FUTURE OF INFORMATION SERVICE DELIVERY USING ARTIFICIAL INTELLIGENCE IN ACADEMIC LIBRARIES IN NASARAWA STATE, NIGERIA

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Abstract

The paper investigated the future of information service delivery using artificial intelligence *in* academic libraries in Nasarawa State. *Four (4) research questions guided the study while two null hypotheses were tested in the study. Descriptive survey design was adopted for the study with the total population comprising of one hundred and fifty-nine (159) library staff from six selected academic libraries in Nasarawa State. Stratified random sampling technique was used in the selection of the respondents from the six academic libraries in Nasarawa State. The instruments for data collection include questionnaire and interviews and the data was analyzed using frequency and simple percentage, mean (X) and standard deviation (SD). Findings of the study revealed the high impacts of artificial intelligence on the future of library and information service delivery. It also pointed application of artificial intelligence by library staff in academic libraries for service delivery. Further findings from the study revealed that, addressing digital divide, transparency and accountability/ job displacement, equity and access/ partnership and collaborations, data quality and integrity, resource allocation/ change management, privacy and security are the main challenges associated with the adoption of artificial intelligence in library and information service delivery in academic libraries. In conclusion, evaluation effectiveness was observed as a strategy that could correct the challenges that alter the workforce of artificial intelligence in library and information service delivery. It is recommended that academic libraries should fully embrace artificial intelligence for effective information services delivery due to its inherent benefits and implications for the future of library and information science profession. Further more, AI-powered service should be designed in a manner that all users can access. AI systems should be transparent and accountable while its data privacy and security should be well secured.*

Keywords: Artificial Intelligence (AI), Library and Information, Service Delivery, University Libraries

Introduction

Generally, intelligence is said to be the state of the capacity of mind, facts or meaning, truth, mainly to understand principles of life, acquired knowledge and apply it to practice; the

willingness to comprehend and learn. Intelligence is the dexterity to ponder, seek, lucubrate facts and skills and apply them when necessary. Developing computers or machines that perceive, lucubrated, mull over and behave like human beings have excited many people. Human beings are born with inherent abilities to mull over and act, which develops and improves over time as a result of so many factors. Intelligence in humans is measured by the Intelligence Quotient (IQ) obtained through series of aptitude test focusing on different aspects of intellectual functioning. Similarly, developing intelligent computers that perceive, think and behave like humans is the crux of Artificial Intelligence.

Artificial intelligence (AI) is the ability of a computer system to perform tasks that would normally require human intelligence, like understanding natural language, recognizing images or objects, and making proper decision Ex Libris (2019),. AI computer systems are often designed in a way to learn and adapt to new idea or data to enable them become more effective, efficient and accurate from time to time. Few examples of AI are self-driving car, virtual assistance and chat bots. AI is a wide discipline that covers many different approaches to developing AI systems. The two major approaches include the following; machine learning and symbolic AI. Machine learning involves training logarithms to recognize patterns into data, while symbolic AI uses rules and knowledge to represent information.

Societal development in recent times have been expedite by the growing demand of access to information with library serving the prime source in providing this access. The paradigm shift in the format and dynamics of information and knowledge as a result of the rapid advancement in computer technology and software applications especially artificial intelligence, have shifted libraries to a demand commensurate to the supply of same technologies. Except libraries begin exploiting the new technologies and innovate their information and services delivery, they may face obsolescence in neoteric times.

Artificial Intelligence is used in many areas such as; military, photography, business, accountancy, sales and advertising, gaming, education mainly in the libraries etc. The ideology of creating Artificial Intelligence systems in libraries dates back to 1990. These intelligent library systems provide enlightenment services to both the library staff and patrons (Asemi & Asemi, 2018). The application of Artificial Intelligence in the library system cut across descriptive cataloguing, subject indexing, reference services, technical services, shelf reading, collection development, information retrieval system etc. This has gone beyond Natural Language Processing (NLP) and knowledge-based services. With the advancement in Artificial Intelligence programming, creating a smart library is not only a possibility but a matter of time. Corroborating this assertion, Corke (2013) reported that researchers and experts in the field of Artificial Intelligence are creating intelligent systems which can think and behave like librarians -library robots.

Libraries are growing living organisms spread in all form of life with activities geared towards the development of man. It evolved basically and structurally and content-wise through different era: the ancient, medieval and modern era. In the ancient times, clay tablets and stones

were used as medium for transmitting information, through the medieval era of papyrus and parchments and the modern era of paper, microform and now the digital or electronic media (Gustavsson & Hedlund, 2011). Libraries have acquired and maintained various forms of information resources throughout these eras so as to meet the information needs of its user communities. Similarly, a library was formally defined as a function of the physical building where books were kept for reading and other purposes. However, the definition of library today has gone beyond the physical building, it now centers on the collections and services offered, since virtual libraries have no physical walls and services could be rendered to users from remote locations. In the effort to satisfy the dynamic information needs of its users at the same time uphold its relevance in this ever-changing technological society, libraries have explored, incorporated and metamorphosed through different technological revolutions of clay tablets, stones, papyrus, parchments, paper, microforms, computers, Internet, virtual libraries, library 2.0, cloud computing etc.

Artificial intelligence is the current technology that has evolved with huge prospects and promising applications in libraries. Hence, the need to explore this tech, its pros and cons, in order to adequately maximize its rich benefits for innovative and optimal services delivery in libraries. Corke (2013) asserted that artificial intelligent systems will be an important technology in this century. In a nutshell, the crux for applying artificial intelligent systems in libraries is the fact that they are less prone to errors unlike human beings; they can work for 24 hours/7 days without getting tired thereby freeing the librarians to do other jobs. Ultimately, since computers can operate efficiently at a scale and speed beyond human abilities, it will maximize speed, efficiency and effectiveness in processing library materials and enhance library services delivery at all levels. An in-depth knowledge to the study of artificial intelligence (AI) in the library services would provide some background information on AI and its potential applications in libraries. It would show and further explain how AI works and some of the common techniques used in other industries, such as machine learning and natural language learning processing. These would also provide an overview of how AI has so far been used in libraries, and some examples of successful implementations.

This work discuss the concepts, foundations, application and advancement in the field of artificial intelligence in libraries, application of robots, virtual, augmented and mixed realities in libraries, their promises, benefits and demerits they hold for future libraries.

Statement of the Problem

Library and information science generally play a key role in the building and promotion of high level of tasks and service delivery to users in academic libraries, particularly in the present AI knowledge-based era. This also underscores the importance attached to AI in all academic libraries. For instance, for any academic library to deliver effective services to its patrons, it must embraced AI technology (gadgets) along-side it services since the technology is known to be reliable and effective in almost all library operations. When carrying out research in an academic library, AI technology will assist the researcher carryout his work smoothly and

effectively without any challenge, though with minimal and to get fast, quality and up-to-date information irrespective of the geographical location of the researcher. This fast and quality assignment performed by AI in an academic libraries, places it above other web technology sources *(*Udensi and Akor 2016).

It is in recognition of this, that the Federal Ministry of Education (FME) initiated AI and other web programmes designed to be lunch by the librarians of the academic libraries into the information global society. Among the programmes, according to Nok (2016), include; automation of academic libraries using Management Information Systems (MIS) and Nigerian Universities Network (NUNET) which was aimed at developing a viable AI components with local and wide area network in the library of various institution of higher learning. The idea is to encourage the use of AI technology in problem solving, data analysis, decision making with its direct involvement in library automation for academic activities in the academic library system (Romero 2018).

Therefore, if quality services are delivered through digital process using AI technology such as Current Awareness Service, charging and discharging service, monitoring of users activities, user's search, recalling among others that are available in the library, it will improve the librarians's work with quick access to information (Nok 2016),.

However, unavailability of Artificial Intelligence technology in the running of academic library operations will affect the future of the library and the extent of its service delivery to their users. This may consequently have negative impact on the quality of their research work. As such, there is need for AI technology services in carrying out effective duties and research in the library. This is imperative as the technology provides libraries with quick access to a very large quality information(s) support multimedia content, provide user- friendly interface, enable 'link' representations to local/external objects (hypertext) and support advanced search and retrieval of information that enrich the quality of research. Asemi, and Asemi, (2022*)* ascertain that, unavailability and provision of AI technology in the library to facilitate the activities of the librarian's task will make the library unattractive to users and the library will not be able to deliver quality and effective service to its users.

In spite of this enormous effort by the National Library Board, Nigerian Library Association, NUC and TETFund on the benefit possessed by the use of AI technology at improving library services and research work, it has been observed that most librarians in academic libraries are yet to come to the knowledge of the benefit of AI technology for effective service delivery (Abram, 2019).

Further interactions with the librarians also suggest they perceived inadequate knowledge of the existence of some of the AI facilities possessed by their libraries. These scenarios if not urgently addressed may have far reaching negative effect on both the academic libraries, researchers, students and other library users. Asemi, and Asemi, (2022*)* observed that, library users may not efficiently derived quality services from the librarians to aid their research work. It

is based on this assumption that the adoption of Artificial Intelligence is been clamored for to see how library and information services delivery could be improved upon.

Objectives of the Study

The general aim of the study is to investigate Library Future in Information Service Delivery Using Artificial Intelligence among Academic Libraries in Nasarawa State, Nigeria.

Specifically, the study objectives are to:

1. To examine the application of artificial intelligence in enhancing library and information service delivery in academic libraries in Nasarawa State.
2. To determine the effects of artificial intelligence applications on the future of library and information service delivery in academic libraries in Nasarawa State.
3. To access the perceived benefits of artificial intelligence applications of library and information service delivery in academic libraries in Nasarawa State.
4. To identify the perceived challenges associated with the use of AI in library and information service delivery in academic libraries in Nasarawa State.

Research Questions

The following research questions are posed for this study:

1. To what extent do AI applications in library and information sciences enhanced service delivery in academic libraries in Nasarawa State?
2. What are the effects of artificial intelligence on the future of library and information service delivery in academic libraries in Nasarawa State?
3. What are the perceived benefits of AI applications in library and information science service delivery in academic libraries in Nasarawa State?
4. What are the perceived challenges associated with the use of artificial intelligence in library and information science service delivery in academic libraries in Nasarawa State?

Hypotheses

Two null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

Ho_1: There is no significant difference between the effect of AI on library and information services delivery among academic libraries in Nasarawa State, Nigeria.

Ho_2: There is no significant difference between the application of AI on library and information services delivery among academic libraries in Nasarawa State, Nigeria.

Literature Review

Generally, artificial Intelligence is of relevance to libraries because it is useful in the organization and providing large collections of information for users (ALA, 2019). According to Sridevi and Shanmugam (2017), artificial intelligence is the modern technology which is used to manage the digital library. The ultimate promise of artificial intelligence is to develop computer systems or machines that think, behave and in fact rival human intelligence, and this clearly has major implications on librarianship. Artificial intelligence is not just an intelligent system or

software program, it is a biologically motivated technology used to replicate human ways of perceiving and processing information (Sridevi & Shanmugam, 2017). Intelligent library automation systems rely on artificial intelligence technologies to provide knowledge-based services to library clientele and staff. Artificial intelligence in libraries should not be misconstrued with library automation (Jacknis, 2017). Main while the recent implies the degree of mechanisation to routine library operations, the former goes beyond just automating library activities, and create intelligent rational systems that behave and act like librarians and requires little or no human intervention. Artificial intelligent systems can replicate and thus replace a human being in the library, although Li, Huang, Kurniawan and Ho (2015) believed that this invention will never replace librarians, but will center on menial and time-consuming library operations such as shelf reading and leave the librarians to engage with the patrons. Corroborating this assertion, Murphy (2015) maintained that the application of robots in libraries will bring librarians and users closer together, against the notion that robots will alienate librarians from their users.

The modern information retrieval tools now used in libraries to provide quick and innovative access to information include: electronic databases, Online Public Access Catalogue (OPAC), web search engines, and robotic systems customised for book retrieval and delivery. Most web search engines today such as Google, incorporates speech recognition to their system. This enable their users to speak the word or phrase they want to search and the web search engines types it into the search box via the use of Natural Language Processing (NLP) before searching and displaying the search results. In addition, Murphy (2015) reported that robotics technology is being used to free space restraints and make information resources readily accessible to users.

The development of shelf reading robots and others gadgets shows that, it is now only a matter of time, the present generation libraries will be flooded with the impact and utility of new applications based on artificial intelligence (Shohana, 2016). There is no doubt that in the nearest future, artificial intelligence may revolutionize many sectors of life, including the library development of shelf reading robots as opined by Li, Huang, Kurniawan and Ho (2015) and others as it is a matter of time it is a matter of time. Information retrieval is another aspect of librarianship that has felt the touch of artificial intelligence. Library information retrieval deals with the recall of information or resources from a file or database, it is concerned with the structure, analysis, organization, storage, searching, and retrieval of information stored in a library collections, information centre or the Internet (Croft, Metzler & Strohman, 2015). As the information held in libraries grew, several types of information retrieval tools were invented to cope with the vast amount of information therein and make them accessible to users. Nowadays, the quantity of new information being generated is at an exponential rate, this led to the invention and use of computerised and artificial intelligence retrieval systems to facilitate information searching and retrieval from the library collection, be it paper-based or electronic (Unagha, 2010). Artificial intelligence has gained tremendous benefits in library information

services, these include but are not limited to; automatic cataloguing and classification using Optical Character Recognition (OCR), automatic translation of foreign language materials using Natural Language Processing (NLP), automatic indexing using Expert Systems etc.

Furthermore, artificial intelligence facilitates human work with greater speed, efficiency and effectiveness in work environments such as the library. According to Vijayakumar and Vijayan (2011), artificial intelligence and expert systems are used in classification, cataloging and indexing of library materials. Via the use of optical character recognition and neural network, the system is able to obtain the bibliographic records of books and classify them accordingly. According to Asemi and Asemi (2018), natural language processing can be used to reduce language barriers. In addition, expertise is needed in the provision of qualitative service delivery in libraries, as such, artificial intelligence and expert systems will improve the performances of library services and reduce the rate of human errors and defects and can perform task faster than a human being can most likely (Shohana, 2016).

A good librarian, through working with a user, can provide a much better tailored service, potentially using up time freed up by using AI. – IFLA Library Policy and Advocacy Blog

The benefits of artificial intelligence in libraries can be summarized as according to ex libris (2019), artificial intelligence in libraries can make research more discoverable which can boost research productivity among faculty members, bridge in time, bridge in space, maximization of efficiency, maximization of effectiveness, minimization of effort, improved and immersive user experience in library services delivery. Although artificial intelligence is a promising innovative idea in the library system, it is not without disadvantages. Shohana (2016) outlined some of the disadvantages of artificial intelligence as follows:

Artificial intelligence systems have the ability to replace human jobs thereby increasing the rate of unemployment in the society. This is an issue of concern among librarians for decades. The fear is that intelligent machines with capabilities of shelving books, retrieving information, answering reference queries and attending to users have great potentials of replacing librarians, leaving them unemployed. Jasrotia (2018) also opines that as intelligent machines in libraries can read digitized resources, analyse and offer customized insights, answers and services faster than librarians, the possibility of AI being a ‘threat’ to librarians but not to libraries does exist. This is probably why many librarians do not like the issue of concern among librarians for decades. The fear is that intelligent machines with capabilities of shelving books, retrieving information, answering reference queries and attending to users have great potentials of replacing librarians, leaving them unemployed. Jasrotia (2018) also opines that as intelligent machines in libraries can read digitized resources, analyse and offer customized insights, answers and services faster than librarians, the possibility of AI being a ‘threat’ to librarians but not to libraries does exist. This is probably why many librarians do not like the idea of artificial intelligence in libraries. Nevertheless, Guion (2019) argues that librarians would still be needed because machines with AI systems would still not be able to fully discern what a library user wants as sometimes search terms do not fully explain the need or even judge how well their

outputs conforms to basic library principles of intellectual freedom, copyright and privacy, intelligent systems lack that common base of human knowledge, severely constraining the types of functions that they can perform, level of effort and technical expertise needed to create artificial intelligence systems in libraries. The level and nature of effort that must be invested to develop an intelligent library system is directly proportional to the power and complexity of the system. This implies that, the more intelligent the system is, the more the effort that must be invested therein. Currently, the required skilled personnel with expensive development tools or techniques, needed to develop sophisticated intelligent system in libraries are lacking or costly, hence, the lack of such systems in libraries, limited amount of artificial intelligence experts among library automation vendors. The field of artificial intelligence is complex and thus, requires a specialised knowledge in that aspect far beyond the development of conventional library automation systems. Consequently, this will require hiring new personnel in that area before any significant, widespread work can be done in the area of artificial intelligence systems in libraries.

Methodology

A descriptive survey research design was adopted for the study to investigate library future in information service delivery using artificial intelligence among academic libraries in Nasarawa State, Nigeria. With a targeted population of one hundred and fifty nine library staff among some selected academic libraries which include Federal University of Lafia, Nasarawa State University, Keffi, Federal Polytechnic, Nasarawa, College of Education Akwanga, Isa Mustapha Agwai Polytechnic, Lafia and College of Agriculture Science and Technology, Lafia. Stratified random sampling technique was used to determine the selection of the six public tertiary institutions in Nasarawa State, Nigeria. The choice of adopting this technique is to give a uniform percentage of the six public tertiary institutions used since all share similar characteristics.

Data was collected using a close-ended questionnaire, and analysis was carried out using frequency counts, relative frequencies, means, tables, and charts.

Results of the Study

Table 1: Questionnaire Distribution/ Returned

Selected Tertiary Institutions	Number of Questionnaires/Distributed	Number of Questionnaire Copies Retrieved	Return Rate
Federal University of Lafia	38	35	24.47
Nasarawa State University, Keffi	28	25	17.48
Federal Polytechnic, Nasarawa	32	29	20.27

College of Education Akwanga	21	18	12.58
Isa Mustapha Agwai Polytechnic, Lafia	23	20	13.98
College of Agriculture Science and Technology, Lafia	17	16	11.18
Total	**159**	**143**	**99.96**

Source: Institutions Library

Table 1 above indicated that 159 questionnaire were distributed to respondents within the affected institutions, out of which 143 representing (99.96) were fully filled and returned. Federal University of Lafia have the highest number of distribution of 38 questionnaire in which 35 copies representing 24.47% were returned. This is followed by Nasarawa State University, Keffi with 28 distribution where 25 or (17.48%) were retrieved back. Federal Polytechnic, Nasarawa got 32 with 29 or (20.27%) returned. Total number of 21 questionnaire was administered at College of Education, Akwanga with 18 or (12.58%) retrieval rate while Isa Mustapha Agwai 1 Polytechnic, Lafia, 23 was administered and 20 or (13.98) returned and College of Agriculture, Science and Technology, Lafia had the least number of questionnaire administration of 17 with 16 or (11.18%) fully returned.

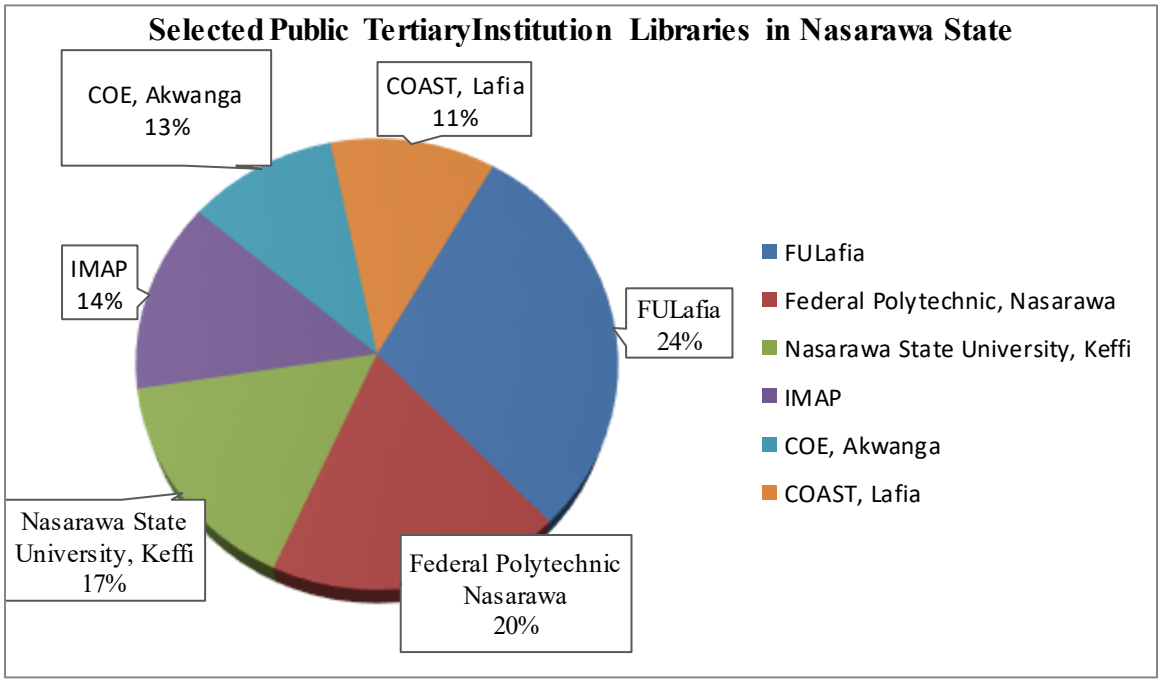

Figure 1: Study Population of Library Staff Working in some Selected Academic Libraries

This section contains the analysis and presentation of results regarding gender and marital status of the respondents.

Table 2: The Demographic Data of the Respondents

Demographics of the Library Staff	Frequency	Percentage (%)
Gender		
Male	82	51.6
Female	77	48.4
Marital status		
Married	66	41.5
Single	93	58.5

Generally, it can be deduced that two genders of the respondents with their marital status were represented, and the result generated covers both male and female likewise married and single library staff opinion, where male staff out-numbered their female colleagues as well as the singles also out-numbered their married counterparts in the academic libraries in Nasarawa State.

This Section is devoted to Responding to the Five Research Questions Drawn to drive this Study.

Research Question 1: To what extent do AI applications in library and information sciences enhanced service delivery in academic libraries in Nasarawa State?

Table 3: How Artificial Intelligence can be Apply

S/N	Items	VHE	HE	LE	VLE	$\overline{X}$	Decision
1	**Library Management**	79 (30.0%)	127 (48.3%)	20 (14.1%)	37 (14.1%)	**4.0**	**Agreed**
2	**Search Engine**	77 (29.3%)	7 (2.7%)	14 (5.3%)	165 (62.7%)	**1.2**	**Disagreed**
3	**Virtual Assistants**	62 (23.6%)	12 (4.6%)	32 (12.2%)	147 (55.9%)	**1.8**	**Disagreed**
4	**Automated Cataloguing**	132 (50.2%)	72 (27.4%)	40 (15.2%)	19 (7.2%)	**3.1**	**Agreed**
5	**Data Analysis**	19 (7.2%)	189 (71.9%)	49 (18.6%)	6 (2.3%)	**3.0**	**Agreed**
6	**Research Assistance**	26 (9.9%)	154 (58.6%)	51 (19.4%)	22 (8.4%)	**3.2**	**Agreed**
7	**User Outreach**	14 (5.3%)	111 (42.2%)	78 (29.7%)	60 (22.8%)	**1.6**	**Disagreed**
8	**Recommendation System**	14 (5.3%)	67 (25.5%)	32 (12.2%)	127 (48.3%)	**3.0**	**Agreed**
9	**Collection**	22	61	115	65	**2.0**	**Disagreed**

	Analysis	(8.4%)	(23.2%)	(43.7%)	(24.7%)		
10	**Digital Preservation**	32 (12.2%)	114 (43.3%)	91 (34.6%)	26 (9.9%)	**2.6**	**Agreed**

Key: VHE=Very High Extent, HE=High Extent, LE=Low Extent, and VLE=Very Low Extent

Table 5 shows librarians' responses regarding how artificial intelligence can be applied in library and information science for service delivery in academic library. From the table, majority of the librarians at great extent agreed that Library Management is one of the ways AI can be applied with mean score $\overline{X}$ = 4.0, Research Assistance ($\overline{X}$ = 3.2), Automated Cataloguing ($\overline{X}$ = 3.1), Data Analysis ($\overline{X}$ =3.0), Recommendation System ($\overline{X}$ = 3.0), and Digital Preservation ($\overline{X}$ =2.6). In another opinion, some responses from the librarians suggest Collection Analysis ($\overline{X}$ =2.0), Virtual Assistants ($\overline{X}$ =1.8), User Outreach ($\overline{X}$ =1.6) and Search Engine ($\overline{X}$ =1.2) in an insignificant manner.

Research Question 2: What are the effects of artificial intelligence on the future of library and information service delivery in academic libraries in Nasarawa State?

Table 4: Effects of Artificial Intelligence

Items Regarding Extent of Agreement or Disagreement in terms of the Effects of Artificial Intelligence	**VH**	**H**	**L**	**VL**	$\overline{X}$	**Decision**
Improved efficiency: AI automate routine tasks, freeing up staff to focus on more complex activities	11 (4.2%)	252 (95.8%)	-	-	3.0	Agreed
Enhanced users experience: AI-powered services provide personalized support and recommendation	100 (38%)	163 (62%)	-	-	3.4	Agreed
24/7 support: AI-powered chat-bots provide round-the-clock assistance	89 (33.8%)	92 (35%)	53 (20.2%)	-	3.2	Agreed
New services and programs: AI enable libraries to offer new services and programs, such as AI-powered research assistance	115 (43.7%)	148 (56.3%)	-	-	3.4	Agreed
Partnership and collaborations: libraries can partner with other organization to leverage AI technologies	121 (46.0%)	152 (57.8%)	19 (7.2%)	-	3.3	Agreed
Professional development: libraries can develop new skills to work effectively	116 (44.1%)	147 (55.9%)	-	-	3.4	Agreed

with AI technologies						
Continuous evaluation and improvement: libraries must regularly assess and improve AI-powered services.	24 (9.1%)	153 (58.2%)		-	3.1	Agreed
Integration with emerging technologies: AI will likely be integrated with other technologies, such as blockchain and IoT	239 (90.9%)	102 (38.9%)	8 (3.0%)	-	3.5	Agreed
AI-powered search engines: improve search results and relevance	11 (4.2%)	252 (95.8%)	-	-	3.0	Agreed
Content discovery: helps users discovered new resources and topics	252 (95.8%)	11 (4.2%)	-	-	3.0	Agreed

Key: VH = Very High; H = High; L = Low, and VL = Very Low

Table 2 shows the effects of artificial intelligence in the first and second column as "Very High" and "High" by the library staff. This is a proof that the respondents observed a high level of the effects of artificial intelligence that is needed for the future of library and information science operations such as; Integration with emerging technologies: AI will likely be integrated with other technologies, such as blockchain and IoT indicated by the $\overline{X}$ = 3.5; Enhanced users experience: AI-powered services provide personalized support and recommendation indicated by the $\overline{X}$ = 3.4; Professional development: libraries can develop new skills to work effectively with AI technologies indicated by the $\overline{X}$ = 3.4; New services and programs: AI enable libraries to offer new services and programs, such as AI-powered research assistance indicated by the $\overline{X}$ = 3.4; Improved efficiency: "AI automate routine tasks "freeing up staff to focus on more complex activities" as indicated by the $\overline{X}$ = 3.0; AI-powered search engines: improve search results and relevance as indicated by the $\overline{X}$ = 3.0; Content discovery: helps users discovered new resources and topics as indicated by the $\overline{X}$ = 3.0; Partnership and collaborations: libraries can partner with other organization to leverage AI technologies, Professional development: libraries can develop new skills to work effectively with AI technologies, 24/7 support: AI-powered chat-bots provide round-the-clock assistance

Research Question 3: What are the perceived benefits of AI applications in library and information science service delivery in academic libraries in Nasarawa State?

Table 5: Perceived Benefits of Artificial Intelligence Application

Perceived Benefits of Artificial	**VHE**	**HE**	**LE**	**VLE**	$\overline{X}$	**Decision**

Intelligence						
Resource optimization: AI can help libraries optimize resources allocation, reducing waste and improving efficiency.	19 (7.2%)	205 (77.9%)	18 (6.8%)	21 (8%)	2.8	**Agreed**
Personalized services: AI can provide personalized recommendations, search results and research assistance	25 (9.5%)	146 (55.5%)	92 (35.0%)	-	2.7	**Agreed**
24/7 Support: AI powered chat-bots can round-the-clock support and answer frequently asked questions	97 (36.9%)	80 (30.4%)	71 (27.0%)	15 (5.7%)	2.0	**Agreed**
Improved accessibility: AI can help make library resources and services more accessible to users with disabilities.	77 (29.3%)	65 (24.7%)	44 (16.7%)	77 (29.3%)	2.5	**Agreed**
Text and data mining: AI powered text and data mining can help researchers extract insights and knowledge from large datasets.	10 (3.8%)	253 (96.2%)	-	-	3.0	**Agreed**
Search strategies: AI can construct search strategies for locating information resources	32 (12.2%)	60 (22.8%)	131 (49.8%)	40 (15.2%)	2.3	**Disagreed**
Predictive analysis: AI powered predictive analysis that can help libraries anticipate and prepare for future trends and demands	4 (1.5%)	251 (95.4%)	3 (1.1%)	5 (1.9%)	3.0	**Agreed**
Collaborative tools: AI powered-collaborative tools that can facilitate communication among researchers	52 (9.8%)	201 (76.4%)	10 (3.8%)	-	3.2	**Agreed**
Automated tasks: AI can automate routine tasks, such as cataloguing, classification and data entry.	40 (15.2%)	214 (81.4%)	9 (3.4%)	-	3.1	**Agreed**
Digital technology: AI can provide digital devices (i.e. the ability to use digital technology tools/devices)	25 (9.5%)	146 (55.5%)	92 (35.0%)	-	2.7	**Agreed**

Key: VHE= Very High Extent; HE= High Extent; LE = Very Low Extent, and VLE= Very Low Extent

Table 5 Attributes such as Collaborative tools: AI powered-collaborative tools that can facilitate communication among researcher scored high with $\overline{X}$ = 3.2. This is followed by Automated tasks: AI can automate routine tasks, such as cataloguing, classification and data entry with $\overline{X}$ = 3.2, and the next highest been Text and data mining: AI powered text and data mining can help researchers extract insights and knowledge from large datasets and Predictive analysis: AI powered predictive analysis that can help libraries anticipate and prepare for future trends and demands accordingly. Exception of Digital technology: AI can provide digital devices (i.e. the ability to use digital technology tools/devices) and Improved accessibility: AI can help make library resources and services more accessible to users with disabilities that recorded lower score of $\overline{X}$ = 2.7 and $\overline{X}$ = 2.5 respectively.

Research Question 4: What are the perceived challenges associated with the use of artificial intelligence in library and information science service delivery in academic libraries in Nasarawa State?

Table 6: What are the Perceived Challenge Associated with the Used of Artificial Intelligence

S/N	Perceived Challenge Associated with the Used of AI	SA	A	D	SD		$\overline{X}$	Decision
1	Privacy and Security: AI system requires access to use data arising concerns about privacy and security.	-	142 (54%)	121 (46%)	-		2.5	Agreed
2	Transparency and Accountability: AI systems can be complex, making it difficult to understand decision making process	115 (43.7%)	148 (56.3%)	-	-		3.4	Agreed
3	Equity and Access: AI powered service may exacerbate existing inequality if not designed to be inclusive.	89 (33.8%)	174 (66.2%)	-	-		3.3	Agreed
4	User Trust and Acceptance: some users may be hesitant to trust to trust AI-powered services.	12 (4.6%)	49 (54%)	142 (54%)	51 (19.4%)		2.0	Disagreed
5	Job Displacement: AI may	124	132	7	-		3.4	Agreed

	automate some tasks currently performed by library staff	(47.1%)	(50.2%)	(2.7%)				
6	Data Quality and Integrity: AI systems requires require high-quality data to function effectively	44 (16.7%)	219 (82.3%)	-	-		3.2	Agreed
7	Partnership and Collaborations: Library may need to partner with other organization to leverage AI technologies.	72 (27.4%)	191 (72.6%)	-	-		3.3	Agreed
8	Addressing Digital Divide: AI-powered services may widen the digital divide if not designed to be accessible to all users.	217 (82.5%)	37 (14.1%)	9 (3.4%)	-		3.7	Agreed
9	Keeping up with rapid technological change: AI technologies are rapidly evolving, making it challenging for libraries to stay up to date	-	137 (52.1%)	37 (14.1%)	89 (33.8%)		2.2	Disagreed
10	Resource Allocation: Implementing AI-powered services may require significant resources.	77 (29.3%)	120 (45.6%)	66 (25.1%)	-		3.0	Agreed
11	Change Management: Introducing AI-powered services may require significant to library operations.	188 (71.5%)	-	-	38 (14.4%)		3.0	Agreed
12	Evaluating Effectiveness: Libraries needs to develop methods to evaluate the effectiveness of AI-powered services	-	52 (19.8%)	159 (60.5%)	52 (19.8%)		2.0	Disagreed

Key: SA=Strongly Agreed, A= Agreed, D=Disagree and SD=Strongly Disagree

Table 5 above shows that most of the challenges listed were strongly agreed and agreed such as; addressing digital divide ($\overline{X}$ =3.7), transparency and Accountability/ job displacement ($\overline{X}$ =3.4), equity and access/ partnership and collaborations $\overline{X}$ =3.3), data quality and integrity ($\overline{X}$ =3.2), resource allocation/ change management ($\overline{X}$ =3.0), privacy and security ($\overline{X}$ =2.5). while few respondents disagreed in their responses to the challenges face by artificial intelligence in library

and information science service delivery in academic library like; keeping up with rapid technological change ($\overline{X}$ =2.2), user trust and acceptance ($\overline{X}$ =2.0) and evaluating effectiveness ($\overline{X}$ =2.0).

Discussion of Findings

From a demographic point of view, the breakdown of the data reveals that majority of the respondents were males, it also indicate that 66 (41.5%) of them were married, while 93 (58.5%) were single. The effects of artificial intelligence to the future of library and information service delivery is "Very High" and "High" from the responses of the library staff, as supported by the associated means, as shown in Table 4 above, is appreciably high.

This finding is supported by Li, Huang, Kurniawan and Ho (2015) research outcome that pointed out that the application of artificial intelligence by library staff in academic libraries for service delivery will enable the future of Library and Information Science profession. Also of interest to the study is the fact that Library Management ($\overline{X}$=4.0), Research Assistance ($\overline{X}$=3.2), Automated Cataloguing ($\overline{X}$=3.1), Data Analysis ($\overline{X}$=3.0), Recommendation System ($\overline{X}$=3.0) were high. While Digital Preservation ($\overline{X}$=2.6), Collection Analysis ($\overline{X}$ =2.0), Virtual Assistants ($\overline{X}$ =1.8), User Outreach ($\overline{X}$ =1.6) and Search Engine ($\overline{X}$ =1.2) were considered as low perceived significance.

Further findings from the study revealed that, addressing digital divide ($\overline{X}$ =3.7), transparency and Accountability/ job displacement ($\overline{X}$ =3.4), equity and access/ partnership and collaborations $\overline{X}$ =3.3), data quality and integrity ($\overline{X}$ =3.2), resource allocation/ change management ($\overline{X}$ =3.0), privacy and security ($\overline{X}$ =2.5) are the main challenges face by artificial intelligence in library and information science service delivery in academic library. This could, therefore, be substantiated by the findings of Coke (2016), who asserted that artificial intelligent systems (robots) will be an important technology in this century. But, the crux for applying artificial intelligent systems in libraries is the fact that they are less prone to errors unlike human beings; they can work for 24 hours/7 days without getting tired thereby freeing the librarians to do other jobs.

As supporting evidence, (Shohana, 2016) pointed out "evaluation effectiveness will be used as a strategy in place to correct the challenges that alter the workforce of artificial intelligence in library and information service delivery.

Conclusion

Findings of the study reveal**ed** the high **impacts** of artificial intelligence to the future of library and information service delivery. It also pointed application of artificial intelligence by library staff in academic libraries for service delivery. Further findings from the study revealed that, addressing digital divide, transparency and accountability/ job displacement, equity and access/ partnership and collaborations, data quality and integrity, resource allocation/ change management, privacy and security are the main challenges face by artificial intelligence in

library and information science service delivery in academic library. In conclusion, evaluation effectiveness was observed as a strategy that could correct the challenges that alter the workforce of artificial intelligence in library and information service delivery.

Recommendations

It is recommended that academic libraries should **fully** embrace artificial intelligence **for effective information service delivery due to its inherent** benefits for the effective future of library and information science profession. Also that AI-powered service should be designed in a manner that all users can access. In addition to transparency and accountability, AI systems should be transparent and accountable wit clear decision making process and its data privacy and security should be well secured.

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