

## Digital Technologies as Tools for Bridging the Digital Divide and Enhancing Academic Library Use in Nigeria

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### Abstract

*The paper discusses the role of libraries in promoting inclusive access to information resources in the information age. Despite libraries' commitment to equitable service delivery, some users experience challenges in accessing library services due to physical, language, and technological barriers. The study employed a systematic literature review approach, utilizing relevant articles published in reputable peer-reviewed journals. Findings reveal that digital and assistive technologies, such as text-to-speech technology, Braille conversion technology and speech recognition tools, enhance access to library resources for users with disabilities and language barriers. However, challenges such as inadequate electricity supply and poor internet connectivity, particularly in developing countries, hinder the effective adoption of these technologies in libraries.*

**Keywords:** Digital divide, Inclusive technologies, Library, Library-access

## **Introduction:**

In today's world, the rapid evolution of digital technology in every facet of life, including the library, has transformed library and information services. These innovations, fueled by digital technologies, have simplified tasks, improved efficiency, and enhanced access to information resources (Lee, 2021). Academic libraries play a crucial role in democratizing access to information and supporting teaching, learning, and research within academic institutions and society at large. As a centre of information dissemination, academic libraries are expected to create inclusive environments that are responsive to the diverse needs of their users. A crucial aspect of this inclusivity is the integration of accessible technology that enables individuals of different abilities to effectively use library resources and services (Lee, 2020).

Technological innovations in academic libraries refer to the application of digital tools and systems that enable libraries to meet the changing information needs of patrons (Lee, 2021). With the increasing demand for timely and convenient access to information, academic libraries have adopted various technological innovations to improve service delivery. Some notable digital innovations used in libraries in recent times include digitization of collections, development of institutional repositories, expansion of open access resources, and the widespread use of the internet for accessing information (Lewis, 2013). Such technologies have improved the speed, convenience, and efficiency with which patrons access information resources.

Libraries serve patrons with diverse backgrounds, abilities, and levels of technological literacy. Among these users are persons with disabilities who often face barriers accessing conventional library resources and services. Persons with disabilities may experience visual, hearing, physical or cognitive impairments that require different formats and assistive technologies to access information effectively (Kimura, 2018). Hence, academic libraries are increasingly expected to adopt technologies that support accessibility and ensure that all patrons benefit from available information resources.

Despite the growing availability of digital and assistive technologies designed to promote accessibility to persons with disabilities, many libraries still face challenges in effectively

integrating these technologies into their services. In some cases, the technologies exist but are underutilized due to factors such as inadequate funding, inadequate staff training or inadequate infrastructure. This situation undermines the core mission of libraries to provide equitable access to information for all patrons. This may create a gap between the accessibility of these assistive technologies and their effective use in promoting inclusive library services. Therefore, this study presents a systematic literature review of assistive technologies used in libraries and inclusiveness in their services.

By fostering a deeper understanding of the current state of technology accessibility in libraries, this study aims to support the vision of libraries as inclusive knowledge hubs where users of all abilities can effectively access and utilize information resources.

The paper applied a systematic literature review methodology, using relevant articles published in reputable peer-reviewed journals. This enables the study to synthesize existing knowledge on accessible technologies in libraries.

## **Literature review**

The purpose of this paper is to present a systematic review of accessible technologies used in the library. The section discusses how applying various technologies has transformed and, in some cases, brought disruption in traditional library services. At the centre of library service is the patron, who possesses various physical and intellectual abilities that influence their access to information. In recognition of this diversity, the International Federation of Library Associations and Institutions (IFLA) guidelines emphasised that development of library collections should be based on formats that ensure access for all categories of users without any exclusion (Akin-Fakorede & Oyelude, 2023).

## **The use of technologies in the library**

In this digital era, serious-minded organizations rely on a range of technologies to drive service innovations for their patrons (Potnis & Mallary, 2022). Within the library environment, particularly in academic libraries, the adoption of technology has become essential for improving

information service delivery. Service innovation in libraries can simply be seen as strategic application of technological, human and information resources the enhance patron satisfaction and improve overall effectiveness of library services. Hertog (2000) posited that service innovation can be achieved by organization through development of new service concept that provides value to users, the creation of a user-friendly interface, the transformation of the organization's work practices to improve service delivery, and the implementation of technologies for effective service delivery. In academic libraries these technologies are reflected in the introduction of automated catalogues, electronic databases, and other technology driven systems that improves access to information resources.

Library patrons in contemporary society are largely composed of individuals who are technology-savvy and regard information access as central to their academic, professional and personal activities (Kumar, 2017). This, by implication, means that the services and operations of the library should not be confined to space and time, as is the practice of traditional libraries. Library users expect timely access to reliable information resources, and technologies plays a significant role in meeting these expectations. Consequently, libraries increasingly rely on information and communication technology (ICT) tools that enable users to search, retrieve, and utilize information resources conveniently from any location.

The concept of library service quality is commonly defined as the gap between user' expectations and their perceptions of the service delivered. In the library settings, quality may be recognized by library patrons in terms of prompt service delivery (Rasul & Sahu, 2011). When libraries attempt to broaden their reach and enhance their services, quality becomes a critical concern. For service quality to be meaningful in the library environment, it must align with the information needs and expectations of users.

### **Accessible technologies used in the library**

- 1. Text-to-Speech Technology (TST):** Text-to-speech technology is one of the major assistive technologies adopted in libraries to enhance accessibility for users with disabilities. Text-to-speech assistive technology refers to compute-based technologies that are capable of converting written text into spoken audio output. It can be in the form of

image-to-text conversion, handwriting recognition systems that convert content into speech, and speech-to-text technology that reads digital text aloud (Shadieva et al., 2014). They can be helpful to those with some levels of challenges, such as those challenged with visual difficulty. The technology is not only useful to patrons who are completely blind but also helpful to those with varying degrees of visual impairment. Text-to-speech technology has been recognized as a useful learning support tool for other categories of library users. According to Hwang et al. (2011), TST technology can enhance comprehension among students with certain levels of physical disabilities and can also assist foreign students, who may experience language barriers when engaging with textual materials.

The integration of Text-to-speech technology into library services represents a significant step toward promoting accessibility and inclusivity in information provision. Thus, the adoption of such assistive technologies, libraries can ensure that information resources are accessible to broader range of users regardless of the physical or cognitive limitations.

According to Adetoro (2014), a library as a public place ought to be properly equipped with relevant technologies to meet the purpose required of it.

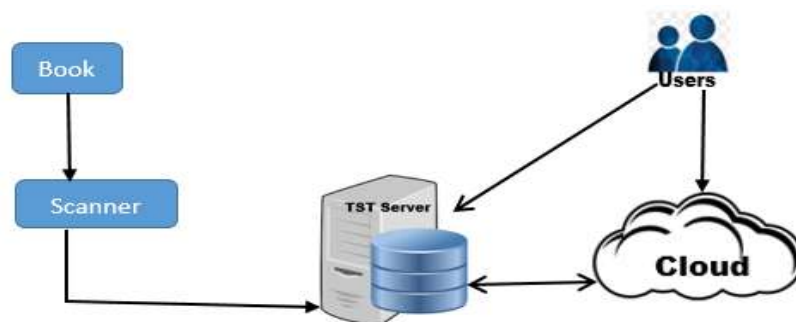


Figure 1: Text-to-Speech Conversion Process

From Figure 1, to convert a book in text format to audio, the first thing done is to scan the book. The scanned format of the book is then fed to the server, where some software will act on it. The converted format can be directly accessed by users in offline mode or accessed through the cloud using the internet.

**2. Braille conversion technology:** This technology is the type that converts plaintext or rich text documents to braille files. This is important to persons with sight predicaments (PwSP), and it does the work by mapping plaintext characters to braille cells, which are otherwise referred to as braille alphabets (Zatserkovnyi, et al, 2019).

The traditional braille conversion technology can only convert documents in plaintext format, which implies that documents in graphics, video, etc. formats will not be accessible to PwSP. These made researchers come up with a series of research classified as smart braille conversion technology, listed in Table 1.

**Table 1: Smart braille conversion technologies**

S/N	Innovations	Media Support	Unique Features	Operating Platform	Uses	Year of release
1	HumanWare Braille Touch	Text	It is equipped with touch screen display and single-lined 1D braille cell.	All	It allows users (which is PwSP) to use a virtual keyboard on the touch screen.	2017
2	Braille Sense Polaris	Audio only	It is built with a feature to display graphic images for school and office use.	Android	Used to display complex graphics for office use.	2017
3	Braille Notetaker	Audio only	It is built with a touchscreen keyboard with 40 Braille cells.	Android	Used to electronically take notes by PwSP.	2016
4	inFORM system	Not specified	Built with actuators to facilitate physical tele-presence.	All	It is used for the dynamic processing of 3D shapes. It attempts to visualize objects remotely.	2018

5	Blitab	Image and Audio	Built with a special image display	Android	Used to display and interpret images for PwSP to understand them.	Unknown
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**3. Augmented Reality:** Augmented reality sits at the forefront in consideration about the technologies that will facilitate the inclusive services rendered to libraries due to the proliferation and ubiquitous nature of mobile devices in our generation. It is a technology that blends the real world with computer-related media (Santos & Esposito-Betan, 2017). AR in use today comes in two variants, which include location-aware and vision. The location-aware model uses GPS (Geographical positioning system) to locate an object, in this case, library resources, where it is located in the library shelves, instead of taking a long time to search for it. The vision model involves integrating 3D virtual objects in a 3D real environment in real time. The 3D virtual objects are made more interactive by inserting the object into traditional print text. This has been discovered through research, solving the problem of reading attention disorder (RAD) that some library patrons may be undergoing. This disorder is capable of excluding potential library patrons, but innovations in AR arrested the situation (Kipper and Rampolla, 2012). Apart from this crucial role played by AR technology in helping libraries to be inclusive in rendering their services, Jonathan and Sharon (2017) pinpointed the following as areas where AR can be applied in our library. They include bookshelves, reading and browsing, library tours, augmenting photo collections, awareness campaigns, library navigation, and readers' advisory.

**4. RFID technologies:** Radio frequency identification (RFID) is a technology that is used to identify and track objects. It can be electronically programmed with unique information and sensors to query tags. This can be used to easily locate resources in the library without wasting time. The technology can also be used to trace the whereabouts of any library holdings, which will mitigate the loss of such holding. Also, this technology can help save the time library staff spend scanning barcodes while charging and discharging. In summary, RFID technologies are used in libraries to reduce the time spent accessing and locating library holdings, provide easy circulation services, ease library staff stress, increase efficiency, and help in the check-in and check-out exercise of library patrons (Gul & Bano, 2019).

## Methodology

(K. Lee, 2020) affirmed that the literature review is a major foundational base for the expansion and the discovery of research gaps for future research. This fast-tracked the discoveries of fresh ground where previous research has not focused. Hence, this systematic literature review was undertaken to ascertain the available accessible digital technologies within libraries and the level of adoption of these technologies.

### **Searching Strategies**

The search for literatures was done from some of the mainline academic online databases using the keywords in the topic.

The keyword was combined with some phrases and Boolean operators such as 'OR', 'AND', '+' and '-'. The keywords used were 'Bridging the Digital Divide through Technologies', 'Digital Technologies in Library', 'Enhancing Library Services through the Use of Digital Technologies', and 'The Library and the Concept of Inclusivity'. The search result was filtered based on the following inclusion/exclusion criteria stated hereunder:

- 1.) An article is considered if the language is in English or translated without error into English.
- 2.) An article is considered if it is a journal paper, textbook, conference paper, unpublished Ph.D and M.Sc theses.
- 3.) Any article that discusses the available accessible digital technologies within the libraries and the level of adoption of these technologies.
- 4.) The authors excluded any article whose context is outside the scope of this study.
- 5.) The authors also excluded duplicate articles.

### **Findings and Discussions**

#### **Enhanced library services**

Approximately twenty of the reviewed studies reported that the use of digital technologies had improved the quality of services provided by library staff to patrons, including persons with disabilities. The library patrons include all categories of users, including persons with disabilities. This supports the findings of Ayiah (2017), which asserts librarians are ethically trained to provide effective access to library services and collections to all users without bias and discrimination.

Before the use of digital technologies, providing quality library services to patrons with disabilities posed challenges for librarians. However, the integration of digital technologies has helped address these challenges. Tripathi & Shukla (2014), in their study, noted that for library collections to be truly inclusive, they should be available in multiple formats such as audiobooks, braille converted texts, and large-print electronic resources.

### **Inadequate amenities**

One of the main findings of the paper revealed that although technologies exist to support library services, inadequate basic social amenities such as electricity and poor internet connectivity are major hindrances for the effective implementation of these technologies in libraries in developing economies such as Nigeria. This discovery was more pronounced in the following journals (Chigwada & Phiri, 2021), (Ajegbomogun et al., 2017; Madu et al., 2018; Salman et al., 2017; Salman, Mugwisi & Mostert., 2017). They observed that inadequate amenities hinder proper service delivery in libraries, resulting in limited learning opportunities, reduced research productivity, and an inability to achieve educational objectives.

### **Inappropriate staff training**

The findings of this study revealed that most of the reviewed papers reported inadequate funding for staff training in libraries. Madu et al. (2018), particularly noted that the lack of technological literacy among librarians has hindered the effective use of available digital technologies provided by the authority, resulting in many of the gadgets being underutilized. It is also observed that some librarians are averse to change, thereby limiting their ability to provide effective services in modern library environment.

### **Poor funding**

Funding is a key factor for the effective running of any organization, of which a library is not an exception. It is important to note that quality resources and service are proportional to the availability of funds.

### **Conclusion**

The findings of this study highlight the growing importance of digital and assistive technology in promoting inclusive library services, the availability and use of these technologies shows that libraries are now capable of providing equitable access to information resources for diverse categories of users, including users with disabilities and those experiencing language barriers. The findings also support the accessibility principles advocated by the International Federation of Library Associations and Institutions (IFLA), which encourages the need for library collections and services to be developed in formats that ensure access for all.

The study further implies that the integration of digital and assistive technologies is gradually transforming libraries into more inclusive learning environments. This development shows the need for continuous investment in digital infrastructure, staff training, and supportive policies to promote accessibility in library services.

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