Available online at https://asric.africa/social-sciences
ASRIC Journal on Social Sciences and Humanities Vol 4(2) (2023) 306-315

Awareness and Availability of Artificial Intelligence (AI) and Machine Learning (Ml) in Academic Libraries in Northern, Nigeria

Oghenevbaire Efevberha-Ogodo[1*], Oghenetega Ivwighreghweta[2]

[1]College of Computing, Western Delta University, Oghara, Delta State
[2]University Library, Western Delta University, Oghara, Delta State

*Corresponding author: anthonyoghenetega@yahoo.com

Abstract
In this research, artificial intelligence and machine learning in academic libraries in Northern Nigeria were examined for availability and knowledge. The study used a descriptive survey methodology. The study's objectives were to determine academic librarians' level of knowledge about AI/ML, what kinds of AI/ML tools are available and used in these libraries, how academic librarians use them to provide library services, and what obstacles stand in the way of their use and adoption by academic libraries. 230 academic librarians who attended the Nigerian Library Association (NLA) conference in Akure, Ondo State in 2023 make up the study's population. The study recommended, among other things, that tertiary institution heads and library heads should make sure their libraries are adequately furnished with modern ICT resources in order to promote the use of AI/ML systems, and that AI/ML experts in the Departments of Computer Science should work with librarians and information specialists in the library in the areas of staff training and retraining in order to improve staff members' skills in the use of AI/ML systems.
Key Words: Artificial Intelligence (AI), Machine Learning (ML), Academic libraries, Northern, Information and communication technology, Robots, Nigeria**.**

1.0 Introduction

Artificial intelligence (AI) is the capacity of a computer or robot to carry out activities that are often done by intelligent individuals. Efforts to create artificial intelligence (AI) systems with cognitive abilities like to those of humans, such as the capacity to reason, decipher meaning, generalise, and learn from experience, are often referred to by this title. The main goals of AI include reasoning, discovery, generalisation, object manipulation, and natural language processing (Copeland, 2015; Tella, 2020).

According to Nwakunor (2021), artificial intelligence (AI) refers to robots that are controlled by computers and have intellect akin to humans. These robots are operated by simulating the mental capabilities of humans using a computer and electrical control. Artificial intelligence keeps track of and analyses every action a user does. As a result of advancing science and technology, artificial intelligence is applied in every part of life for human comfort and development.

Microsoft Encarta dictionary (2009) defined AI as a branch of computer science that creates software to enable computers to carry out tasks that would typically need human intellect, examples are, online platforms and computerised machines like robots. It explains that one of the main advantages of AI is that by automating complicated and time-consuming tasks, it frees up time that would be spent on them and allows humans to concentrate on other intelligent activities.

The majority of the modern technology we use have AI/ML characteristics; examples include chatbots, e-payment, face recognition text editors, Google Assistant, voice search, and Google Translate (Ali, 2020).

A library management system like Web-OPAC (online public access catalogue), which automates libraries for access control, conservation, and security of print materials, has enhanced the working environment for libraries and their users as compared to a manual OPAC for cataloguing services. As a result, the reference desk service was replaced with web-based remote access to information resources. To make sure that services are provided to consumers effectively and efficiently, these reactive automated systems are given repetitive jobs in the library (Echedom & Okuonghae, 2021).

According to Liu (2011), who supported the claim that integrating AI/ML into library operations would assist in providing library users the best service possible. In order to better serve its customers, the library now has a leg up thanks to AI/ML robots. The use of AI/ML in libraries can be seen as the culmination of a number of cutting edge technological advancements that have made it possible for libraries to have access to devices that can perceive, understand, act, and learn. Using cutting-edge technologies is one new trend in libraries, making librarianship a profession known for doing so (Owolabi et al., 2022).

The use of AI/ML in libraries has affected information technology connection, actively encouraged information utilisation, facilitated client search, and promptly met client information demands. Future libraries will take on a very different character as a result of AI/ML and modern computer technology, according to experts (Vijayakumar & Sheshadri, 2019). Thus, this study set out to assess the degree of awareness and availability of AI/ML tools in academic libraries in Northern, Nigeria

2.0 Objective of the Study

Investigating the availability and knowledge of AI/ML in university libraries in South-South, Nigeria, was the study's major goal. The study has the following precise goals:

i. To assess academic librarians in Northern Nigeria's degree of understanding of AI/ML technologies.
ii. Learn about the many AI/ML technologies that university libraries provide.
iii. Identify the methods through which academic librarians use AI/ML technologies to provide effective library services.
iii. List the barriers to the usage and use of AI/ML technologies by academic librarians.

3.0 Research Questions

The study presented answers to the following questions:

i. What is the level of awareness of AI/ML tools by academic librarians in Northern, Nigeria?
ii. What types of AI/ML tools are available in the academic libraries?
iii. How do academic librarians apply AI/ML tools to offer efficient library services?
iv. What are the obstacles to the utilization and adoption of AI/ML tools in academic Librarians?

4.0 Statement of the Problem

The advent of AI/ML is so robust that it has changed many narratives on how tasks are executed by humans in recent times. Its use and availability in libraries can be seen as the culmination of a number of cutting edge technological improvements that have made it possible for libraries to have access to devices that can perceive, understand, act, and learn (Owolabi et al., 2022). However, it has been observed in most literature such as the ones of Emiri (2023), Oyewale and Aishatunya (2023) and Codex (2019) that there is low level of awareness and availability of AI/ML tools in libraries. Personal observation by the researchers also indicated the same situation in university libraries in Northern, Nigeria. This phenomenon may not be unconnected with the fact that stakeholders in the academic sector have not invested in AI/ML systems and also have not encouraged the training of librarians who are afraid that intelligent robots will take over their jobs when AI/ML is adopted and used. Thus, this study investigated the awareness and availability of AI/ML in academic libraries in South-South, Nigeria.

5.0 Literature Review

The following concepts are discussed in the review of related literature:

5.1 Concept of Artificial Intelligence and Machine Learning

The field of AI has seen tremendous developments since 1956 when the word was first formed by a group of researchers. AI is the science of computing that seeks to imbibe intelligent behaviors in a computer system. Experts in the field of AI purports that a computer machine of software can be described as intelligent if it can replicate certain functionalities of humans and other intelligent organisms do. The ability of this machine to be able to observe and learn from its experiences is also a critical feature that displays intelligence (Wahl *et al*., 2018).

A significant branch of AI is Machine Learning (ML). ML was formulated when the idea that computer machines can exhibit learning capabilities without clearly following a specific set of instructions as computers have previously been directed to do was birthed (Mueller & Massaron, 2016). This idea was conceived out of another branch of AI known as Pattern Recognition. Data is a core requirement in ML and together with particular techniques is what leads to discovery of new information previously unknown. The same way humans learn using different methods including learning from experience, following clear instructions and even collecting information, computers can also learn in different ways using step-by-step instructions known as algorithms (Vysakh & Babu, 2020).

Machine Learning has gone far beyond a concept in AI and it is gradually being applied ubiquitously in our everyday life. In the finance industry, credit card companies employ machine learning to detect fraudulent transaction. The automatic friend tagging suggestion feature on Facebook is a clear indication of the use of ML through Image and Face Recognition. Tesla's self-driving vehicle production and the operations of ridesharing services like Uber, Bolt, and Taxify both use machine learning algorithms. Machine learning is applied in the implementation of virtual assistants like Siri and Alexa which can listen, hear and respond to speech (Mueller & Massaron, 2016). Meaningful assertions can result from the large volumes of data that is available in the library by identifying relevant patterns which will improve decision making of librarians. Machine learning techniques have also been applied to library management in tertiary institutions. ML can be applied in the library for offering references services, cataloguing, classification, indexing, acquisition of books, image recognition for users' identification, for recommending reading materials to library users based on borrowing history, monitoring library users' activities and it can also predict the reading habits of library users.

5.2 Awareness and Availability of Artificial intelligence and Machine learning in Libraries

AI and machine learning have significantly changed how humans think, behave, and make choices during the last several decades (Vysakh & Babu, 2020). Integrating AI/ML tools in libraries is a developmental strategy that most libraries have come to embrace. There are a lot of services that libraries offer, with the use of ML, the duties of the librarians can be made more effective and proficient service rendered. It could as well improve the relevance of libraries in this era of scientific advancement (Obiano et al., 2022).

On whether or not to utilise AI/ML, robotics, and other forms of technology in library operations and services, there have been a number of discussions among librarians and information scientists. According to Momoh (2018), the addition of ICT to libraries has led to the emergence of several schools of thought. This is because a number of people think that AI and ML may jeopardise the careers of librarians and other information specialists. Galeon (2017) expressed worry over the issue. He said that when intelligent robots replace humans in the workforce, people would almost likely be forced to leave the globe in search of new homes.

In the 2023 research by Oyewale and Aishatunya, 80% of the respondents admitted to knowing about AI, saying it was intended to simplify library chores rather than replace librarians' employment, and lastly said that AI has not yet been accepted and employed in the examined libraries. Based on the results, the awareness level of librarians was high, however, AI is yet to be adopted among the libraries surveyed. The study, therefore, suggested that stakeholders need to invest in AI and also encourage the training of librarians.

Abayomi et.al., (2020) affirmed that most academic librarians were aware of the existence of AI/ML usage in their libraries. Similarly, Berdasco et al., (2019) claimed that ninety-nine percent of their respondents were aware of AI/ML but, only eighty-six percent had made use of them. Codex (2019) stated that at least twenty-two percent of librarians investigated were aware of having used AI/ML tools at some point as part of their job duties. Despite the fact that they each conveyed a different understanding of the idea.

Emiri (2013) discovered that libraries in Southern Nigeria have implemented AI at an incredibly sluggish pace. The technology that is most often employed to stop harmful users from illegally seizing or stealing library resources is the security scanning apparatus at entry/exit points of libraries. Despite these benefits, Southern Nigerian educational institutions have not fully adopted AI, which explains why university libraries still have very low adoption rates.

Yusuf et al. (2022) primarily focused on librarians' ignorance of how to utilize AI to meet their service expectations and the major disruption that AI has brought to traditional library services, which has continued to confound most library professionals.

5.3 Obstacles to the utilization of AI/ML by academic Librarians

Several studies have investigated the obstacles to the utilization of AI/ML by academic Librarians in tertiary institutions in Nigeria. According to Ajani, et al. (2022), academic libraries in Nigeria may struggle with finance, a lack of expertise, a restricted power supply, a small budget for purchasing technology and difficulty in hiring and training of staff who would be responsible for system maintenance. The research advocated hiring librarians with the necessary technical expertise to interact with the technology, as well as providing libraries with the cash to enable them to purchase ML and other information and communication technology infrastructure.

According to Emiri (2023), there are a number of drawbacks to using AI, including the enormous disruption it causes to conventional library services, the requirement for training and a lack of critical skills before AI is applied in university libraries, unpredictable power sources, and a lack of infrastructure for doing so.

Obiano et al., (2022) identified lack of the needed ICT skills, lack of ICT, insufficient funds / low budget, negativism in attitudes of institution or organization’s management, inadequate technological infrastructure and inadequate planning as obstacles to the utilization of AI/machine learning by academic librarians in Nigeria.

A few barriers have been noted by Liau (2019) as potential barriers to robot integration in libraries. Some of these restrictions include the need to restructure workflow, the fact that robots can only do one or two tasks and cannot be used for all library activities, and the fact that robots sometimes have meltdowns that might impair library services.

World Bank (2016) noted that poor nations like Nigeria may be less likely to embrace technology owing to the potential that it may cause large job losses. This research demonstrates that ML has the potential to result in both significant job losses and employment destruction.

Ivwighreghweta and Igere, (2014); Ivwighreghweta, (2012); Ogbomo and Ivwighreghweta, (2013); Ivwighreghweta and Onoriode, (2012); Ivwighreghweta & Eireyi-Fidelis (2022), Efevberha-Ogodo (2023) and Ivwighreghweta and Smart (2020) stated that lack of reliable electricity and slow internet were the difficulties experienced by both librarians and users of the library when attempting to use open electronic resources.

6.0 Materials and methods

In order to achieve the goals of this investigation, a descriptive survey design was implemented. There were a total of 230 academics librarians in Northern, Nigeria who participated in the research. The respondents participated in the 2023 conferences of the Nigerian Library Association which was held in Akure, Ondo State. In order to conduct this research, the researchers had devised their own questionnaire, titled "Awareness and Availability of AI/ML Questionnaire" (AAAIMLQ)". Two hundred and thirty questionnaires (a total of 230) were dispatched, and one hundred and nine-five (195) of those surveys were received back with a response and found usable. Total enumeration and accidental sampling were employed as investigative strategies. In order to conduct the analysis on the data, statistics were utilized, specifically those based on frequency and percentage.

7.0 Results

The following tables provide a short description of the study's results along with the findings themselves.

Participants in the Study's Demographics and Respondents' Distribution by Sex

Table 1: Distribution of the Respondents by Sex

Sex	Frequency	Percentage %
Male	103	53
Female	92	47

Table 1, shows that 92 (47%) respondents were female, while 103 (53%) are male. This finding reveals that more male participated in the study than female.

Distribution of the Participants by Rank

Table 2: Distribution of the Participants by Rank

Rank of Librarians	Frequency	Percentage %
University Librarian	6	3
Deputy University Librarian	7	6
Senior Librarian	30	15
Librarian I	31	15
Librarian II	61	31
Assistant Librarian	39	20
Graduate Assistant	21	10

Table 2 shows that the librarians that partook in the study are the University librarians 6 (3%), deputy university librarian 7 (6%), senior librarian 30 (15%), librarian I, 31 (15%), librarian II, 61 (31%), assistant librarian, 39 (20%) and graduate assistant, 21 (10%). This implies that librarian II have the highest number of involvement in this study.

Table 3: Academic Qualification

Qualifications	Frequency	Percentage
PhD	76	39%
Masters	98	50%
Bachelors	21	11%

Table 3 shows that majority 98 (50%) of the Librarians possess Master's degrees. This was followed by 76(39%) who have PhD degrees.

Research Question 1: What is the level of awareness of AI/ML tools by academic librarians in Northern, Nigeria?

Table 4: Awareness of AI/ML by librarians

Awareness	Frequency	Percentage
Yes	175	90%
No	20	10%

Table 4 shows that 175 (90%) of the respondents were aware of AI/ML tools while 20 (10%) were not. This implies that the awareness level of librarians was high

Research Question 2: What categories of AI/ML tools are available in the academic libraries to use?

AI/ML available in University Libraries	Available	Not available
AI/ML cataloguing and classification tools like, Shelf Pro, CUTT-x. Coal Sort and N-cube are available in my library.	23 (12%)	172 (88%)
Face recognition technology is available for security purposes in my Library.	43(22%)	152 (78%)
The library website has chatbots for quick reference assistance.	21 (11%)	174 (89%)
In my library, robots are ready for usage.	30 (15%)	165 (85%)
The university library where I work has thump recognition technology.	16 (8%)	179 (92%)
My library has the Machine Readable Catalogue (MARC).	52 (27%)	143 (73%)
RFID technologies are adopted in my university library.	28 (14%)	167 (86%)
At the entrance of my library, security scanning devices are available to screen visitors.	120 (62%)	75 (38%)
AI/ML smart features are available in my library.	41 (21%)	154 (79%)
Humanoids are available in my library.	39 (20%)	156 (80%)
Alert machine are available in my library.	45(23%)	150(77%)

Table 5: Availability of AI/ML tools in academic libraries?

Table 5 shows that security scanning devices were the only AI/ML tools available in most libraries in Northern, Nigeria. Thumb recognition, RFID, AI classification tools, Machine Readable Catalogue (MARC) and Robots, technologies were not available in majority of the libraries. This implies that AI/ML tools were not available in the libraries investigated.

Research Question 3: How do academic librarians employ AI/ML tools to offer efficient library services?
Table 6: Use of AI/ML for Efficient Library Service Delivery

The Use of AI/ML	SA	A	D	SD
ML tools is used to predict the reading habits of library users.	51(26%)	52(27%)	2(1%)	90(46%)
AI/ML chatbots can be used for reference services.	98 (50%)	34 (17%)	60 (31%)	3 (2%)
AI tools is used for cataloguing, classification, indexing and Acquisition of library materials.	62(32%)	43(22%)	42(22%)	48(25%)
User identification in the area of speech, typing and Monitoring.	54 (28%)	49 (25%)	17 (9%)	75(38%)
AI/ML alarms for informing users time of their arranged visit with a librarian.	120(61%)	8 (4%)	60 (30%)	7 (6%)
ML is used to monitor library users activities.	45(23%)	34(17%)	23(12%)	93(47%)
Humanoid robots can be used for providing assistant to the Librarians.	95(49%)	45 (23%)	5 (3%)	50 (25%)
AI/ML can be used for computerizing library routines.	101(52%)	4(2%)	34(17%)	56(29%)
For technical service delivery like assigning and creating subject's headings, classification as well as metadata description.	87 (45%)	75 (38%)	30(15%)	3(2%)
Face recognition can be used for library security.	91(47%)	65 (33%)	9(5%)	30(15%)
For online messaging needs.	82(42%)	93(48%)	-	10(5%)
Based on users' search history ML systems can recommend reading materials.	101(52%)	71(36%)	23(12%)	-
AI/ML can be used as a reference pointer to direct users on the resources of the library.	76 (39%)	63 (32%)	50(26%)	6(3%)
AI/ML can also be used by libraries as an alert machine to signal or give warnings, like when a book is due.	71 (36%)	54(28%)	29(15%)	41(21%)
AI tools can be used for planning, scheduling and optimizing library operations/activities.	62(32%)	73(37%)	-	60(31%)
AI is used for image recognition for library identification.	53 (27%)	51(26%)	41(21%)	51(26%)

Note: SA: Strongly Agree; A: Agree; D: Disagree; SD: Strongly Disagree

Table 6 reveals that majority of the librarians are relatively knowledgeable about the various ways in which AI/ML tools were used and applied to deliver effective library services in academic libraries in Northern, Nigeria. Majority of the respondents, 101(52%) and 71(36%) stated that AI/ML systems can recommend reading materials. This was followed 87 (45%) and 75 (38%) who stated that AI/ML can be used for technical service delivery like assigning and creating subject's headings, classification as well as metadata description.

Research Question 4: What are the obstacles to the utilization and adoption of AI/ML in academic Librarians?

Table 6: Challenges that militate against the usage of AI/ML

Challenges	SA	A	D	SD
My library lacks needed AI/ML tools.	97(50%)	50(25%)	27(14%)	23(11%)
The absence of will on the part of the university authorities.	87(45%)	35(18%)	13(6%)	60(31%)
Inadequate funding to procure AI/ML systems in libraries.	76(39%)	81(42%)	8(4%)	30(15%)
Inconsistent power supply.	69(35%)	83(43%)	40(21%)	2 (1%)
AI/ML is perceived as a threat to the job of librarians.	74(38%)	72(37%)	9(5%)	40(20%)
Lack of clarity of the concept of AI/ML among librarians.	63(32%)	81(42%)	31(16%)	20(10%)
Absence of technical know-how to use AI/ML systems among the librarians.	54(28%)	84(43%)	4(2%)	53(27%)
I do not have adequate ICT competence to use the ML tools.	81(42%)	34(17%)	46(24%)	34(17%)
High disruption brought by AI/ML on traditional library Services.	91(47%)	48(25%)	6(3%)	50(26%)
Poor training in the field of AI/ML.	71(36%)	71(36%)	50(26%)	3(2%)

Table 6 shows that majority of the respondents indicated 76(39%) and 81(42%) inadequate funding to procure AI/ML systems in libraries as one the challenges militating against AI/ML usage and adoption. This was followed by 69(35%) and 83(43%) who stated inconsistent power supply, lacks of needed AI/ML tools 97(50%) and 50(25%), threat to the job of librarians, 74(38%) and 72(37%) respectively.

8.0 Discussion of Findings

The study shows that the librarians in academic libraries in Northern, Nigeria were aware of AI/ML tools. This implies that the concept of AI/ML was familiar to them. This study concurs with Oyewale and Aishatunya's study from 2023, which found that 80% of their respondents were aware of AI/ML, that it is here to make library tasks easier rather than replace librarians' jobs, and that 100% of respondents said that AI/ML has not yet been adopted in the surveyed libraries. The majority of academic librarians are aware that AI/ML is being used in university libraries, according to Abayomi et al. (2020).

The study reveals that security scanning devices were the only AI/ML tools available in all most all the libraries. Thumb recognition, RFID, MI classification tools, Machine readable catalogue and robots, technologies were not available in majority of the libraries studied. This shows that AI/ML tools were not available in academic libraries in the study area. This result is consistent with Emiri (2013), who reported that libraries in Southern Nigeria have implemented AI/ML at an incredibly sluggish pace. The security scanning equipment at entry/exit points of libraries is the most common method used to prevent the unauthorised seizure or theft of library goods by dishonest users.

The study discovered that majority of the librarians are relatively knowledgeable about the various ways in which AI/ML can be used and applied for effective service delivery in libraries. This may be as a result of the fact that AI/ML has made the job of librarians to be more effective and has enabled them to provide proficient library service delivery which has improved the relevance of libraries in this scientific era. This study is in agreement with Owolabi et al., (2022) whose study showed that AI/ML use and availability in libraries can be seen as the peak of a number of cutting edge technological developments that have made it possible for libraries to have access to devices that can perceive, understand, act, and learn.

The study discovered that inadequate funding, inconsistent power supply, high disruption brought by ML on traditional library services, lack of needed AI/ML tools, threat to the job of librarians, absence of technical know-how to use AI/ML systems were some of the challenges militating against AI/ML use and adoption in the respective libraries. This study is in conformity with Obiano et al (2022) whose study identified lack of the needed ICT skills, lack of ICT, insufficient funds/low budget, negativism in attitudes of institution management, inadequate technological infrastructure and inadequate planning as obstacles to the utilization of ML by academic librarians. Similar to this, Ajani et al. (2022) claimed that academic libraries in Nigeria may likely struggle with finance, a lack of expertise, a restricted power supply, a limited budget to purchase technology, and a lack of funds to hire staff who would be responsible for system maintenance. Liau (2019) cited a number of potential obstacles to libraries adopting and utilizing robots, including the need to redesign workflow, the fact that robots are only designed to perform one or two tasks and cannot be used for all library activities, the fact that robots occasionally have tantrums that could disrupt library services, and other issues.

9.0 Recommendations

The following recommendations were made from the study:

i. AI and machine learning experts at the Departments of Computer Science should work with librarians and information specialists in the library to retrain and teach personnel in the use of AI and machine learning technologies for effective and efficient service delivery.
ii. Heads of Tertiary Institutions and Library Heads should ensure that their libraries are adequately equipped with up-to-date ICT facilities in order to encourage the use of AI/ML systems.
iii. Government stakeholders are encouraged to develop policies that will bring about improvement in the electricity sector so AI/ML systems can be put to proper use in academic libraries.
iv. Academic libraries should fully put to use AI/ML technology, such as Chatbots, Machine Readable Catalogue, Thumb recognition technology, humanoids, RFIDs, and robotics, in order to provide effective library services

10. 0 Conclusion

The study concluded that librarians in Northern, Nigeria were aware and familiar with AI/ML tools. However, security scanning devices were the only AI/ML tools available and used in their respective libraries. AI/ML tools such as thumb recognition, RFID, AI/MI classification tools, machine readable catalogue technologies were not available. This points to the fact that AI/ML tools were not available in academic libraries in the study area. The study discovered that librarians were relatively knowledgeable about the various ways in which AI/ML is used and applied for deliver effective library services. However, inadequate funding, inconsistent power supply, high disruption brought by AI/ML, lacks of needed AI/ML tools, threat to the job of librarians were the obstacles militating against AI/ML use and adoption in the respective libraries.

11. 0 Acknowledgement(s)

No particular grant was given to this study by funding organisations in the public, private, or not-for-profit sectors. The authors alone were responsible for paying for this study's financing.

References

Abayomi, O. K, Adenekan, F. N. & Abayomi, A.O (2021). Awareness and perception of the artificial intelligence in the management of university libraries in Nigeria. *Journal of interlibrary loan, 3* (6), 28-32.

Ajani, Y.A., Tella, A, Salawu, K.Y., & Abdullahi, F. (2022). Perspectives of Librarians on Awareness and Readiness of Academic Libraries to Integrate Artificial Intelligence for Library Operations and Services in Nigeria. *Internet Reference Services Quarterly*, DOI: 10.1080/10875301.2022.2086196

Ali, M. Y. (2020). Artificial intelligence tools and perspectives of university librarians: An overview. Business Information, accessed on 21/6/23, Review https://doi.org/10.1177/0266382120952016

Berdasco, A., L´opez, G., Diaz, I., Quesada, L., & Guerrero, L. A. (2019). User experience comparison of intelligent personal assistants: Alexa, Google Assistant, Siri and Cortana. *Proceedings, 31* (1), 51-62, accessed on 21/6/23, https://doi.org/10.3390/proceedings2019 031051

Codex, A.M. (2019). The intelligent library: Thought leaders' views on the likely impact of artificial intelligence on academic libraries. *Library Hi Tech, 37* (3), 418–435.

Copeland, B.J. (2023). Artificial intelligence. 51 accessed on 21/6/23, https://www.britannica.com/technology/artificial-intelligence

Echedom, A. U., & Okuonghae, O. (2021). Transforming academic library operations in Africa with artificial intelligence: Opportunities and challenges: A review paper. *New Review of Academic Librarianship, 27* (2), 243–214. doi:10.1080/13614533.2021.1906715

Emiri, O.T. (2013). Adoption and utilisation of artificial intelligence by adoption and utilisation of artificial intelligence by librarians in university libraries in southern Nigeria. Retrieved from Library Philosophy and Practice (e-journal)

Galeon, D. (2017). The point of no return. Pp. 19-24, accessed on 21/6/23, https://www.weforum.org/agenda/2017/11/why-stephen-hawking-thinks-aimight-replac humans?utm_content=bufferb8243&utm_medium=social&utm_source=facebook.com&utm_campaign=buffer.

Ivwighreghweta, O. & Efevberha-Ogodo, O. (2023). ICT competence and use of digital resources among lecturers in Michael and Cecilia Ibru University (MCIU), Agbarha-Otor, Delta State, Nigeria. *Library Waves, 9* (1), 26-36.

Ivwighreghweta, O. (2012). An investigation to the challenges of institutional repositories development in six academic institutions in Nigeria. *International Journal of Digital Library Services, 2* (4), 1-16

Ivwighreghweta, O.& Eireyi-Fidelis, E. (2022). The usage of electronic academic database resources among lecturers and postgraduate students in Western Delta University, Oghara, Delta State, Nigeria. *International Journal of Librarianship, 7* (2), 106-112.

Ivwighreghweta, O., & Igere, M.A. (2014). Impact of the Internet on academic performance of students in tertiary institutions in Nigeria. *Journal of Information Knowledge Management, 5* (2), 1-10

Ivwighreghweta, O., & Onoriode, O. K. (2012). Open access and scholarly publishing: Opportunities and challenges to Nigerian researchers. *Chinese Librarianship: an International Electronic Journal*, 33. Retrieved from http://www.iclc.us/cliej/cl33IO.pdf

Ivwighreghweta, O., & Smart, A. (2020). Open educational resources utilization under the Covid-19 pandemic lockdown among distance postgraduate students of National Open University, Benin Study Center, Edo State, Nigeria. *African Journal of Studies in Education, 15* (1), 1-14.

Liau, Y. (2019). Transforming Library Operation with Robotics. https://library.ifla.org/id/eprint/2701/1/s08-2019-liau-en.pdf

Liu, G. (2011). The application of intelligent agents in libraries: A survey. *Program, 45* (1), 78–97.

Microsoft Encarta Dictionary (2009). 1993-2008. New York: Microsoft Corporation.

Momoh, E. O. (2018). Information technology and the future of librarianship. Library Philosophy and Practice, 2–9. Retrieved from https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=5447&context=libphilprac

Mueller, J. P. & Massaron L. (2016). Machine Learning for Dummies. John Wiley. New Jersey, United States

Nwakunor, J. A. (2021). Leveraging artificial intelligence to enhance brand management. The Guardian Newspaper.

Obiano, D.C; Onuoha, C.O, Adeoye, Y., Nwosu, J.C. & Motunrayo, F. (2022). Aiding the exploration of artificial intelligence in Nigerian academic libraries in the 21st century. *Information Technology and Librarianship, 2* (1&2), 1-13

Ogbomo, M.O. & Ivwighreghweta, O. (2013). Awareness, attitudes, and use of open access journals by master's degree students of the Department of Library, Archival, and Information Studies, University of Ibadan, Nigeria. *PNLA Quarterly, 2* (77), 130-141.

Owolabi, K. A., Okorie, N. C., Yemi-Peters, O. E., Oyetola, S. O., Bello, T. O., & Oladokun, B.D. (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. *Library Management, 43* (3/4), 296-305

Oyewale, O.J., & Aishatunya, Z.I. (2023). Assessment of awareness, perceptions, and adoption of artificial intelligence in university libraries in Osun state, Nigeria. *Tin-City Journal of Library, Archival & Information Science, 12*, (1), 131-138

Tella, A. (2020). Robots are coming to the libraries: are librarians ready to accommodate them. Library Hi Tech News, 37(8), 13-17.

Vijayakumar, S. & Sheshadri, K. (2019). Applications of Artificial Intelligence in Academic Libraries. *International journal of Computer Science and Engineering, 5* (4), 12-19, accessed on 21/6/23, DOI: 10.26438/ijcse/v7si16.136140.

Vysakh, W. H. & Babu, L. S., (2020). Optimal portfolio choice under a liability constraint. *Annals of Operations Research, 97* (1–4), 131– 141. accessed on 21/6/23; https://doi.org/10.1023/A

Wahl, B., Cossy-Gantner, A., Germann, S. & Schwalbe, N. R. (2018). Artificial Intelligence (AI) and Global Health: How Can AI contribute to Health in Resource-Poor Settings? *British Medical Journal Global Health 2018*, DOI: 10.1136/bmjgh-2018-000798

World Bank. (2016). World Development Report: Digital dividends. World Bank.

Yoganingrum, A., Rachmawati, R., & Koharudin, K. (2022). Past, present, and future of artificial intelligence in library services. In Handbook of research on emerging trends and technologies in librarianship (pp. 91–114). IGI Global.

Yusuf, T. I., Adebayo, O. A., Lateef, B. A., & Kayode, J. O. (2022). Adoption of artificial intelligence for effective library service delivery in academic libraries in Nigeria.
https://www.researchgate.net/publication/358429744_adoption_of_artificial_intelligence_for_effective_library_service_delivery_in_academi