3.59	1.39	Accept
5	Inaccessibility issues	283	254	67	144	106	854	3.54	1.41	Accept
6	Irregular staff training	312	277	57	121	87	854	3.71	1.35	Accept
7	Behavioural resistance by students or librarians	287	273	71	104	119	854	3.59	1.41	Accept
8	Institutional policies	189	213	90	177	185	854	3.05	1.49	Accept
9	Technical issues	124	209	67	245	209	854	2.76	1.43	Reject
10	Ethical concerns	181	177	77	279	140	854	2.98	1.43	Reject

Keys: Strongly Agree = SA, Agree = A, U = Undecided, D=Disagree, SD= Strongly Disagree, N=sampled population, x̄ = Mean, SD = Standard Deviation

Table 5 presents the mean scores of challenges associated with the adoption of digital technologies in Nigerian university libraries. The findings show that irregular staff training (x̄ = 3.71), inadequate funding (x̄ = 3.67), fear of job loss or replacement (x̄ = 3.67), limited digital infrastructure (x̄ = 3.59), and behavioural resistance by students or librarians (x̄ = 3.59) were perceived as major challenges. Inaccessibility issues (x̄ = 3.54) and lack of skilled IT personnel (x̄ = 3.31) also recorded relatively high mean values, indicating their significance as barriers to technology adoption. In contrast, institutional policies (x̄ = 3.05) recorded a marginal mean value, while technical issues (x̄ = 2.76) and ethical concerns (x̄ = 2.98) recorded lower mean scores, suggesting that they are perceived as less critical challenges. The results in Table 5 highlight that financial, infrastructural, and human capacity constraints constitute the major obstacles to effective digital technology adoption in Nigerian university libraries.

Hypothesis Testing

Table 6: Model Summary of the Regression Analysis Predicting Users' Patronage

Model	**R**	**R²**	**Adjusted R²**	**Std. Error of Estimate**	**F**	**Sig. (p)**
1	0.420	0.176	0.154	0.381	1.49	0.261

Table 7: Regression Coefficients for Level of Adoption of Digital Technologies and Users' Patronage

Model	**Predictor**	**Unstandardized B**	**Std. Error**	**Standardized β**	**t**	**Sig. (p)**
1	(Constant)	1.970	0.412		4.78	0.000

	Level of Adoption of Digital Technologies	0.467	0.381	0.420	1.22	0.261

Table 6 presents the model summary of the simple linear regression analysis examining whether the level of adoption of digital technologies predicts users' patronage of Nigerian university libraries. The results show a positive relationship between the variables (R = 0.420), with the level of adoption accounting for 17.6% of the variance in users' patronage (R^2 = 0.176). However, the regression model is not statistically significant at the 0.05 level (F = 1.49, p = 0.261), indicating that the model does not adequately explain users' patronage. Further, Table 7 shows the regression coefficients for the predictive relationship. The unstandardized coefficient for the level of adoption of digital technologies (B = 0.467) and the standardized coefficient (β = 0.420) indicate a positive influence on users' patronage. Nonetheless, this effect is not statistically significant (p = 0.261). Based on these results, the null hypothesis is not rejected, implying that the level of adoption of digital technologies does not significantly predict users' patronage of Nigerian university libraries.

Discussion

This study revealed that Nigerian university libraries have made notable progress in adopting mainstream and user-facing digital technologies, particularly artificial intelligence tools for information search, mobile technologies, e-learning applications, social media platforms, virtual and augmented reality tools, and barcode or QR code systems. These technologies appear to be more visible in everyday library operations, especially those directly supporting access, discovery, and communication. However, more advanced infrastructural technologies such as robotics, RFID systems, and big data applications remain minimally adopted. This pattern suggests that libraries prioritize technologies that are relatively affordable, user-oriented, and easier to integrate into existing systems while postponing capital-intensive and technically complex innovations. These findings align with Owolabi et al. (2022) and Abayomi et al. (2021), who reported low institutional readiness for advanced technologies in Nigerian academic libraries due to infrastructural and financial constraints. Similarly, Anna and Mannan (2020) found that sophisticated digital innovations such as big data analytics are still at experimental stages in libraries globally, largely because of skills gaps and resource limitations. In contrast, the present findings extend those of Agbetuyi and Olorunyomi (2024), who reported growing adoption of digital tools in Nigerian university libraries, by demonstrating that such adoption is uneven and skewed toward basic service-enhancing technologies rather than transformative infrastructural systems.

Regarding the perceived use of digital technologies, respondents indicated strong reliance on online databases, OPAC systems, and AI-driven expert search tools for information retrieval and academic work. These technologies are now central to students' learning experiences and librarians' service delivery roles. This finding corroborates Isiaka et al. (2024), who observed that AI-powered discovery tools,

institutional repositories, and electronic databases have significantly improved access to scholarly information in Nigerian academic libraries. It also supports Fernandez's (2016) argument that AI-driven information retrieval and metadata systems are among the earliest and most practical applications of artificial intelligence in library environments. However, advanced applications such as chatbot services, facial recognition systems, drone surveillance, and big data-driven metadata creation were perceived as minimally used. This result diverges from findings in technologically advanced contexts where chatbots and automated user services are becoming routine (Adams Becker et al., 2017; Yoon et al., 2022). The limited uptake of such tools in Nigerian libraries confirms earlier assertions by Owolabi et al. (2022) and Rahman et al. (2025) that infrastructural instability, limited staff capacity, and organizational readiness remain significant constraints in developing-country contexts.

The study further established that digital technologies positively influence users' patronage of university libraries, particularly by enhancing learning engagement, improving access to librarians remotely, facilitating resource sharing, and supporting innovation-friendly organizational cultures. Students reported that digital services make reading and learning more interesting and enable convenient communication with librarians without physical visits. These findings support those of Odunola and Tella (2019), who found that information technology skills and digital services significantly increase students' library use and engagement. Similarly, Okon et al. (2024) reported that information technologies positively influence patronage patterns in Nigerian polytechnic libraries by improving service accessibility and efficiency. The present findings also align with Malik et al. (2024), who argued that service quality and technological infrastructure strengthen users' satisfaction and loyalty to library services. However, despite the positive influence of digital technologies on engagement, the regression analysis revealed that the level of technology adoption did not significantly predict users' patronage. This suggests that while digital tools enhance the user experience, they are not the sole determinants of library usage, and factors such as academic culture, curriculum demands, staff support, and availability of relevant resources may play more decisive roles. This outcome diverges slightly from Michael and Olayemi (2023), who found that service-related variables strongly predicted patronage, but it reinforces Oviri and Adesina's (2025) conclusion that access to relevant information resources, rather than technology alone, remains a primary driver of library use.

In relation to challenges, the study identified inadequate funding, irregular staff training, fear of job loss, limited infrastructure, lack of skilled IT personnel, behavioral resistance, and accessibility issues as major obstacles to the adoption of digital technologies in university libraries. These challenges mirror those reported in earlier studies within Nigeria and other developing contexts. For instance, Owolabi et al. (2022) found that librarians' readiness to adopt robotics and advanced technologies was constrained by insufficient training and institutional support. Similarly, Enweani (2018) identified lack of technical competence, funding constraints, and resistance to change as major impediments to digital transformation in Nigerian university libraries. The finding that fear of job displacement constitutes a

significant barrier also supports Rahman et al. (2024), who reported that concerns about job security and professional relevance often generate resistance to emerging technologies among library professionals. Furthermore, Shahzad et al. (2024b) documented that infrastructural deficits and financial limitations remain persistent global barriers to the integration of robotics and AI in academic libraries, especially in resource-constrained environments.

Interestingly, institutional policies, ethical concerns, and technical issues were perceived as less critical barriers in this study. This finding contrasts with Rahman et al. (2025), who emphasized the centrality of organizational policy frameworks and governance structures in shaping adoption readiness. The difference may reflect contextual variations, as Nigerian university libraries may prioritize addressing funding, infrastructure, and human capacity issues before confronting ethical and policy-related complexities associated with advanced digital technologies. Nonetheless, the relatively low concern for ethical and technical issues may also indicate limited exposure to high-risk AI applications, thereby reducing awareness of associated governance challenges, as suggested by Yoon et al. (2022).

Finally, the findings indicate that Nigerian university libraries are experiencing a gradual but uneven transition toward digital transformation, characterized by stronger adoption and use of basic and service-oriented technologies and weaker engagement with advanced infrastructural and intelligent systems. This pattern largely supports the literature, which portrays technology adoption in developing contexts as incremental, constrained by resource limitations, skills gaps, and organizational readiness issues (Abayomi et al., 2021; Owolabi et al., 2022; Rahman et al., 2025). At the same time, the study extends existing knowledge by empirically demonstrating that although digital technologies enhance user engagement and service satisfaction, their adoption alone does not significantly predict patronage, suggesting the need for a more holistic approach to library service innovation that integrates technology with pedagogy, content relevance, staff competence, and institutional culture.

Conclusion and Recommendations

This study examined the adoption, use, influence, and challenges of digital technologies in Nigerian university libraries. The findings show that libraries have made progress in adopting widely used digital tools such as AI-based search systems, mobile technologies, e-learning platforms, and online databases, while advanced technologies such as robotics, RFID, and big data applications remain minimally adopted. Digital technologies were found to enhance user engagement, learning experiences, remote access to librarians, and service delivery, although their level of adoption did not significantly predict users' patronage. The study further identified inadequate funding, limited infrastructure, irregular staff training, lack of technical expertise, behavioral resistance, and fear of job displacement as major barriers to technology adoption. Based on this, the study concludes that Nigerian university libraries are experiencing gradual digital transformation but remain constrained by financial, infrastructural, and human capacity challenges. Addressing these constraints is essential for achieving sustainable and effective integration of advanced digital

technologies in academic library services.

Based on the findings of this study, the following recommendations are proposed:

1. University administrators should increase budgetary allocations to libraries specifically for digital infrastructure development, system upgrades, and emerging technology acquisition. Institutional leadership should also integrate library digital transformation into broader university ICT and innovation strategies, ensuring sustained financial commitment and policy support for long-term modernization efforts.
2. Library management should prioritize structured digital transformation plans that move beyond basic technologies toward advanced systems such as RFID, big data analytics, and intelligent automation tools. They should also foster innovation-friendly organizational cultures that encourage experimentation with emerging technologies while addressing staff concerns about job displacement through transparent communication and capacity-building initiatives.
3. Librarians should actively engage in continuous professional development to strengthen competencies in artificial intelligence, data analytics, digital service design, and emerging information technologies. They should also adopt proactive attitudes toward innovation by integrating available technologies into user education, reference services, and information literacy programs to maximize the impact of existing digital tools on service delivery.
4. Government agencies and regulatory bodies such as the National Universities Commission and Tertiary Education Trust Fund should establish targeted funding schemes and policy frameworks that prioritize digital library infrastructure development and staff capacity building. National policies should also encourage inter-university collaboration and shared digital platforms to reduce implementation costs and enhance technology diffusion across institutions.
5. Students and faculty members should be encouraged to actively utilize available digital library services and participate in feedback mechanisms that inform service improvement. Their engagement in digital literacy programs will further strengthen the effectiveness of technology-enhanced library services and support a culture of innovation within academic environments.

Limitations of the Study

This study has some limitations. First, the study was limited by its reliance on a cross-sectional survey design, which captured respondents' perceptions at a single point in time and did not allow for the examination of changes in digital technology adoption and use over time. The use of convenience sampling and the inclusion of only four universities restrict the generalizability of the findings to all Nigerian university libraries. In addition, the study relied on self-reported data from students and librarians, which may be subject to response bias and social desirability effects. The focus on quantitative methods also limited deeper exploration of contextual and institutional factors that influence technology adoption, implementation processes, and user experiences.

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