# AWARENESS AND ADOPTION OF ARTIFICIAL INTELLIGENCE (AI) TECHNOLOGIES FOR USERS WITH VISUAL AND HEARING IMPAIRMENT IN UNIVERSITY LIBRARIES IN NIGERIA

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**Abstract**
*New technologies including Artificial Intelligence (AI) are increasingly becoming a major force in contemporary society as they touch almost our lives, health, education and business. AI is modelled after human intelligence to adapt, recognize and process information and is increasingly changing the ways and manner people handle certain tasks. This study examines the awareness, preparedness and challenges of adoption of AI tools in Nigerian university libraries for information service delivery to users with visual and hearing impairment. This study adopted a descriptive survey design. The sample population consists of university librarians in the federal, state and private universities in all 36 states and the Federal Capital Territory in Nigeria. The questionnaire was the main instrument for data collection. The questionnaire was administered face-to-face to the respondents by the researchers with the support of ten research assistants. Data were collected at the 2024 Nigeria Library Association (NLA) conference/Annual General Meeting (AGM) that was held at the University of Port Harcourt from 7th to 12th July 2024. The researchers randomly administered a total of 1000 copies of the questionnaire to librarians who attended the conference/AGM. From the 1000 questionnaires that were distributed, a total of 624 (62.4%) were retrieved and found usable for the analysis of this study. The collected data were analyzed using SPSS (Statistical Package for the Social Sciences), version 16.0. The results show that over 50% of librarians in this study are aware of AI tools and the majority of them are highly prepared to adopt AI for delivery of library and information services to users with visual and hearing impairment. The results moreover, revealed notable challenges facing the adoption and use of AI in university libraries in Nigeria. Recommendations to increase awareness, preparedness and solutions to the challenges are offered.*

**Keywords**: Artificial Intelligence, hearing impairment, visual impairment, Librarians, University Library, Nigeria.

## Introduction

New technologies including Artificial Intelligence (AI) are increasingly becoming a major force in contemporary society. It touches almost all areas of our endeavours, including business, education and health. Before the emergence of new technologies in the library and information centres and for delivery of information services, library users particularly, students, staff and researchers with hearing and visual impairment used the general reading areas of the library and information centre to access information on the shelves with little or no support. The increasing need to provide access to information in the library has led to the development and use of different tools such as library catalogues, integrated library software (ILS) and institutional repositories (IR) among others for the delivery of information services (Omeluzor, et al., 2017). None of them has shown any significant advantage towards supporting library users with hearing and visual impairment global statistics reveal that there are about 466 million people who are suffering from hearing loss; and visually impaired students who rely on lip reading to understand speech (Kumar, et al. 2022). Observations have shown that library users with impairment faces a lot of challenges in using the library information and services with less or no technology to support their learning and research in most university libraries in Nigeria. Students with visual and hearing impairment experience educational barriers that many other students do not know. Such barriers can be resolved with the use of Artificial intelligence (AI) in the library and information centres. AI technologies are viable tools that emulate human cognitive abilities and thinking processes that can aid and support hearing and visually impaired persons in the library (Laskowski & Tucci, 2024). IFLA in 2012 agreed that the library community was a major provider of services that assisted blind people to access information. A review of 67 articles on the application of AI and its impact on library operations between 1989 and 2023 showed a gap in the literature on the awareness, preparedness and challenges of using AI by librarians for the benefit of people with impairment in Nigeria (Subaveerapandiyan, 2023). This study therefore seeks to close that gap by investigating the challenges with the adoption of AI technologies for delivery of library services to users with hearing and visual impairments at university libraries in Nigeria.

## Research Objectives

This research is guided by three objectives:

1. Find out the level of librarians' awareness of AI technologies for users with hearing and visual impairment among librarians in university libraries and information centres.

2. Know if librarians are prepared to adopt AI technologies to support users with hearing and visual impairment in University Libraries and information centres.
3. Identify the challenges confronting the adoption of AI in university libraries and information centres for users with hearing and visual impairment.

**Literature Review**

The university library and information centre in recent past have consistently developed tools to support library patrons. Studies such as (Agboola, 2000; Sani & Tiamiyu, 2005; Osaniyi, 2010; Omeluzor, et al., 2012; Mbakwe & Ibegbula, 2014), have shown that several tools that were adopted in the past are riddled with a series of shortcomings since they fail to recognize the changing needs of the library users including those with visual and hearing impairment. Contemporary technological tools such as Artificial Intelligence (AI) are changing the landscape of information access and delivery to people with different health challenges. Irrespective of the penetration of AI in several areas of human endeavour, literature is still scanty on the awareness and preparedness of librarians to adopt it in library services, especially for users with impairment.

There is current literature that shows the effect of technology such as AI on online learning and education processes in China, India and the United States for the support of learners (Dogan, Dogan & Bozkurt, 2023). In another dimension, Omame and Alex-Nmecha (2020), Echedom and Okuonghae (2021) and Hassain (2023) have revealed that the application of AI in the library has several positive implications in demystifying services to library users including people with disability. Currently, inquiry into the use of AI technologies for the improvement of more accessible learning environments for people with hearing and visual impairment is growing (Educause Review, 2022). Hence the enquiry into the awareness and preparedness for the adoption of AI in library services for users with impairment at the university libraries in Nigeria.

Artificial Intelligence (AI) is changing the ways and how people do things and would serve a great deal for people with different forms of disability. For information users with hearing and visual impairment, several AI tools have been developed to assist them achieve their educational purposes. Google or smart phones has increasingly been developed to support people with impairment using speech recognition, natural language processing, self-driving or autonomous cars, machine learning, deep leaning and robotics among others (Omame & Alex-Nmecha, 2020). Similarly, AI-based tools such as Apple Siri, Amazon Echo and

Alexa have been found to help with interactions by people who are unable to see content. Such tools provide ways of interacting with content through a spoken dialogue model. Using the tools, could help students to find the contents of a webpage to be too visually stimulating. Students could ask the virtual assistant to read aloud the headings on a page, allowing them to get a sense for how the page is structured, figure out where to go on the page, or skip content that is not relevant (Tugend, 2022).

Furthermore, the use of AI for the improvement of visual and auditory accessibility is evolving. For instance, the National Technical Institute for the Deaf, one of the nine colleges of the Rochester Institute of Technology, worked with Microsoft to customize technology and platforms that already existed to caption classes for deaf and hard-of-hearing students (Tugend, 2022). Similarly, AI can help students with disabilities using accessibility in testing, content descriptions and webpage interactions (Educause Review, 2022). The AI content description tool is used to automatically describe images for students who are legally blind or have low vision. It could be used in the library to do a "first pass" at describing content for students who have visual impairment. Moreover, the tool can be used to help with interactions by people who are unable to see content. A recent study by Wang, Wang and Zhang (2023) delved into the deep learning methods applied in diagnosing eye diseases and smart devices to help visually impaired people in their daily lives. The study summarized some recent research on the development of AI-based eye disease diagnosis and visual aids. The summary shows that AI may be able to assist the visually impaired in the future which can be applied in the library for users with visual and hearing challenges.

The awareness of librarians about AI around the world is increasing and it is of high importance. It underscores the fact that users with special needs to access information at the library and information centre depend majorly on the ability of librarians to know and use such technology for the benefit of library patrons with visual and hearing impairment. Berdasco, et. al. (2019) studied users' experiences while comparing intelligent personal assistants such as Alexa, Google Assistant, Siri and Cortana. The study showed that 99% of the participants were aware of the existence of various AI assistants, but only 86% had used at least one of them. In another study by Moustapha and Yusug (2023), the study revealed that librarians in a university library were aware of the many ways in which AI can be applied to provide services to library users. Similarly, while focusing on the barriers to the adoption of artificial intelligence in academic libraries, the study of Yusuf, et. al. (2022) indicates that the lack of preparation of

librarians on the use of AI to meet their service needs was a challenge. The study confirmed that the low level of preparation by librarians on the application of AI for their service needs was a challenge. In Kwara State, Nigeria, a study on perceived awareness and usefulness of AI for efficient library operations in university libraries was carried out. The findings revealed that a higher percentage of the respondents were aware of AI robots, AI Chatbots, Humanoids, Face recognition technology, Dynamed, AI Expert Systems and Virtual References (Isiaka, et. al., 2024).

In a related development, Oyekale and Zubairu (2023) assessed the awareness perceptions, and adoption of AI in university libraries in Osun State, Nigeria. The study showed that 80% of the librarians were highly aware of AI but none of the libraries surveyed has adopted AI for library services. Equally, Abayomi, et. al.'s (2021) study indicates that librarians were aware of AI in the management of university libraries in Nigeria. Moreso, Ali, et. al. (2022) study on AI tools and university librarians revealed that librarians were aware of AI technologies. The level of preparation as revealed in the literature here was as a result of various conversations and ongoing conferences and workshops on the impact of AI on libraries (Hervieux, & Wheatle, 2021). However, Wood and Evans (2018) insisted that AI is not much discussed in library literature as compared to professions like medicine, law, military, and aviation, which is affecting its adoption and use by librarians and librarians. Notwithstanding the challenges, Obiano, et al. (2016) studied the facilitating conditions for the adoption of AI in Nigeria academic libraries. The study revealed that a total of 170 librarians who responded in the study were prepared to adopt AI in library services. In Nigeria, Adebayo, et. al. (2022) takes a *look at the adoption of AI for effective library services in academic libraries in Nigeria. The paper established some of the benefits of adopting AI in academic libraries which include user-friendly, infinite functions, ability to take complex work among others. The paper concluded that the adoption of AI in academic libraries is setting a new level of efficiency and effectiveness in library service delivery that would help the financial uncertainty, emerging skill gap, and competing with today's alternative sources of information that is prevailing among developing countries such as Nigeria.* Despite the benefits of AI, some studies have demystified the challenges facing the adoption and use of AI by librarians for information services to patrons with visual and hearing impairments. Hussain (2023) stated that even though AI is a potential and vibrant technology that can be used in the university library for the acceleration of library services to people with disability several factors such as inadequate funding, the attitude of librarians and technical skills were a few

obstacles that is hampering its adoption in library operations (Hussain, 2023). Similarly, a lack of trained sign language facilitators and the high cost of assistive devices such as AI were some of the major challenges facing the deployment of AI in libraries for the benefit of users with hearing and visual impairment (Kumar, et al., 2022).

## Methodology

The study adopted a descriptive survey design. The choice of a survey design was due to its reliable means of providing the researchers with an opportunity to use the data gathered from this study to ascertain the awareness, preparedness and challenges of adopting Artificial Intelligence (AI) tools by librarians to aid information access to users with hearing and visual impairment in Nigerian universities. The population of the study consists of all the university libraries in the 170 universities across Nigeria (National Universities Commission, 2024). The sample of the population cut across all university librarians in federal, state and private universities in all 36 states and the Federal Capital Territory in Nigeria. The instrument for data collection was a structured questionnaire designed by the researchers. Before the administration of the questionnaire to the intended respondents, a pre-reliability test was conducted by sending the instrument to 15 librarians who work at public libraries who were not part of the study. The 15 copies of the questionnaires were all returned and analyzed using Cronbach's alpha correlation coefficient at 0.50 level of significance, with a result of r = 0.84. The collected data were analyzed using SPSS (Statistical Package for the Social Sciences), version 16.0. The results were presented in tables with frequency counts and percentages for precision and understanding.

## Result and Discussion

### Demographic Information of Respondents

The demographic result of the respondents shows that 624 librarians responded to the instrument from the six (4) geo-political zones and the Federal Capital Territory. The result reveals that among those that responded, 187 of them had PhD, 114 had Masters Degree, 210 had Bachelors Degree and 113 had HND and OND in librarianship. Among the respondents, 89 were university librarians, 108 were Associate Professors/Deputy University Librarian, 240 were Senior Librarians, 87 were Librarian 1, and 34 were Librarian II, 100 were Assistant librarians. The result further shows that 152 of the respondents have 1 to 5 years of work experience, 98 of them had 6 to 10 years of work experience, and 112 had between 11 to 15 years of work experience. The result reveals that 104 of the

respondents had work experience between 16 to 20 years while 158 of the respondents had work experience of 21 years and above at their libraries. This result implies that the respondents were qualified to be part of this study as the majority of them have worked for many years in various capacities at the university library with requisite experiences that can help them in making necessary decisions.

The results in Table 1 revealed the level of librarians' awareness of AI technologies for users with hearing and visual impairment among librarians in university libraries and information centres.

Table 1

| **Awareness of AI Technologies for Hearing and Visual Impairment** | Aware | Unaware |
|---|---|---|
| **For Hearing Impairment** | | |
| Automatic Speech Recognition (ASR) | 594 (95.2) | 30 (4.8) |
| Real-Time Captioning (RTC) | 541 (86.7) | 83 (13.3) |
| Sign Language Recognition (SLR) | 320 (51.3) | 304 (48.7) |
| Speech-to-Text (STT) Apps | 489 (78.4) | 135 (21.6) |
| Chatbots for Communication | 406 (64.9) | 218 (34.9) |
| Speech Recognition Technology (SRT) | 624 (100) | - |
| Smart Assistants for Library Services | 366 (58.7) | 258 (41.3) |
| Social Robot (SR) | 124 (19.9) | 500 (80.1) |
| Advanced speech synthesis technologies | 549 (88.2) | 74 (11.9) |
| **For Visual Impairment** | | |
| Text-to-speech (TTS) software | 212(34) | 412 (76.3) |
| Image Recognition for Visual Content Description (IRVCD) | 444 (71.2) | 180 (28.8) |
| Braille Translation Software (BTS) | 550 (88.1) | 74 (11.9) |
| Voice Command Navigation (VCN) | 561 (89.9) | 63 (10.1) |
| Accessible Graphs and Data Representation (AGDR) | 489 (78.4) | 135 (21.6) |
| Smart Cameras and Object Recognition (SCOR) | 332 (53.2) | 292 (46.8) |
| Natural Language Processing (NLP) for Search | 321 (51.4) | 303(48.5) |
| Electronic Braille Displays (EBD) | 444(71.2) | 180 (28.8) |
| Screen Readers with AI Enhancements (SR) | 540 (96.8) | 84 (13.5) |

| | | |
|---|---|---|
| AI-Driven Educational Games (AI-DEG) | 444 (71.2) | 180 (28.8) |
| Gesture Recognition for Navigation (GRN) | 550(88.1) | 74 (11.9) |
| Smart Assistants for Library Services (SALS) | 561 (89.9) | 63 (10.1) |
| AI-Powered Accessibility Testing (AI-PAT) | 489 (78.4) | 135 (21.6) |
| Real-Time Translation Services (RTTS) | 332 (53.2) | 292 (46.8) |

**N = 624**

Table 1 has two parts. The result in the first part indicates that 95.2% of the respondents are highly aware and aware of ASR, 86.7% are aware of Real-Time Captioning, 51.3% are aware of Sign Language Recognition and 78.4% are aware of Speech-to-text apps. The result further shows that 64.9% of the respondents are aware of Chatbots, 100% are aware of speech recognition Technology, 58.7% are aware of Smart Assistants for Library Services, 19.9% are aware of Social Robot and 88.2% of the respondents are aware of advanced speech synthesis technologies. In the second part of Table 1, the result shows that 34% of the respondents are aware of text-to-speech software. The result reveals that 71% were aware of image recognition for visual content description, 88.1% were aware of Braille translation software, and 89.9% were aware of voice command navigation. The result also shows that 78.4%, 53.2% and 51.4% were aware of accessible graphs and data representation, smart cameras object recognition and natural language processing for Search respectively. The result further reveals that 71.2% are aware of electronic Braille displays, 96.8% are aware of screen readers with AI enhancements, 71.2% are aware of AI-driven educational games, 88.1% of the respondents were aware of gesture recognitions for navigation, 89.9% were aware of smart assistants for library services. The result also reveals that 78.4% and 53.2% of the respondents are aware of AI-powered accessibility testing and real-time translation services respectively.

The result in Table 2 shows the level of preparedness of the respondents to adopt AI technologies.

Table 2: **Librarians' Preparedness on the Adoption of AI at the Library**

| **Question** | Highly prepared | Prepared | Slightly prepared | Not prepared |
|---|---|---|---|---|
| How prepared are you to receive training for the integration of AI tools into library services for users with impairments | 389 (62.3) | 135 (21.6) | 55 (8.8) | 45 (7.2) |
| How prepared are you to familiarize yourself with AI technologies designed to assist users with impairments | 306 (49) | 218 (34.9) | 35 (5.6) | 65 (10.4) |

| | | | | |
|---|---|---|---|---|
| How prepared are you to incorporate AI into library services for users with impairment | 135 (21.6) | 326 (52.2) | 96 (15.3) | 67 (10.7) |
| How prepared are you to support users with impairments in using AI technologies in the library and information centre | 382 (61.2) | 242 (38.8) | - | - |
| How prepared are you to increase patronage of AI technologies in the library and information centres | 302 (48.3) | 229 (36.6) | 48 (7.6) | 45 (7.2) |

N = 624

The result in Table 2 shows the level of preparation of the respondents to adopt and use AI technologies for library services to users with visual and hearing impairments. The result revealed that the majority or 524 (83.9%) of the respondents combined were highly prepared and prepared to receive training on AI integration with library services. Another 524 (83.9%) combined were highly prepared and prepared to familiarize themselves with AI technologies. The result also shows that 461 (73.8%) of the respondents combined were highly prepared and prepared to incorporate AI into library services for users with impairment. The result in Table 2 further indicates that 624 (100%) of the respondents were highly prepared and prepared to support users with impairment to use AI technologies while another majority 531 (84.9%) were highly prepared and prepared to increase patronage of AI technologies among library users in the library and information centres.

The result in Table 3 reveals the challenges confronting the adoption of AI technologies for information users with hearing and visual impairment.

Table 3

| **Challenges** | Strongly agree | Agree | Disagree | Strongly disagree | Ranking |
|---|---|---|---|---|---|
| Cost of acquisition of AI tools | 489 (78.4) | 135 (21.6) | - | - | 1st |
| Inadequate knowledge about AI technologies | 353 (56.6) | 148 (23.7) | - | 123 (19.7) | 2nd |
| Inadequate Library funding | 353 (56.6) | 123 (19.7) | 148 (23.7) | - | 3rd |
| Lack of technical skills by Users | 346 (55.4) | 123 (19.7) | 155 (24.8) | - | 4th |

| | | | | | |
|---|---|---|---|---|---|
| Cost of implementation of AI Technology | 229 (36.7) | 186 (29.8) | 74 (11.9) | 135 (21.6) | 5th |
| The attitude of librarians towards new technology | 197 (31.6) | 198 (31.7) | 155 (24.8) | 74 (11.9) | 6th |
| Institutional bureaucracy | - | 137 (22) | 487 (78) | - | 7th |

N = 624

The result in Table 3 shows some of the challenges facing the adoption and use of AI in libraries and information centres. From the ranking, the result shows that all the respondents 624 (100%) strongly agree and agree that the cost of acquisition of AI tools was a challenge. This is followed by another 501 (80.3%) and 476 (76.3%) of the respondents combined who strongly agree and agree that inadequate knowledge about AI technologies and inadequate library funding were challenges of using AI in libraries and information centres. The result further shows that 469 (75.1%) of the respondents combined strongly agree and agree that lack of technical skill is a challenge. The result in Table 3 also reveals that 415 (66.5%) of the respondents combined respectively strongly agree and agree that the cost of implementation of AI technology was a challenge. Another 395 (66.3%) of the respondents combined strongly agree and agree that the attitude of librarians towards new technology was a challenge. The result shows that 137 (22%) agree that institutional bureaucracy was not a challenge while 487 (78%) of the respondents strongly disagree it was a challenge. The implication of this result in Table 3 is that several impediments are hindering the adoption and use of AI in libraries for the support of users with hearing and visual impairment in Nigeria.

**Discussion of Findings**

The findings in Table 1 revealed that the respondents were aware of all the AI technologies for hearing and visual impairment. The findings however showed that the awareness level varied for each of the technologies with some having a higher percentage and others with a lower percentage. For instance, the awareness level for AI technologies for hearing impairment such as ASR, RTC, STT, Chatbots for Communication, SRT, and ASST was higher while that of SR was lower. On the awareness of AI technologies for visual impairment, the findings show that most of the respondents were aware of the technologies. There is evidence in the findings that the majority or above 70% of the respondents were aware of IRVCD, BTS, VCN, AGDR, EBD, SR, AI-DEG, GRN, SALS and AI-PAT. The findings also revealed that an average percentage above 50% of the respondents was aware of SCOR, NLP for search and RTTS (see Table 1). These

findings aligned with several literatures, for instance, Bardasco, et al. (2019); Moustapha and Yusug (2023) whose studies revealed that librarians were highly aware of various AI technologies for library services. Similarly, Oyekale and Zubairu (2023) in their study of the awareness and perception of librarians on AI in university libraries in Osun State showed that 80% of the librarians were highly aware of AI. The finding in Table 1 also shows that only 51.3% of the respondents were aware of SLR for hearing impairment while 48.7% were unaware. Similarly, the majority of the respondents were unaware of TTS while more than 40% of the respondents were unaware of SCPR, NLP and RTTS for visual impairment.

The findings in Table 2 revealed the preparation of the respondents to adopt AI technologies for users with impairment. The findings show that the majority of the respondents who are more than 50% were highly prepared and prepared to receive formal training, familiarize themselves, incorporate AI in library services, support users and increase the patronage of AI technologies in the library. The level of preparation as revealed in Table 2 indicates that the respondents are imbibing the use of emerging technologies in the library. It also reveals that the respondents are willing to support users with impairment. The findings align with Obiano, et al. (2016) who found out that 170 academic librarians in Nigeria who responded in their study were prepared to adopt AI at their various libraries. The findings also confirm the findings of Adebayo, et. al. (2022) whose study revealed that librarians stand a chance of benefiting from the adoption of AI should they prepare to adopt it. The implication of the findings in Table 2 is that if adequate arrangement is made for the use of AI, the respondents are prepared to adopt it at the library to improve information services to users with impairment.

Table 3 shows that the challenges affecting the preparation and use of AI in university libraries and information centres in Nigeria are enormous. The challenges were ranked based on the number of respondents. The findings revealed that cost of acquisition, inadequate knowledge and inadequate funding were the major challenges facing the use of AI in libraries and information centres. Other challenges such as lack of technical skills, cost of implementation and attitude of librarians towards new technology were also identified as challenges facing the preparation and use of AI in university libraries in Nigeria. The finding reveals that institutional bureaucracy was less of a challenge as only 22% of the respondents agreed to that as a challenge. These findings are in tandem with the study of Hussain (2023) who identified inadequate funding, attitude of librarians and technical skills as major challenges affecting the

adoption and use of AI in universities. Similarly, the findings is supported by Kumar, et al., (2022) who attributed some of the challenges facing the preparation of librarians in the use of AI in library services to inadequate knowledge and lack of skill in using new and emerging technologies.

**Conclusion and Recommendations**

This study highlighted evidence on the level of preparedness of the respondents towards the adoption and use of AI technologies for information services to library users with visual and hearing impairments. The challenges currently affecting the adoption of AI tools at the university library and information centres were explored. Some literatures were reviewed to anchor the study on existing theories in the field of Library and Information Science. Given the high level of awareness and preparedness as shown in the results, there is a tendency that the respondents may adopt AI in library services for those with visual and hearing impairment which would impact the users and improve their experience. The result from the study has demonstrated that the application of AI in library and information centres will no doubt improve information service delivery to library users including those with impairment. The results show the consciousness, enthusiasm and preparedness of the respondents over AI as emerging technology. It is pertinent to state that from the results of this study, the respondents would be willing to participate in ongoing conversations for the development of AI that will have greater impact on the library users.

The study recommended that the management of university libraries and information centres should maintain the awareness level of librarians on AI through engagements in seminars, workshops and ongoing conversations on the development of AI tools. The management of libraries and information centres should awaken the information professionals by engaging them in training in order to be abreast of different AI tools that are capable of supporting the information needs of people with visual and hearing impairment. Considering the preparedness of librarians as shown in this study, the management of university library and information centres should introduce some useful AI tools in the library for the delivery of information services to library users with visual and hearing impairment and the university management should endeavour to resolve all contending challenges that this study identified and ensure the adoption of AI is not hindered as such may affect the delivery of library services to users including those with visual and hearing impairment.

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