Fourth Industrial Revolution (4IR) and Sustainable Library Service Delivery in Academic Libraries in Akwa Ibom State

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Abstract

The study examined fourth (4th) industrial revolution and sustainable library service delivery in academic libraries in Akwa Ibom State. Two objectives and research questions guided the study. The study adopted a descriptive survey design. The study was carried out in public university libraries in Akwa Ibom State, namely: University of Uyo, Uyo (UNIUYO), Federal University of Technology, Ikot Abasi (FUTIA) and Akwa Ibom State University (AKSU). The population of the study consisted of all the 22 professional and 56 para-professionals in UNIUYO, 27 professional staff in AKSU and 4 professional and 1 para-professional staff in FUTIA. Total enumeration sampling technique was used to sample the entire population of 110 library staff.The main instrument used for data collection is questionnaire titled "Fourth Industrial Revolution and Sustainable Service Delivery Questionnaire (FIRSSDQ)". The instruments were administered in public university libraries in Akwa Ibom State with the help of a research assistant. The data collected were analyzed using frequency tables, percentages and a chart for emphasis. The study came to the conclusion that the use of AI technology in academic libraries is raising the bar for effective, efficient, and long-lasting library service delivery. Additionally, the adoption gives libraries the chance to provide their clients with enhanced and dynamic services. The study recommended among other that in order to increase operational efficiency in libraries where the technology is to be adopted or already deployed, library staff should be subjected to training and retraining in the use of AI in the delivery of library services.

Keywords: fourth, industrial revolution, sustainable library, service delivery, academic libraries

Introduction

Observably, academic librarians are not familiar with the technologies of the Fourth Industrial Revolution, it may be challenging for them to fully investigate the advantages these technologies offer and how they might help them achieve their goals. The Internet of Things (IoT), robotic systems, cloud computing, augmented reality, and artificial intelligence (AI) are some of the technologies of the Fourth Industrial Revolution. Libraries in developed nations have already begun integrating 3-D printing into their operations and services. According to Cox et al. (2019), these gadgets carry out certain tasks that primarily rely on data and the internet and provide instructions on how to collect data in the age of the constantly expanding information explosion.

Digital technologies enabled by automation, mobile computing, AI, and the IoT, among other things, are the main focus of the

disruptive change known as the 4IR. The 4IR's devices have had a big impact on enterprises, trades, and other areas, including libraries. According to Oladokun et al (2024), in the virtual world , users interact with digital objects, avatars, and environment as if they were engaging with the physical world. The paradigms of academic libraries in the twenty-first century are changing from the classic arrangement to the contemporary information networking. Academic libraries are becoming increasingly important as resources for everything from data analysis to 3-D printing and basic coding lessons. These libraries must be digitally equipped and staffed with knowledgeable, skilled, and competent librarians who can serve as the information superstructure for the application and use of 4th industrial revolution devices and technologies (Chigwada, 2021). This position buttresses that of Ben et al (2024), who affirmed that, digital technologies have remarkably enhanced information services in the 21st century. These days, academic libraries are more than merely repositories of books and other materials.

A new degree of organization and control over the whole value chain of products is understood to be represented by the term "4th Industrial Revolution" (or "4th IR"). It is intended to meet the escalating needs of certain clients. The fourth industrial revolution is changing how we communicate, work, and live. The best examples are things like drone delivery services, online shopping, and self-driving cars. The main focuses of the 4IR are robotics and AI. The 4IR brings a shift in the workforce due to artificial intelligence and automation, which will result in the replacement of some workers with machines that can perform tasks more cheaply or with the necessary abilities (Vaidya, 2018).

Artificial Intelligence

According to Cao (2020), AI is a technology that mixes computer-generated content, including text, photos, videos, animations, and sound, with real-world environments. Artificial intelligence records and analyzes the environment in real time. The increasing use of contemporary mobile computing devices, such as smartphones and tablet computers with location-based services, is largely responsible for its expanding appeal as a mainstream technology. In order to assist people perform to their fullest potential, artificial intelligence builds knowledge layers on top of human intelligence.

AI enable machines sense, comprehend, act, and perform a variety of jobs that are similar to those carried out by people (Cox, Pinfield, & Rutter, 2019). Grover (2020) claims that AI is now included into a number of academic library operations, including service delivery, data storage, and managing the diverse types of data they have collected for future use. Artificial intelligence (AI), a rapidly developing technological phenomenon, is sought after by all industries to boost production and reduce expenses. The aim of implementing AI in libraries is to provide efficient services to patrons.

Academic libraries are essential to the lives of scholars, researchers, and students. These users value information and expect access to it through the use of technology and gadgets. According to Cotera (2018), these gadgets and apps are cutting edge and adapt to the newest developments in technology. academic libraries employ gamification, gesture recognition, humanoid robots, mobile apps, augmented reality, virtual reality, immersive reality, and sensory immersion. The user experience has completely altered as a result of these efforts, and library service delivery is now more user-friendly, accessible, and enjoyable. AI technology can be defined as a group of technologies that allow machines to perceive, understand, act, learn, carry out administrative tasks, and offer state-of-the-art solutions for libraries. Technology based on artificial intelligence is now the newest developing trend in libraries. For the information industries, such as media outlets, libraries, and so on, it has proven to be revolutionary.. The provision of library

services has been significantly impacted by this (Cox, Kennan, Lyon, Pinfield, and Sbaffi, 2019).

As a 4th IR gadget, artificial intelligence can assist librarians in identifying important mistakes made when presenting data online. Examples of AI and IoT in the context of library data in the 4IR are excellent. In the foreseeable future, library services will acquire more traction if such modifications are implemented. Since libraries have always handled information and welcomed technology, AI would not be an exception. One of the most distinctive characteristics of librarians is their constant eagerness to employ new technologies to provide library services and completely satisfy customer needs.

Library Service Delivery

The range of services offered to patrons is known as library services. Direct and indirect services are the two categories into which it can be divided. This can include the Library Orientation, which provides information on how to use and access library materials. The library provides a variety of services, including circulation, reference, online book reservations, digital book recommendations, current awareness, inter-library loans, library mobile services, photocopying and printing, library orientation and knowledge sessions, selective data dissemination, audio-visual services, and multimedia sections. Furthermore, these are expert services provided to patrons of libraries ahead of time and when needed to fulfill their information requirements (Adeyoyin, 2015).

Libraries are no longer the only places where customers or clients can retrieve information nowadays. Libraries must develop strategies on how to provide services and resources to patrons as efficiently as possible in order to attract patrons, create non-user awareness, and raise awareness of the library's available services and resources (Tella, 2020). Library service delivery is one that fully meets the expectations and requirements of the users. One may argue that libraries are maintaining quality if it gives the correct user the right information at the right time in the proper format. In the context of a library, the term "library service delivery" refers to the discrepancy between users' expectations and impressions of the quality of the service and the actual service (Clement, 2020). Due to the proliferation of information and the integration of ICT into all facets of library services, academic library services are being provided in a way that drives modern practices in the twenty-first century. In spite of this, libraries are utilizing the expanding capabilities of ICTs to offer fresh, creative offerings that improve the manner they assist their current clientele.

Statement of the problem

The sustainable service delivery efforts of academic libraries do not seem to be keeping up with the present level of user expectations and demand for information, nor with the rate at which users wish to obtain it. The quality of service that users receive is negatively impacted by subpar digital services. In Nigeria, a large number of academic libraries lack automated resources and services designed to give users high standard service. With regards to services and marketing values, this fourth industrial revolution significantly impact academic libraries and librarians. Librarians around the world are afraid that the 4IR will have a detrimental effect on their jobs and result in alarmingly high unemployment rates.

Odeyemi (2019) noted that academic libraries in Nigeria are lagging behind in embracing the emerging fields and potentials embedded in the 4th Industrial Revolution; however, the author maintained that existing literatures did not address the status of Nigerian academic libraries in the deployment of 4th Industrial Revolution technologies with emphasis on AI for improving library services delivery. It has been demonstrated that the application of the 4th Industrial Revolution technologies helps librarians, their users, and other libraries to improve on their services. However, the

question arises if it can be applicable for academic libraries in Akwa Ibom State?

According to Vaidya (2018), many librarians are not aware with the concept of 4th industrial revolution technology, such as the utilization of AI in library services delivery; yet, AI represents a new advance in the provision of library services. This study looked at the Fourth Industrial Revolution and Sustainable Library Service Delivery in Academic Libraries in Akwa Ibom State in light of these factors.

Objectives of the study

The main objective of the study is to examine 4th Industrial Revolution and Sustainable Library Service Delivery in Academic Libraries in Akwa Ibom State. The specific objectives are to:

1. identify the types of library services that can be deployed using AI technology in academic libraries in Akwa Ibom State.
2. state the extent of usage of AI technology among librarians in academic libraries in Akwa Ibom State.

Research questions

The following research questions were formulated for the study.

1. What are the types of library services that can be deployed using AI technology in academic libraries in Akwa Ibom State?
2. **What is the extent of usage of AI technology among librarians in academic libraries in Akwa Ibom State?**

Literature Review

The term "fourth industrial revolution" ("4IR") is used, according to Schwab (2016), to describe and evaluate the effects of emerging technologies in the twenty-first century. The concept was first put forth by Klaus Schwab at the World Economic Forum in Davos, Switzerland. He mentioned how it would build upon the third technological revolution, the digital revolution, and be characterized by a merging of technologies that make it more difficult to distinguish between the digital, biological, and physical domains.

Industry 1.0, often known as the First Industrial Revolution, dates back to the early 1760s. The mechanical apparatus that powered this revolution was primarily powered by steam, water, and electricity. The time allowed for the change from an agrarian and feudal civilization to one based on new manufacturing techniques. During this time, trains served as the primary mode of transportation, and coal was also employed as a source of energy (Mafumana, 2019). Commencing in 1900, the Second Industrial Revolution, often known as Industry 2.0, relied on mass production made possible by electricity and the division of labor. The internal combustion engine, which was developed during the revolution and used electricity and oil to power mass production, ushered in a period of rapid industrialization. New electronics and technology were introduced by the Third Industrial Revolution (Industry 3.0) to increase process automation. It introduced computing, the internet, and mainframe computers. History and how things work have been altered by the internet and renewable energy sources. The fourth industrial revolution, or "industry 4.0," was built on technologies like computer-generated product design and three-dimensional (3D) printing, which can create solid objects by stacking layers of materials (Xu, Jeanne & Kim, 2018).

The “4IR” is fueled by disruptive innovation and has a positive impact on key industries and sectors, going beyond simple technological development. sectors and industries include business, health, and education, among others. The revolution has altered the way we work, live, and communicate, as seen by the widespread use of drone delivery services, online shopping, and self-driving cars in modern society. In terms of education, the first industrial revolution was centered on traditional teaching methods like the McGuffey reader. Education was service-oriented throughout the Second Industrial Revolution, which was centered on mass manufacturing and standardized testing. As we entered the Third

Industrial Revolution, students were placed under a customer learning model. The barriers between the physical, digital, and biological domains have been significantly changed by technologies as we enter the 4IR (Schwab, 2016).

Universities and libraries are greatly impacted by the recent growth of technology, which has resulted in a significant change in library services toward the use of modern technologies. Academic libraries should offer the greatest services and make use of the latest technology because they play a significant role in the expansion of the educational system (Emiri, 2019). Academic libraries are currently evolving into fourth-generation libraries, which calls for the use of the newest technology together with the provision of the required space, equipment, and facilities. Libraries now have different collections, services, operations, and functions thanks to technology. To further improve library services, librarians must be proficient in managing the multitude of technologies that have been introduced to libraries thus far.

Furthermore, Yusuf (2022) claims that software for effective reference services, precise textbook scanning, and the identification of pertinent subject areas can be developed using artificial intelligence (AI). AI technology can also assist library patrons in finding resources through intelligent tutoring programs and automated library services. the adoption and usage of AI in libraries will enable improved information processing and search, which will satisfy both staff and patrons by facilitating quicker and simpler access to information. Efficient utilization of library resources is one of these libraries' concerns. For academic libraries to effectively manage their resources, offer services, and draw in patrons, dynamic systems are thus necessary. Artificial intelligence technologies and other new services may be helpful in this regard (Arroyo-Vazquez, 2018).

The emergence of artificial intelligence is arguably the world's most significant and impactful development. Nowadays, relationships, interactions, production, and services are just a few of the areas of human existence where artificial intelligence has a noticeable impact (Aharony, 2019). In order to increase our knowledge, libraries are vital in our daily lives. The idea of artificial intelligence technology, which creates a network by exchanging data about every sensing object, has gained international attention lately. Cloud computing is one sort of artificial intelligence technology that libraries are investigating and developing for their future generation library catalogue. This has shown to be an essential part of these new systems. The efficiency and visibility of a library's collection and administration services are enhanced by cloud computing (Corfe, 2018). A magic mirror is an application-based device that could be installed in libraries all over the place. It would be able to recognize the book a patron is holding, suggest related books, indicate upcoming events, and provide a preview of the book. Another cutting-edge technology is the use of pressure pad sensors in the aisle beneath the floor, which allows the library to track how many patrons are perusing the aisles, aiding in collection development and identifying potential areas in which better signage may be needed. In order to conserve energy and build a smart library, the technology also automatically turns on and off lightbulbs. Wi-Fi-enabled wireless sensor networks allow communication nodes to exchange and collect data from the sensing nodes. The aforementioned technologies work together to increase service effectiveness and transform academic libraries into smart libraries (Schopfel, 2018).

A robotic book delivery system known as BookBot can store up to 2 million volumes and deliver any item within five minutes of the user clicking on the online catalogue thanks to high-density automated shelf technology. BookBot transforms the library from a place of storage into a dynamic center for learning and collaboration with just one-ninth of the space required for standard

bookshelves. The technology scans every book and item that is checked out or returned, allowing the library's online catalog to keep track of all information at all times. More than 18,000 boxes include bar-tagged books and other items that are arranged according to size (Kushins, 2018). The general public is currently the most familiar with artificial intelligence (AI) in numerous ways. However, libraries can employ AI applications to transform its emphasis and attention. The pattern of obtaining data is always evolving. AI provides a very practical way to put this information to work and get better results. Libraries concentrate on utilizing AI to improve content accessibility.

But Pujar and Satyanarayana (2015) noted that the internet has advanced recently from the Internet of Communication to the IoT, enabling the connection and transfer of data between devices with or without human involvement. Better services and communication were facilitated by the Internet of communication, but not without human interaction. The unique feature of the IoT is its ability to link items with very little or no human interaction through the use of sensors and networking capabilities. The concept encourages the convergence of many items, such as RFID tags, sensors, actuators, networked devices, and others, which can communicate with one another to accomplish shared objectives thanks to distinct addressing systems. IoT has many prospects for better and more effective services in a variety of sectors and establishments, including libraries. As a result, Omosor (2021) provided evidence in a research indicating the use of technology-based support services has enhanced academic libraries' ability to provide library services more quickly and accurately, which supports the value of suggested developing technologies for libraries. Libraries have recently been exposed to technologies such as RFID, big data, digital storytelling, IoT, and library bookmark applications.

Higher education institutions, libraries, and their students now function in better environments credited to technology and web-enabled services. Some examples include the library management system, which automates libraries, RFID access control, print resource conservation and security, and Web-OPAC (online public access catalogue), which replaces manual OPAC cataloguing services. Reference desk support is giving way to web-based remote access to information resources (Kaladhar & Rao, 2018). Other recently introduced technologies in libraries include gamification, cloud computing, enabled integrated library management system (which also houses OPAC), virtual reality (VR), artificial intelligence (AI), quick response (QR) barcode technology, and social media applications. These days, libraries are becoming smarter thanks to the introduction of AI, robotics, ambient intelligence, and data mining. This has improved staff work capabilities, satisfied patron needs, and closed the information gap, all of which have a hugely positive impact (Gul & Bano, 2019).

According to Komosany & Alnwaimi's Research on Developing Technologies in Academic Libraries (2021), Online resources offer cutting-edge search and analytical capabilities that increase the accessibility and functional utility of large data sets for researchers. These technologies include machine learning, AI, and big data. According to certain research, artificial intelligence technology was not a commonly used idea in many university libraries, including those in Nigeria. This is also the case for many library workers. The majority of academic libraries are still hesitant to employ AI technology. Lack of seminars or workshops to educate library personnel about the application and value of AI technology in library services is one of the main causes of this. Because of this, the majority of librarians are ignorant about their options and the capabilities of technology (Odeyemi, 2019).

Saibakumo (2021) looked on Nigerian academic libraries' awareness of and adoption of new technologies for the extension of information service delivery. A large number of Nigerian academic libraries, despite their potential to offer efficient services, do not use or are unaware of artificial intelligence technology, according to surveys. This suggests that university libraries' extensive literature reports on patrons' ignorance of artificial intelligence technology. Additionally, Ahmed (2021) examined the obstacles and future directions of contemporary developments in Nigerian library and information science education. It was discovered that a high degree of knowledge about the numerous developing technologies and their importance to academic libraries exist among Nigerian librarians. Instead, as observed in emerging nations, the rate of adoption is lower than anticipated. Librarians also support making cutting-edge technologies, like social media, institutional repositories, Cybrary, library websites, WEBOpac, RFID, integrated library management systems, the use of the Library Guide application, and the Internet of Things, easily accessible for effective service delivery (Massis, 2018).

Research Methodology

Descriptive survey design was adopted for the study. The population of the study comprised 22 professional and 56 para-professionals in UNIUYO, 27 professional staff in AKSU and 4 professional and 1 para-professional staff in FUTIA. The full population of 110 library employees was sampled using the total enumeration sampling approach. The "Fourth Industrial Revolution and Sustainable Service Delivery Questionnaire (FIRSSDQ)" is the primary tool used to collect data. With the assistance of a research assistant, the instruments were administered in Akwa Ibom State's public university libraries. Frequency tables, percentages, and a chart for emphasis were used in the analysis of the gathered data.

Results and Discussion

Results of Findings

The results of the study are presented using frequency table and simple percentages to answer research question, while mean and standard deviation and t-Test are used to test the hypotheses.

Research Question 1: What are the types of library services that can be deployed using artificial intelligence technology in academic libraries in Akwa Ibom State?

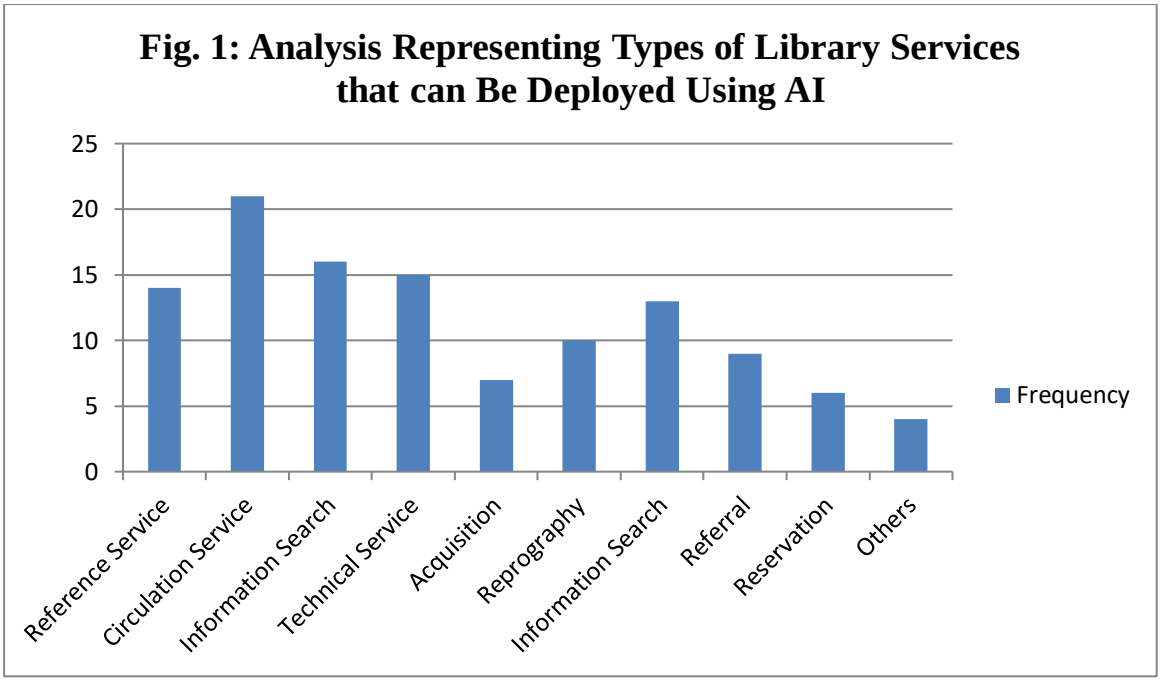
Table 4.1: Percentage Analysis of Types of Library Services That Can Be Deployed Using AI

S/N	Library Services that can be Deployed Using AI Technology	Frequency	Percentage (%)
1.	Reference service	14	12
2.	Circulation service	21	18
3.	Information search	16	14
4.	Technical service	15	13
5.	Acquisition	7	6
6.	Reprography	10	9
7.	Information retrieval	13	11
8.	Referral	9	8

S/N	Library Services that can be Deployed Using AI Technology	Frequency	Percentage (%)
9.	Reservation service	6	5
10.	Others	4	4
	Total	**115**	**100%**

Source: Field Survey

Fig. 1: Analysis Representing Types of Library Services that can Be Deployed Using AI



The above table 1 and figure 1 present the percentage analysis representing types of library services that can be deployed using AI. Table 4.1 presents the percentage analysis of influence of digital literacy skills on information service delivery in public university libraries in Akwa Ibom State. The result revealed that majority of the respondents agreed to the items that they have basic computer skills to enable them carry out task with 78(70%) response. 75(67%) agreed to the statement that they have the ability to use the Internet and web browsers. Furthermore, 68(61%) agreed that they have the ability to establish who owns information and ideas found online, 65(58%) are of the opinion that they can manage email accounts effectively. Also, 71(63%) agreed that they can evaluate information resources they found online, 59(53%) agreed to the statement that they have the ability to filter large numbers of search results quickly and 54(48%) disagreed to the statement that they can manage digital tools like software and applications for various purposes. This finding reveals that there is a significant influence of digital literacy skills on information service delivery sustainability in public university libraries in Akwa Ibom State.

Research Question 2: What is the extent of usage of artificial intelligence technology among library staff in academic libraries in Akwa Ibom State?

Table 4.2: Percentage Analysis of Extent of Usage of AI Technology Among Library Staff

S/N	Level of Usage of AI	VH	H	L	VL	Total

S/N	Level of Usage of AI	VH	H	L	VL	Total
1.	I can navigate via search engines to retrieve information	35 30%	47 41%	11 10%	22 19%	115 **100%**
2.	I can download and install web applications on computer system	23 20%	26 23%	39 34%	27 23%	115 **100%**
3.	I provide current information to users through web OPAC	14 12%	19 17%	54 47%	28 24%	115 **100%**
4.	I can use different web browsers to retrieve information from the Internet	38 33%	30 26%	25 22%	22 19%	115 **100%**
5.	I render reference services to users through the use of web technologies	21 18%	17 15%	48 42%	29 25%	115 **100%**
6.	I can convert and retrieve information in different formats from the web	26 23%	29 25%	37 32%	23 20%	115 **100%**
7.	I can send and retrieve information (documents, images and videos) from emails	42 37%	37 32%	20 17%	16 14%	115 **100%**

Note: VH –Very high H – High L – Low VL - Very low

From the table above, the respondents indicated their extent of usage of artificial intelligence technology. Out of the 115 respondents, 35 constituting (30%) said that they can navigate via search engines to retrieve information to a very high extent, 47(41%) can navigate it to a high extent, 11(10%) said they can navigate search engine to a low extent and 22(19%) to very low extent. Also, 23(20%) of the respondents are of the opinion that they can download and install web applications on computer system to a very high, 26(23%) can do it to a high extent, 39(34%) can do it to a low extent and 27(25%) to a very low extent. Furthermore, 14(12%) said they provide current information to users through web OPAC to a very high extent, 19(17%) to a high extent, 54(47%) does this to a low extent and 28(24%) does it to a very low extent. 38(33%) of the respondents said to a very high extent, they can use different web browsers to retrieve information from the Internet, 30(26%) said they can do same to a high extent, 25(22%) to a low extent and 22(19%) to a very low extent. Also, 21(18%) said they render reference services to users through the use of web technologies to a very high extent, 17(15%) to a low extent, 48(42%) to a low extent and 29(25%) to a very low extent. From their response also, 26(23%) of the respondents said to a very high extent, they can convert and retrieve information in different formats from the web, 29(25%) to a high extent, 37(32%) to a low extent and 23(20%) to a very low extent. Lastly, 42(37%) of respondents to a very high extent can send and retrieve information (documents, images and videos) from emails, 37(32%) to a high extent, 20(17%) to a low extent and 16(14%) to a very low extent.

Discussion of Findings

The findings in table 1 revealed the various types of library services that could be deployed using artificial intelligence technology in academic libraries to include circulation services, information search, technical service, reference service, information retrieval, reprography, referral service, acquisition, reservation and other

services. In support of this conclusion, Arroyo-Vazquez (2018) claimed that in order to manage resources, offer services, and draw in patrons, academic libraries need dynamic systems; new services, such as AI technology which may be helpful in this regard. In support of these justifications, AI can be used to create programs for efficient reference services, efficient textbook scanning, and the selection of suitable subject groups, Yusuf et al. (2022). AI technology can also assist library users in finding resources through intelligent tutoring programs and automated library services. The authors continued by saying that the use of AI in libraries will improve information processing and, at the same time, improve information search, which will excite both library employees and patrons because information will be more readily available.

On the extent of usage of AI technology among staff in academic libraries, it was revealed that library staff can navigate via search engines to retrieve information; they can use different web browsers to retrieve information from the Internet and that library can send and retrieve information (documents, images and videos) from emails. However, low frequency was recorded on the statements that library staff can download and install web applications on computer system; that library staff provide current information to users through web OPAC, they render reference services to users through the use of web technologies and that library staff can convert and retrieve information in different formats from the web. This result is consistent with the findings of Ahmed (2021), who discovered that although Nigerian librarians were highly aware of the various emerging technologies and their importance for academic libraries, their adoption rate fell short of the anticipated trend observed in developing nations. As a result, Komosany and Alnwaimi (2021) corroborated the study by pointing out that many library professionals and academic libraries in Nigeria still do not make extensive use of AI technology. This suggests that the majority of academic libraries are still hesitant to adopt AI technology.

Conclusion

Delivering library services efficiently, effectively, and in a sustainable manner is being elevated to a new level by academic libraries' incorporation of AI technology. Additionally, the adoption gives libraries the chance to provide their clients with better, more engaging services. This study demonstrates how AI is being used to direct and assist library tasks.

Recommendations

The following recommendations are proffered based on the findings of this study;

1. Academic libraries must implement AI in accordance with the most recent standards, government and library administration must work together to provide a path ahead.
2. in order to increase operational efficiency in libraries where the technology is to be adopted or is already in use, library employees should be trained and retrained in the application of artificial intelligence in the provision of library services.

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