

Leveraging Innovative Technologies for Improved Library Practices in the Digital Era

The Nigerian Perspective

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ABSTRACT

Lack of expertise, among other reasons, has been cited as the reason for Nigerian libraries' sluggish adoption and application of innovative technology. To solve this problem, a thorough analysis of the level of technology implementation in Nigerian libraries is needed. This work closes the gap in the literature by using the PRISMA search method to examine 42 pertinent works published between 2016 and 2023. A questionnaire was used to collect data from 240 respondents using the survey approach. Six federal university libraries were selected by a stratified random sampling procedure, one from each of Nigeria's six geopolitical zones. Then, 40 library employees from each of the selected libraries were selected using a purposive sample technique. Mean and standard deviation were used to analyze the responses. The results demonstrate a grand mean of 2.44 (SD=1.15), indicating low staff awareness of the potential benefits of innovative technology for library operations. A negative grand mean of 2.42 on the degree of usage was also noted, indicating low use of cutting-edge technology in the research area. A lack of internet penetration, a deficiency of digital literacy, insufficient funds, and unstable power sources were among the problems found limiting Nigerian libraries from taking advantage of advanced technologies. In light of this, the study suggests that the Nigerian government should increase budget allocations for libraries and enhance policies that support the self-development of library staff. Additionally, libraries in developing countries should seek mentorship from those in developed nations to update their knowledge and skills, enabling better implementation and deployment of cutting-edge technology in their libraries.

INTRODUCTION

As creative thinkers, humans have generated many ideas that have significantly evolved over time. The application of changes to these ideas is referred to as innovation. It is the process by which ideas created by humans are filtered, captured, sponsored, developed, clarified, and then put into practice.¹ Notably, human ideas have constantly changed in the sphere of technology. Technology is an outcome of humanity's intrinsic knowledge or skills acquired through learning or collective efforts to solve problems and improve sociocultural and economic well-being. Generally, humanity's drive to advance itself or society leads to the creation of novel or innovative technologies, which are tools for growth and the application of new inventions to meet emerging social needs, environmental challenges, and organizational opportunities. They include, but are not limited to, artificial intelligence (AI), computer technologies, digital technologies, networking technologies, telecommunications, and web technologies. Adoption and application of such technologies could revolutionize organizational processes and services to increase user

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satisfaction, particularly in libraries.

Libraries are essential centers for education, information sharing, and community involvement, but are typically impacted by the constantly shifting environment brought about by technological advancements resulting from human ideological changes. In view of this, libraries have continuously evolved to remain relevant and valuable in the ever-changing world, integrating innovative technology while staying relevant to their mission of providing access to information, education, and community resources. By keeping library staff members up to date on new developments in technology, innovative technologies have the potential to completely change libraries and library operations in the digital age.² Libraries in the digital era are characterized by redesigned practices, including digitally transforming library management systems to improve innovative services. However, due to the notable disparities between the degree of technological advancement adoption and implementation in developed and developing nations, the operations and services provided by libraries in less developed nations like Nigeria are unappealing to the patrons.

Nigeria is a sovereign country in West Africa situated on the continent's southeast coast. Six geopolitical zones make up the country: North West, North East, South South, South West, South East, and North Central. The topography, climatic conditions, and vegetational patterns of these zones vary substantially. Nigeria is the most populous and largest country in Africa, with more than 206 million people living there as of mid-2020, according to United Nations (UN) figures. This accounts for 2.64 percent of the world's total population. The country has about 516 tertiary/higher education institutions with their respective libraries.³ Nonetheless, the country's access to technology and degree of digital literacy are below the global average.⁴ This has had a significant influence on the country's libraries, which hardly have enough funding to provide the information and communication technology (ICT) infrastructure required to organize training on digital literacy for better technological usage.⁵ As a result, patrons are deterred from using most of the nation's libraries since they are technologically outdated and unable to keep up with the latest developments in digital library services. Therefore, to address this issue, an evaluation of the current condition of technology implementation in the country's libraries is necessary. This study examines and evaluates data from previously published research on the level of technology use in Nigerian libraries.

The findings of a study, "Assessing the Use of Innovative Tools for Library Instruction and Services in Federal Universities Libraries in South-South Nigeria," served as an inspiration for this investigation.⁶ According to that study, 71 percent of the participants were not aware that library services and training could be provided through Ask a Librarian and video conferencing. Ask a Librarian is a collection of library services created to facilitate communication between patrons and librarians for support and direction on how to effectively utilize the resources that are available. Additionally, it makes it possible for users to ask for information that meets their needs. These services include chat, face-to-face interactions, and email communication. Chat services enable users to engage with librarians in real time via a library's website or messaging platform. Face-to-face encounter, commonly known as in-person reference, entails interacting directly with a librarian at a library's reference desk. Email lets users send queries or requests to librarians and receive responses within a certain period.

The infrequent use of innovative technologies for training and services impacted the delivery of service to users. Given their technological sophistication, library patrons in the twenty-first century might also be underserved if innovative instruments are not employed to provide services.

The findings of Odeyemi's article "Robots in Nigerian Academic Libraries: Investigating Infrastructural Readiness and Potential for Library Services" also inspired this study. Odeyemi used the lens of robotics and related strands such as artificial intelligence (AI) in the libraries to view the preparedness of the selected Nigerian universities' libraries vis-a-vis their librarians' potential to leverage technologies.⁷ The study aimed to assess the level of readiness of university libraries in Nigeria with regard to digital infrastructure, policy framework, and digital literacy for the adoption and use of robots in providing library and information services. The study was also to ascertain the available services in university libraries that could be adopted and rendered through robots, as well as the attitudes of librarians toward the potential use of robots in providing and accessing library and information services. The study revealed various challenges confronting Nigerian libraries, which include but are not limited to unreliable power supply, inadequate technology infrastructure, absence of technical skills, somewhat negative attitude towards advanced automation, perceived absence of senior management support, and threat to job. A similar study conducted by Owolabi et al., "Readiness of Academic Librarians towards the Use of Robotic Technologies in Nigerian University Libraries," also motivates this study.⁸ Their study discovered that Nigerian university libraries are not particularly prepared for the adoption or application of robotic technologies, suggesting that even with the significant advantages that technology can provide for library operations, university libraries across the nation are not prepared to implement its use.

METHODOLOGY

This section describes the literature search and selection process as well as the survey approach adopted in addressing the state of technology implementation for improved library practices in Nigerian libraries. Six federal university libraries were selected, one from each of Nigeria's six geopolitical zones.

The Literature Search and Selection Strategy

Science Direct and Google Scholar were used to obtain literature for the study. The researchers adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) technique to ensure a thorough search and selection process for gathering pertinent materials for the study. PRISMA was created to assist researchers in creating transparent reports of their reviews and is widely accepted and used by many researchers.⁹ Through its flowchart, PRISMA methodically explains how to choose pertinent literature for a given study. To create a search framework based on keywords and other search queries related to the study's concepts, the researchers downloaded the PRISMA flowchart as the first step in applying the PRISMA technique. The search for keywords from the databases came next. The researchers individually input each keyword for every database until every keyword had been searched. However, the researchers used Boolean operators like "AND" and "OR" where necessary to combine some of the search phrases in various groupings. The researchers built a search framework—search results are shown in table 1. A detailed column for the search query, the total number of records retrieved from the two databases during the search (records matched), relevant records selected based on title and text snippet, duplicates found during the search, and the actual literature that was screened and used for the study are summarized in table 1. With the aid of this search framework, the study's included papers are

- full text publications written in English that were published between 2016 and 2023 (the restriction to publications written in English is because the researchers do not understand other languages);

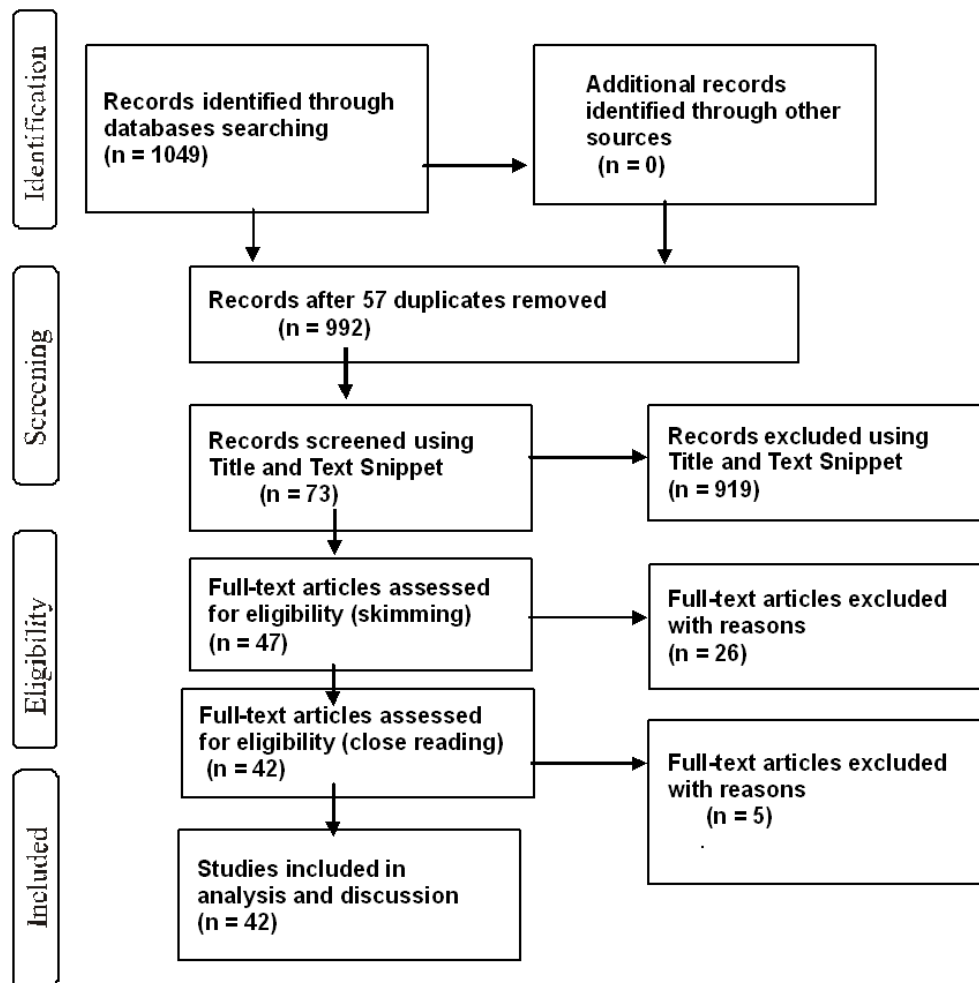
- publications that address innovative technology, adoption, and implementation in Nigerian libraries; and
- publications that draw attention to the difficulties, repercussions, and implications of technology adoption and implementation in libraries in developing nations.

Articles excluded include

- publications published before 2016 and written in languages other than English;
- publications that are of low academic significance with low-quality publication venues (examples include papers having incomplete details or those published in non-peer-reviewed journals and conferences); and
- theses, dissertations, surveys, patents, and citations.

Table 1. Search framework—keywords and other criteria for selecting relevant publications for the study

S/N	Search query	Records matched	Relevant records by title and text snipped	Duplicates identified	Net item to be screened by title and abstract
1	"libraries AND academic libraries", "federal university", "federal university libraries", "Nigeria"	129	8	7	1
2	"innovative technologies", "types", "technological innovation", "libraries", "Nigeria"	118	20	2	18
3	"adoption", "implementation", "technological advances", "libraries", "Nigeria"	40	17	7	10
4	"innovative OR emerging technologies", "technological readiness", "e-readiness", "digital services", "libraries", "Nigerian"	155	15	5	10
5	"library staff", "awareness", "technological innovations", "libraries", "Nigeria"	138	15	13	2
6	"drone technologies", "drone AND library services", "library", "Nigeria"	48	6	0	6
7	"cloud computing", "cloud computing AND library services", "Nigeria"	71	6	5	1
8	"blockchain technologies", "blockchain AND library services", "library", "Nigeria"	71	9	0	9
9	"robotic technology OR AI technology", "robotic technology AND library services", "robotic technology readiness", "Nigeria"	154	10	9	1
10	"broadband penetration", "digital technology gap", "libraries", "developing countries", "Nigeria"	105	10	7	3
11	"challenges", "innovative technology implementation", "developing countries", "libraries", "Nigeria"	20	12	0	12
Total		1049	128	55	73

Figure 1. PRISMA diagram showing the selection process for relevant publications.

The search procedure using the PRISMA diagram is depicted in figure 1. A total of 1,049 records were obtained from the Science Direct and Google Scholar databases. From the search queries, 57 duplicate entries were detected and eliminated, leading to 992 records that remained for initial screening. Nine hundred and nineteen records were excluded after the first screening utilizing title and text excerpts, of which 73 were deemed relevant. The titles, abstracts, and other details of the 73 records were further accessed through their publishers' websites. The full texts of these papers were obtained. Following the inclusion/exclusion criteria and applying skimming to the full text of the 73 records, 26 records were eliminated, leaving 47 publications for further examination and analysis. After carefully reviewing each of the 47 publications and applying the inclusion/exclusion criteria, five articles were found to be further irrelevant, leaving 42 relevant articles for analysis and discussion.

The Survey Approach

The survey approach used to elicit information from 240 library staff members from six federal university libraries in Nigeria is described. The study was limited to federal university libraries because they are expected to have the necessary infrastructure and human resources that could promote the implementation and use of emerging technologies in library practices. A multistage sampling method was employed. Six federal university libraries were first selected using a

stratified random sampling technique, one from each of Nigeria's six geopolitical zones (South East, South West, South South, North East, North West, and North Central). When a population is separated into numerous smaller subpopulations that are each more homogeneous, the stratified random approach is typically used to create a representative sample.¹⁰ Then, 40 respondents from each of the selected libraries were selected using a purposive random sampling technique; this sums up the sample size of 240. A questionnaire was used for data collection. A total of 240 copies of the questionnaire were administered to the respondents, and a response rate of 212 (88.3%) was generated and used for the study (see table 2). Data collected were analyzed using mean and standard deviation. Items with mean scores between 2.50 and above were accepted, while those below 2.50 were rejected. The scope of the study is limited to library staff of NnamdiAzikiwe Library (University of Nigeria, Nsukka (UNN)), Kenneth Dike Library (University of Ibadan), Donald E.U. Ekong Library (University of Port Harcourt), Ramat Library (University of Maiduguri), Kashim Ibrahim Library (Ahmadu Bello University), and University Library (University of Ilorin).

Table 2. Questionnaire administration and response rate

S/N	Geopolitical zone in Nigeria	Selected federal universities	Sampled libraries	No. of questionnaires administered	Response rate	Percentage response (%)
1	South East	University of Nigeria Nsukka	NnamdiAzikiwe Library, UNN, Enugu state	40	38	95
2	South West	University of Ibadan	Kenneth Dike Library, Oyo state	40	36	90
3	SouthSouth	University of Port Harcourt	Donald E.U. Ekong Library, Rivers state	40	36	90
4	North East	University of Maiduguri	Ramat Library, Borno state	40	33	82.5
5	North West	Ahmadu Bello University, Zaria	Kashim Ibrahim Library, Kaduna state	40	35	87.5
6	North Central	University of Ilorin	University Library, University of Ilorin, Kwara state	40	34	85
	Total			240	212	88.3

SUMMARY OF KEY OBSERVATIONS

This section reveals the state of technology deployment in Nigerian libraries. It first reviews current literature on the state of technology deployment in Nigerian libraries, identifying challenges, consequences, and possible opportunities for improvement. Secondly, it relates the findings of previous researchers to the findings of the present study to assess the current state of libraries in the country regarding technology deployment.

Technology Deployment in the Light of Published Literature

Despite the benefits technology offers libraries, certain factors prevent Nigerian libraries from using it effectively. This section discusses various constraints to technological deployment in Nigerian libraries, their consequences, and opportunities for improvement as disclosed from preceding published literature. Among the challenges discussed are limited infrastructure, the level of digital literacy skills, and the digital divide.

Limited Infrastructure

Limited infrastructure in the context of a library refers to insufficient or inadequate facilities, systems, and resources that make it more difficult for the library to provide effective services to its patrons. It includes, but is not limited to, workforce shortages, old or badly maintained facilities, poor accessibility, and poor training programs. The poor nature of infrastructure in Nigerian libraries hardly supports the implementation and adoption of innovative technologies for improved library practices. Due to insufficient information and communication technology (ICT) infrastructure, Nigeria and other developing nations are playing catch-up to industrialized nations as they create new technologies to propel the digital age.¹¹ It is not hyperbole to say that Nigerian libraries face more challenges than just a shortage of computers because most of the available facilities are obsolete and cannot compete with modern models in terms of functionality and speed. Additional infrastructure limitations to the effective functioning of Nigerian libraries are inconsistent power supplies and inadequate internet connectivity.¹² A survey on connecting libraries to the future revealed that about one-third of the nation's libraries have broadband connections that scarcely meet patron needs.¹³ Furthermore, a large number of African libraries, particularly those in Nigeria, lack the infrastructure and policies necessary to promote access to and usage of innovative technology.¹⁴ The available literature lists a few other factors that add to the poor nature of infrastructural facilities in Nigerian libraries; among these factors are

- high cost of computer equipment,¹⁵
- insufficient megawatts,¹⁶
- underfunding,¹⁷
- limited bandwidth,¹⁸
- lack of government support,¹⁹ and
- poor maintenance culture.²⁰

Limited infrastructure in Nigerian libraries has consequently resulted in restricted access to information, especially educational materials, thereby hindering effective research, learning, and academic progress. Outdated infrastructure affects the quality and range of services that libraries can offer and leads to underutilization of available resources, which reduces the library's potential impact on education, research, and community development.²¹ Insufficient technological infrastructure perpetuates the digital divide, leaving potential users without adequate access to digital resources and hindering their ability to participate in the digital age.²²

Addressing these issues requires concerted efforts from various stakeholders, including increased government funding, improved planning and management strategies, together with collaboration among libraries and relevant institutions to enhance infrastructure and promote access to information and education for all.²³ Investment in modern ICT infrastructure to provide high-speed internet access, computers, tablets, e-readers, and other digital devices for library practices should be prioritized.²⁴ Collaboration with government agencies, nongovernmental organizations, educational institutions, and private sectors to secure funding, resources, and expertise for infrastructure development should be encouraged.²⁵ Library management should also consider sustainable practices in infrastructure development by focusing on energy efficiency, fundraising, and environmentally friendly initiatives.²⁶

Level of Digital Literacy Skills

Digital literacy is the ability to comprehend, evaluate, and use information in a variety of formats from a wide range of sources that can be accessed through digital technologies such as tablets, laptops, smartphones, and desktop computers, among others.²⁷ Proficiency in digital literacy

necessitates critical thinking, application, information appraisal, and the dissemination of all kinds of information in digital format. In an increasingly digital world, librarians with low levels of digital literacy may struggle with basic online communication tools like email, social media, or video conferencing, affecting their ability to connect with others and participate in online discussions or events.²⁸ Research evidence showed that the majority of librarians in developing nations lack the education and contemporary skills necessary to embrace technological innovation and provide pertinent services to their sizable clientele from remote areas.²⁹ The issue is worse in Nigeria, where most of the library workers are averse to change, even if information technology is spurring innovation globally.³⁰

Some of the contributing factors to low levels of digital literacy, as disclosed in the published literature, include the following:

- limited access to technology,³¹
- lack of training or education among patrons,³²
- staff unwillingness to use emerging technologies due to limited exposure or familiarity with digital devices and online resources,³³
- language or cultural barriers that exacerbate difficulties in understanding and utilizing digital resources,³⁴ and
- librarians' phobia of emerging technologies.³⁵

The efficacy of librarian services, as well as library customer satisfaction, is significantly impacted by low levels of digital literacy.³⁶ Low levels of digital literacy create a skills gap in developing technologies, obstruct the deployment of innovative services, and reduce customer delight to the greatest extent. However, improving digital literacy, as disclosed in the literature, requires ongoing efforts, flexibility, and adaptability to meet the evolving technological needs of the user community.³⁷ Libraries, as an invaluable unit of academic institutions in empowering individuals to navigate the digital world effectively and independently, should offer various programs and services such as digital literacy workshops which enable libraries to teach patrons basic digital skills, including using computers, browsing the internet, utilizing library databases, and understanding online security and privacy. Sahabi and Otobo encouraged one-on-one assistance, where librarians provide personalized assistance to patrons who need help in navigating digital resources, filling out online forms, or learning how to use specific software or applications.³⁸ To accomplish this, libraries should often provide access to computers, Wi-Fi, and other digital resources, ensuring that patrons without personal devices can still benefit from digital services.³⁹ They should also collaborate with communities, organizations, and computer-based companies to create specialized programs that address the specific digital literacy needs of patrons.⁴⁰ Multilingual support—a service where libraries offer resources and assistance in multiple languages to accommodate diverse communities to bridge language barriers in digital literacy—should also be considered.⁴¹

The Digital Divide

The digital divide is the gap between those who have access to various kinds of information and communication technologies and those who do not; it exists between people who live in urban and rural areas, people from different socioeconomic levels, and globally between countries with more and less industrialized economies.⁴² The digital divide presents a significant obstacle for developing countries, as it continues to expand the disparity between them and affluent nations. According to Ezeh, this gap has led to libraries in developing countries struggling to sustain effective information use, as they lack the essential ICT infrastructure needed for technological

progress. Ezeh further revealed that while libraries in developed countries are bridging the digital divide by giving free internet access to people who would not otherwise have access to workstations, training and assisting people who are not proficient in ICT or who experience difficulties using the services, and offering resources to assist users with research, resume writing, assignment writing, and other social entertainment, libraries in developing countries are fighting to survive their unstable economies, an endeavor which is fraught with difficulties.⁴³ The impact of the digital divide in Nigeria, particularly in academic settings where libraries serve the vast majority of users who reside in rural areas, is concerning. Several factors have been revealed in published literature as contributing to the digital divide in Nigeria, including but not limited to

- high cost of computer equipment, lack of ICT skills, and poor knowledge of available search engines;⁴⁴
- lack of electrical infrastructure, income, and urban drift in Nigeria;⁴⁵
- language barriers and geographical disparities;⁴⁶
- socio-economic demographics;⁴⁷ and
- differences in digital skills, autonomy, social support, and the aims of digital technology use.⁴⁸

Consequently, the digital divide leads to educational disparities between those who can access digital resources for learning and those who cannot. Students without access to digital tools and the internet face challenges in keeping up with online learning, which has become more prevalent in the digital era.⁴⁹ It also perpetuates economic inequality. Individuals without access to digital technologies may struggle to find job opportunities, access online markets, or participate in the digital economy, limiting their potential for economic growth and financial stability. Social exclusion may equally occur as a result of the digital divide. With much of social interaction moving online, those without internet access may feel socially isolated and miss out on social connections, networking opportunities, and community engagement activities that often take place online.⁵⁰ However, the available literature offered some suggestions to address the issue. Among the suggestions are an improved economy, improved budgetary allocation, and provision of adequate ICT infrastructure.⁵¹ Furthermore, the federal government should expedite and fully implement the National Broadband Plan, designed to expand broadband access, to tackle the infrastructure shortcomings in the country's information and communications technology sector.⁵²

TECHNOLOGY DEPLOYMENT IN NIGERIAN LIBRARIES IN THE LIGHT OF THE STUDIED LIBRARIES

Using information gathered from the employees of the libraries under study, this section aims to illustrate the present condition of technology deployment in Nigerian libraries. The descriptive data gathered for the research objectives are based on the descriptive survey discussed in the methodology section. The study begins by evaluating the degree to which library employees are aware of the potential applications of a few cutting-edge technologies in libraries.

Research Question 1: To what extent are you aware of the potentials of technological innovations to improve library practices in the digital era?

Table 3 depicts the results of library staff awareness of the potential of technological advancements for enhancing library practices in the digital era. The mean response of the respondents shows that the library staff are aware of cloud computing (3.28), robots (2.91), smart things (2.66), and library websites (3.62). However, the calculated grand mean of 2.44 (SD = 1.15), below the criterion mean of 2.50, indicates that library staff in the study area are less aware of the potential benefits of the outlined technology to enhance library services.

Table 3. Descriptive statistics on the mean response of library staff awareness of the potentials of innovative technologies in libraries

S/N	Item statement	HA	A	LA	NA	Response weight	Mean	Std. dev.	Decision
1	Drone	33	18	87	74	434	2.05	1.03	LA
2	Cloud computing	112	63	22	15	696	3.28	0.92	A
3	Block chain	36	20	80	76	440	2.08	1.06	LA
4	Smart School Manager (SmartSM)	40	17	82	73	448	2.11	1.08	LA
5	Robots	65	83	44	20	617	2.91	0.94	A
6	Patron driven acquisitions	27	19	76	90	407	1.92	1.01	LA
7	Automated book delivery system	24	23	55	110	385	1.82	1.03	LA
8	Smart objects	47	78	55	32	564	2.66	0.99	A
9	Big data	22	35	57	98	405	1.91	1.02	LA
10	Library website	133	78	0	1	767	3.62	0.52	HA
	Grand mean	53.9	43.4	55.8	58.9	516.3	2.44	1.15	LA

Key: HA = highly aware, A= aware, LA = less aware, NA = not aware

Research Question 2: To what extent are the following technological innovations being utilized in Nigerian libraries to improve library practices in the digital era?

The opinions of the respondents regarding the extent to which Nigerian libraries employ technological innovations are presented in table 4. According to the statistics, the technological innovations commonly utilized in Nigerian libraries are cloud computing (3.28), smart objects (2.67), and the library website (3.37). Despite this, the data's grand mean for this goal is 2.42, suggesting that Nigerian libraries underutilize technology advancements.

Table 4. Respondents mean response on the extent of technology usage

S/N	Item statement	VHE	HE	LE	VLE	Response weight	Mean	Std. dev.	Decision
1	Drone	20	43	60	89	418	1.97	1.00	LE
2	Cloud computing	109	70	17	16	696	3.28	0.91	HE
3	Blockchain	26	23	73	90	409	1.93	1.01	LE
4	Smart School Manager (SmartSM)	35	46	68	63	477	2.25	1.06	LE
5	Robots	30	22	60	100	406	1.92	1.07	LE
6	Patron driven	22	59	53	78	449	2.12	1.03	LE

S/N	Item statement	VHE	HE	LE	VLE	Response weight	Mean	Std. dev.	Decision
	acquisitions								
7	Automated book delivery system	41	51	78	42	515	2.43	1.02	LE
8	Smart objects	60	45	84	23	566	2.67	0.96	HE
9	Big data	44	23	100	45	490	2.31	1.03	LE
10	Library website	90	112	8	2	714	3.37	0.61	HE
	Grand mean	47.7	49.4	60.1	54.8	514	2.42	1.10	LE

Key: VHE = very high extent, HE = high extent, LE = low extent, VLE = very low extent

Research Question 3: What are the challenges to effective use of technological innovations in Nigerian academic libraries?

A number of barriers to the successful adoption of technology improvements in libraries are shown in table 5. The table displays the degree to which each of the factors below prevents technology from being implemented in Nigerian libraries. The grand mean score of 3.36 (SD = 0.74) obtained from the respondents' response to this effect shows how responsive they were to the elements that were identified as hindrances to the adoption and use of cutting-edge technology in Nigerian academic libraries.

Table 5. Respondents' mean response to factors limiting technology adoption and implementation in libraries

S/N	Item statement	SA	A	D	SD	Response weight	Mean	Std. dev.	Decision
1	Under funding of Nigerian libraries	145	65	2	0	779	3.67	0.49	SA
2	Poor training programs	136	69	6	1	764	3.6	0.57	SA
3	Inadequate ICT facilities	95	87	16	14	687	3.24	0.86	A
4	Unreliable power supply	91	109	8	4	711	3.35	0.65	A
5	Low level of digital literacy	74	123	12	3	692	3.26	0.63	A
6	Lack of broadband penetration	115	95	0	2	747	3.52	0.55	SA
7	Inadequate maintenance of the existing ICT facilities	78	94	19	21	653	3.08	0.92	A
8	Frequent network failure	77	92	31	12	658	3.1	0.85	A
	Grand mean	101.38	91.75	11.75	7.13	711.4	3.36	0.74	A

Key: SA = strongly agree, A= agree, D = disagree, SD = strongly disagree

DISCUSSION AND ANALYSIS

Based on the technology awareness survey shown in table 3, the study found that library staff in the study area have limited awareness of how innovative technology could enhance library

services. This, as shown in table 4, has an impact on the libraries' capacity to adopt and use new tools, methods, and practices to enhance services that better meet the evolving needs of their patrons in the digital era. The findings are consistent with those of Okere, who found that lack of exposure to or familiarity with digital devices and online resources is the reason behind staff members' hesitancy to embrace emerging technology.⁵³ Among the key issues raised in the previous section is the need for continuous efforts, adaptability, and flexibility on the part of library staff in Nigeria to satisfy the changing technological demands of the user community. Launching a campaign to raise awareness of developing technologies and how to manage them for optimal use in order to improve performance in institutions such as libraries is necessary.⁵⁴ This could be achieved through continuous professional development (CPD), partnerships and collaborations, training programs, and internal knowledge sharing. CPD programs keep information professionals up-to-date in their areas of specialization and provide them with training in new developments in their fields; its venues include but are not limited to formal courses, workshops, seminars, conferences, presentations, teaching, independent study, and publishing.⁵⁵ The library and information science (LIS) profession, like other professions around the globe, provides professional development opportunities at the international, national, and local levels for its members. This corresponds with Oduwole, Adekunmisi, and Oyedokun's article that the Information Technology (IT) Section of the Nigerian Library Association (NLA) aimed at organizing a conference/workshop that focused on enhancing participants' skills in the use of open technologies for the provision and delivery of a range of innovative library information products and services.⁵⁶ Although training and sharing of acquired knowledge are other modes of creating awareness of new technology among patrons, it was revealed that many employees hardly participate in professional development programs or share their knowledge due to lack of motivation, organizational rewards, and lack of trust among colleagues.⁵⁷ The scenario in Nigeria is unbearable as the poor state of the country does not only affect institutions/organizational support but also the employees who hardly strive for personal development due to economic downturns of the country. The lack of support by Nigerian libraries has a detrimental impact on librarians' awareness of technological advancements.⁵⁸ The lack of technology awareness leads to outdated library management systems and is detrimental to the implementation of technological advances for innovative service delivery in the libraries. Data presented in table 4 depict the state of technology deployment in nations where people are less aware of advanced technology.

Data in table 5 revealed a lack of finance, poor training programs, a lack of internet access, and inconsistent power supplies as other major deterrents to the implementation of cutting-edge technology in Nigerian libraries. This result is congruent with that of previous researchers, who found that a lack of training, retraining, and inadequate support for staff development had a negative impact on the skills and abilities needed for librarians to implement technological improvements.⁵⁹ Once more, the financial situation of Nigerian libraries is often mentioned as a major impediment to the adoption of innovative technology for the provision of high-quality services.⁶⁰ Rarely is the government's paltry 10 percent financial allocation sufficient to build the necessary ICT infrastructure and support the library staff for the enhanced technological advancements in libraries.⁶¹ In addition to a lack of infrastructure, many African countries also struggle with a lack of laws and policies promoting access to and use of cutting-edge technology.⁶² The study's findings also align with Zubairu and colleagues, who discovered that poor broadband penetration and variable power supply in many regions of Nigeria discourages most organizations, including libraries, from adopting and implementing technological advancements.⁶³

CONCLUSION

Based on the study's goals and findings, it is concluded that librarians in the study area are less aware of the potential benefit of most of the innovative technologies and subsequently do not use them for service delivery primarily due to poor budgetary situation, a lack of adequate resources, and a lack of required ICT skills among other reasons. The implication of the findings is that library staff may have a skills gap because of a lack of awareness and use of technology. Librarians may find it more difficult to properly assist consumers if they lack the necessary training or understanding of new technology, which could lower the overall quality of services offered. Furthermore, the study's conclusions suggest that the nation's libraries may run the risk of losing their relevance to younger generations who are used to accessing information digitally. This could lead to a decline in library usage and a loss of significance within the user community, endangering the libraries' mission to support teaching, learning, and research in the country's higher education institutions. However, the study recommends providing underprivileged communities with community access centers equipped with computers and internet connection. These facilities can raise awareness of emerging technologies and offer resources and training to those without access to technology at home. The Nigerian government should increase funding for libraries and introduce policies to reduce the cost of technology and internet access in the country. Libraries in Nigeria should seek mentorship with libraries in developed countries to become familiar with new technologies and improve their proficiency in their use. Librarians throughout the country should be encouraged to embrace self-development initiatives to enhance their knowledge and skills, facilitating better implementation and deployment of cutting-edge technology in libraries.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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ENDNOTES

- ¹ Thomas A. Ogunmodede and Sunday O. Popoola, "Librarians' Innovation in the Federal Universities in Nigeria," *Journal of Balkan Libraries Union* 8, no. 1(2021):33–41, <https://doi.org/10.16918/jblu.834099>.
- ² Shashikumara A.Aavarti et al., "Emerging Technology Trends for Libraries and Library Professionals," paper presented at Librarianship Development through Internet of Things and Customer Service (LDITCS), January 2019, <https://www.researchgate.net/publication/348871131>.
- ³ Najeem Olawale Adelakun, "Present State of Tertiary Institutions in Nigeria," *Mendeley Data*, 2021, <https://data.mendeley.com/datasets/4c8vv5h42j/1>.
- ⁴ Abubakar H. Zubairu et al., "Assessing the E-readiness of Nigeria for Digital Economy," *American Journal of Computer Science and Information Technology* 8, no.2 (2020):50.
- ⁵ Ohis K. Irenoa, Bribena Emilian, and John Eru, "Funding Academic Libraries in Nigeria for Effective Services: Alternative to Resource Development and Library Management," *Journal of Library and Information Science* 21, no.1 (2019): 104–111.
- ⁶ Saturday U. Omeluzor, Molokwu Ugochi, and Victoria K. Izuakolam, "Assessing the Use of Innovative Tools for Library Instruction and Services in Federal Universities Libraries in South-South Nigeria," *Journal of Information and Knowledge Management* 2020, <https://doi.org/10.4314/ijikm.v11i4.9>.
- ⁷ Samuel Oladunjoye Odeyemi, "Robots in Nigerian Academic Libraries: Investigating Infrastructural Readiness and Potential for Library Services," 2019, <https://library.ifla.org/id/eprint/2776/1/s08-2019-odeyemi-en.pdf>.
- ⁸ Abayomi K. Owolabi et al., "Readiness of Academic Librarians Towards the Use of Robotic Technologies in Nigerian University Libraries," *Library Management* 43, no.3/4 (2022): 296–305, <https://doi.org/10.1108/LM-11-2021-0104>.
- ⁹ Alessandro Liberati et al., "The PRISMA Statement for Reporting Systematic Reviews and Meta Analyses of Studies that Evaluate Health Care Interventions: Explanation and Elaboration," *British Medical Journal* (2009): 339, <https://doi.org/10.1136/bmj.b2700>.
- ¹⁰ Mohamed Elifil and Ahmed Negida, "Sampling Methods in Clinical Research: An Educational Review," *Emergency (Tehran)* 5, no.1 (2017): e5, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5325924/>.
- ¹¹ Sunday N. Okoye, Umeifekwem T. Uchenna, and Eme I. Okechukwu, "Addressing Digital Technology Gap Challenges: The Nigerian Experience," *Nigerian Journal of Social Development*, 11 no.1 (2023): 95–100.
- ¹² Roseline Bawack and Prudence P. Nkolo, "Open Access Movement: Reception and Acceptance by Academic Libraries in Developing Countries," *Library Philosophy and Practice*, 2018, <http://digitalcommons.unl.edu/libphilprac/2023>.

-
- ¹³ John S. and James L. Knight Foundation, "Connecting Libraries to the Future," 2017, <https://www.ctcnet.us/wp-content/uploads/2018/06/Bandwidth-for-the-Library-of-the-Future-FINAL-20171025.pdf>.
- ¹⁴ Friday James, Oluchi Chidozie, and Laretta N. Chukwuma, "Social Media and Library Services: A Case of COVID-19 Pandemic Era," *International Journal of Research and Review* 7, no. 10 (2020): 230–37, https://www.ijrrjournal.com/IJRR_Vol.7_Issue.10_Oct2020/IJRR0031.pdf.
- ¹⁵ Williams T. Saibakumo, "Awareness and Acceptance of Emerging Technologies for Extended Information Service Delivery in Academic Libraries in Nigeria," *Library Philosophy and Practice*(2021), <https://digitalcommons.unl.edu/libphilprac/5266>.
- ¹⁶ Uzoma A. Madu, Hajara Usman, and Fati Abba, "Challenges of Virtual Reference Services Implementation by Nigerian Academic Libraries in the 21st Century in Nigeria," *Journal of Economic Development* 1, no. 2,(2020): 144–55, <https://www.researchgate.net/publication/346659669>.
- ¹⁷ Muhammad K. Sahabi and Elvis E. Ootobo, "Academic Library and Challenges of Service Delivery in Nigerian Universities in the Digital Era," *Information Impact: Journal of Information and Knowledge Management* (2021), <https://doi.org/10.4314/ijikm.v12i2.4>.
- ¹⁸ Sahabi and Ootobo, "Academic Library and Challenges of Service Delivery," 58.
- ¹⁹ Victoria O. Okojie and Rose B. Okiy, "Public Libraries in Nigeria and the Development Agenda," *Library Philosophy and Practice* (2020), <https://digitalcommons.unl.edu/libphilprac/4251>.
- ²⁰ Saibakumo, "Awareness and Acceptance of Emerging Technologies," 8.
- ²¹ Omeluzor, Molokwu, and Izuakolam, "Assessing the Use of Innovative Tools," 103.
- ²² Robert Rockmann, Heiko Gewalt, and Maximilian Haug, "Equal Access for Everyone? A Digital Divide Cascade for Retired Senior Citizens," *European Conference of Information Systems Proceedings* 30, 2018, https://aisel.aisnet.org/ecis2018_rp/30.
- ²³ Madu, Usman, and Abba, "Challenges of Virtual Reference Services Implementation," 147.
- ²⁴ Saturday U. Omeluzor, Chidi C. Nwosu, and Ugochi E. Molokwu, "Effects of Library Infrastructure on Turnover Intentions of Librarians: A Study of University Libraries in South-South and South-East of Nigeria," *Library Philosophy and Practice*, 2018, <https://digitalcommons.unl.edu/libphilprac/1967/>.
- ²⁵ Emmanuel Okwu and Augustine C. Oporum, "Inadequate Library Services: A Challenge to 21st Century Education in a Developing Economy," *British Journal of Library and Information Management*, 2021, <https://doi.org/10.52589/BJLIM-NJ8CWGZF>.
- ²⁶ Saibakumo, "Awareness and Acceptance of Emerging Technologies," 9.
- ²⁷ Endouware B. Christy and Dushu T. Yusuf, "An Investigation of the Level of Digital Literacy Skills Possessed by Academic Librarians in Nigerian Universities," *World Journal of Innovative Research (WJIR)* 10, no.2 (2021):1–8.

- ²⁸ Saidu Sonfada Ndagi and E. C. Madu, "Effect of Information Literacy Skills on Use of Electronic Library Resources by Lecturers in Universities in North Central Nigeria," *International Journal of Applied Technologies in Library and Information Management* 4 (3): 13–22, <https://jatlim.org/volumes/volume4/Volume%204%20No%203/Saidu.pdf>.
- ²⁹ Adeyinka Tella, "Robots Are Coming to the Libraries: Are Librarians Ready to Accommodate Them?," *Library Hi Tech News* 37, no. 8 (2020):13–17, <https://doi.org/10.1108/LHTN-05-2020-0047>.
- ³⁰ Madu, Usman, and Abba, "Challenges of Virtual Reference Services Implementation," 15.
- ³¹ Sahabi and Otobo, "Academic Library and Challenges of Service Delivery," 58.
- ³² James, Chidozie, and Chukwuma, "Social Media and Library Services," 233.
- ³³ Oluchi Okere, "Factors Affecting Librarians' Use of Information and Communication Technologies (ICTs) in Federal Colleges Of Education, Southwestern Nigeria," *Library Philosophy and Practice* (2022), <https://digitalcommons.unl.edu/libphilprac/6911>.
- ³⁴ Sharifah Rohayah Dawood, "Digital Divide and Poverty Eradication in the Rural Region of Northern Peninsular Malaysia," *Indonesian Journal of Geography* 51, no.2 (2019): 172–82, <https://doi.org/10.22146/ijg.37758>.
- ³⁵ Nkechi M. Amaechi, Uchechukwu V. Enweani, and Catherine C. Eke, "Challenges to Library and Information Services (LIS) Delivery in the 21st Century: The Situation in Three Academic Libraries in Imo State, Nigeria," *Library Philosophy and Practice* (2018), <http://digitalcommons.unl.edu/libphilprac/2075>.
- ³⁶ Madu, Usman, and Abba, "Challenges of Virtual Reference Services Implementation," 151.
- ³⁷ A. Subaveerapandiyani, Sinha Priyanka, and Jeremiah Emeka Ugwulebo, "Digital Literacy Skills among African Library and Information Science Professionals—An Exploratory Study," *Global Knowledge Memory and Communication* (2022), <https://doi.org/10.1108/GKMC-06-2022-0138>.
- ³⁸ Sahabi and Otobo, "Academic Library and Challenges of Service Delivery," 57.
- ³⁹ Omeluzor, Nwosu, and Molokwu, "Effects of Library Infrastructure," 9.
- ⁴⁰ Cynthia K. Sanders and Edward Scanlon, "The Digital Divide Is a Human Rights Issue: Advancing Social Inclusion Through Social Work Advocacy," *Journal of Human Rights and Social Work* 6, no. 2 (2021):130–43, <https://doi.org/10.1007/s41134-020-00147-9>.
- ⁴¹ Dawood, "Digital Divide and Poverty Eradication," 174.
- ⁴² Okoye, Uchenna, and Okechukwu, "Addressing Digital Technology Gap Challenges," 96.
- ⁴³ Rose U. Ezeh, "Digital Divide in Educational Environment (Libraries) in Developing Nation: Challenges and Prospects," *International Journal of Academic Library and Information Science*

- 10, no.2 (2022): 61–68,
<https://academicresearchjournals.org/IJALIS/PDF/2022/February/Ezeh.pdf>.
- ⁴⁴ Omolara Tayo, Randall Thompson, and Elizabeth Thompson, “Impact of the Digital Divide on Computer Use and Internet Access on the Poor in Nigeria,” *Journal of Education and Learning* 5, no. 1 (2016), <https://doi.org/10.5539/jel.v5n1p1>.
- ⁴⁵ Ezeh, “Digital Divide in Educational Environment (Libraries),” 67.
- ⁴⁶ Dawood, “Digital Divide and Poverty Eradication,” 180.
- ⁴⁷ Polyxeni Vassilakopoulou and Eli Hustad, “Bridging Digital Divides: a Literature Review and Research Agenda for Information Systems Research,” *Information Systems Frontiers* 25, (2023): 955–69, <https://doi.org/10.1007/s10796-020-10096-3>.
- ⁴⁸ Rockmann, Gewalt, and Haug, “Equal Access for Everyone?,” 5.
- ⁴⁹ Kamal Ahmed Soomro et al., “Digital Divide among Higher Education Faculty,” *International Journal of Educational Technology in Higher Education*, 17 no. 21 (2020), <https://doi.org/10.1186/s41239-020-00191-5>.
- ⁵⁰ Okoye, Uchenna, and Okechukwu, “Addressing Digital Technology Gap Challenges,” 98.
- ⁵¹ Ezeh, “Digital Divide in Educational Environment (Libraries),” 67.
- ⁵² Okoye, Uchenna, and Okechukwu, “Addressing Digital Technology Gap Challenges,” 99.
- ⁵³ Okere, “Factors Affecting Librarians’ Use,” 9.
- ⁵⁴ Saibakumo, “Awareness and Acceptance of Emerging Technologies,” 9.
- ⁵⁵ Mac-Anthony Cobblah and Marian Jiagge, “An Assessment of Staff Training and Development Monitoring and Evaluation Mechanisms: A Case Study,” *International Journal of Library Science* 15, no. 3 (2017):1–25, <http://hdl.handle.net/123456789/3700>.
- ⁵⁶ Adebambo A. Oduwole, Sowemimo R. Adekunmisi, and Siddigah O. Oyedokun, “Adoption of Innovative Library Products and Services among Library and Information Science Professionals in Nigeria,” *Library and Information Perspectives and Research* 5, no. 2 (2023): 1–14, <http://doi.org/10.47524/lipr.v5i2.2>.
- ⁵⁷ Nancy Okorie, Philomena Gbemi-Ogunleye, and Ugochi Molokwu, “Knowledge Sharing and Technological Innovation of Librarians in Nigerian Tertiary Institutions,” *Library Philosophy and Practice* (2021), <https://digitalcommons.unl.edu/libphilprac/6296>.
- ⁵⁸ Elizabeth Inyang and James Mngutayo, “Required Skills and Competences of Librarians for Effective Software Application and Use in Contemporary Libraries in Nigeria,” *Library Philosophy and Practice* (2018), <http://digitalcommons.unl.edu/libphilprac/2092>.
- ⁵⁹ James, Chidozie, and Chukwuma, “Social Media and Library Services,” 234.

⁶⁰ Siphamandla M. Mthembu and Dennis Ocholla, "Perceptions on Job Requirements of LIS Graduates in Public Libraries: A Reflection on Public Libraries in KwaZulu-Natal," *South Mousaion: South African Journal of Information Studies* 36, no.4 (2018): 1–25, <https://doi.org/10.25159/2663-659X/6153>.

⁶¹ Irenea, Emilian, and Eru, "Funding Academic Libraries in Nigeria," 104–111.

⁶² Tella, "Robots Are Coming to the Libraries," 16.

⁶³ Zubairu et al., "Assessing the E-readiness of Nigeria for Digital Economy," 4.