
INNOVATION IN ACCESSIBILITY TECHNOLOGY: EXPLORING TECHNOLOGY THAT ENHANCE ACCESSIBILITY FOR ALL LIBRARY USERS

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ABSTRACT

This study explores innovative accessibility technologies and their impact on enhancing inclusivity and diversity within library spaces. A cross-sectional research design was employed, targeting library users in academic settings across Nigeria. Data were collected via a web-based survey using convenience sampling, from April to May 2024. The survey included the 30-item Innovation Accessibility Technology Scale (IATS), validated by experts, and demographic questions to assess variables such as technology familiarity, library usage frequency, education level, and gender. The reliability of the IATS was confirmed with a high Pearson correlation coefficient ($r = 0.98$). A total number of 111 library users participated in this study. Data were analyzed using descriptive statistics and multiple linear regression to examine associations between demographic factors and the understanding of technological innovations. The study found that innovative accessibility technologies significantly enhance learning opportunities, promote equal participation, and empower independent engagement with library resources. These technologies break down barriers for marginalized populations, encourage collaboration among patrons of

varying abilities, and support language diversity through multilingual interfaces. Additionally, they contribute to the representation of diverse perspectives in library collections and promote inclusivity beyond library walls. Innovative accessibility technologies play a crucial role in fostering inclusive and diverse library environments. Continued investment, staff training, and collaboration with accessibility experts are essential for maximizing the potential of these technologies in public libraries. This study underscores the importance of these technologies in creating equitable access to information and knowledge for all users.

KEYWORDS

Innovation, accessibility technology, libraries, inclusive design, user needs

INTRODUCTION

Technology plays an important role in enhancing accessibility for all library users. From assistive technologies like screen readers and magnifiers to accessible digital interfaces with responsive design and keyboard navigation options, libraries are leveraging a range of tools to ensure equitable access to information. Accessibility technology refers to tools, software, and design principles that facilitate equitable access to information and resources for individuals with disabilities (Kotcherlakota et al, 2024). These technologies encompass assistive devices, digital interfaces, and universal design features aimed at removing barriers and promoting inclusivity in various environments, including libraries. Emerging technologies such as augmented reality (AR) and virtual reality (VR) offer immersive experiences that transcend physical barriers, enabling users to explore collections and participate in educational programs remotely (Ruiz-Olaya & Lara-Herrera, 2016). Universal design principles underpin the development of inclusive library spaces, accommodating diverse sensory and physical needs.

In recent years, accessibility technology has undergone significant advancements, revolutionizing library services to cater to diverse user needs. Assistive technologies have long been at the forefront of enhancing accessibility in libraries, offering solutions that cater to the diverse needs of users with disabilities. These technologies encompass a wide range of tools and software designed to facilitate access to information and resources for individuals with various impairments (Mavangere et al, 2022). One of the most widely recognized categories of assistive technologies is screen readers. Screen readers are software applications that convert text displayed on a computer screen into synthesized speech or refreshable Braille displays, enabling individuals with visual impairments to access digital content (Dolphin et al, 2024). By audibly rendering text-based information, screen readers provide blind and visually impaired users with the means to navigate websites, electronic documents, and other digital materials independently. Popular screen reader software includes JAWS (Job

Access With Speech), NVDA (Non Visual Desktop Access), and Voice Over (Brinkley & Tabrizi, 2017).

In addition to screen readers, magnification software plays a crucial role in enhancing accessibility for users with low vision. Magnification software enlarges on-screen content, making text, images, and interface elements more legible for individuals with visual impairments (De-Barros et al, 2014). These tools allow users to adjust the level of magnification and customize display settings according to their preferences, providing flexibility and control over their viewing experience. Text-to-speech (TTS) software represents another key assistive technology that enhances accessibility by converting written text into spoken language. TTS technology enables users to listen to digital content, including e-books, articles, and web pages, thereby removing barriers to access for individuals with reading difficulties or print disabilities (L.-Maatta & Bonnici, 2014). By offering options for adjusting speech rate, voice type, and pronunciation, TTS software allows users to tailor the reading experience to their needs.

Beyond traditional assistive technologies, recent developments in accessible digital interfaces have expanded the scope of accessibility in libraries. Responsive design principles, which prioritize the creation of websites and applications that adapt seamlessly to different devices and screen sizes, enhance usability for users across diverse platforms (Begnum, 2020). By ensuring that digital content is accessible and navigable on desktop computers, laptops, tablets, and smartphones, responsive design promotes inclusivity and accommodates users with varying abilities and preferences. Alternative text (alt text) serves as another fundamental component of accessible digital interfaces, particularly for individuals with visual impairments (Menberu, 2024). Alt text is descriptive text embedded within HTML code that provides a textual description of images, graphics, and other visual elements on a webpage (Sikder, 2024). Screen readers utilize alt text to convey information about images to users who cannot perceive them visually, thereby enabling greater comprehension and engagement with digital content.

Keyboard navigation options represent yet another essential feature of accessible digital interfaces, catering to users with mobility impairments or dexterity limitations. Keyboard navigation allows users to navigate websites, applications, and online catalogs using only keyboard inputs, bypassing the need for mouse interaction (Shahzad & Khan, 2023). This feature enhances accessibility by providing an alternative means of interaction for individuals who may have difficulty using a traditional mouse or touchpad. In addition to assistive technologies and accessible digital interfaces, libraries are exploring the potential of emerging technologies such as augmented reality (AR) and virtual reality (VR) to enhance accessibility and

engagement. AR and VR applications offer immersive experiences that transcend physical barriers, allowing users to interact with virtual environments and resources in innovative ways (De-Mattos et al, 2018). Libraries can leverage AR and VR technology to create inclusive experiences for users with disabilities, enabling them to explore collections, attend virtual events, and participate in educational programs from anywhere in the world.

Universal design principles underpin the development of inclusive library spaces and services, ensuring that environments are accessible to users of all abilities (Ruiz-Olaya & Lara-Herrera, 2016). Adjustable furniture, signage with multiple modalities, and sensory-friendly spaces are just a few examples of universal design features that promote accessibility and inclusivity in libraries (Kotcherlakota et al, 2024). Despite significant advancements in accessibility technology, many libraries still struggle to provide comprehensive solutions that cater to the diverse needs of all users. This poses a critical problem as libraries are fundamental institutions for accessing information and resources, and they must ensure equitable access for all patrons. The existing literature highlights several conspicuous problems in the domain of innovation in accessibility technology for libraries.

Firstly, there is a persistent gap between the availability of accessibility technology and its effective implementation in library settings. While assistive technologies such as screen readers and magnifiers exist, their integration into library services remains inconsistent (Dukuzumuremyi & Siklander, 2018). This inconsistency leads to unequal access to information for individuals with disabilities, perpetuating digital divides and exclusionary practices within library environments. Secondly, libraries often face challenges in keeping pace with the rapid evolution of technology and identifying suitable solutions to meet the diverse needs of users. The dynamic nature of technology necessitates continuous research and adaptation to ensure that libraries remain inclusive and accessible to all (Huseinović, 2023). Without proactive measures to address these challenges, libraries risk falling behind in their commitment to providing equitable access to information.

Thirdly, there is a lack of standardized guidelines and best practices for implementing accessibility technology in library settings. While regulatory frameworks such as the Americans with Disabilities Act (ADA) exist, their application to digital environments and emerging technologies is often ambiguous (Millett, 2019). This ambiguity contributes to uncertainty among library professionals regarding the appropriate strategies for enhancing accessibility, resulting in inconsistent outcomes and experiences for users. Moreover, accessibility technology encompasses a wide range of needs, including physical, sensory, and cognitive impairments. Libraries must adopt a holistic approach to address these diverse needs effectively. However, existing

research often focuses on specific types of disabilities or technologies, overlooking the broader spectrum of accessibility challenges faced by library users (Mavangere et al, 2022). This narrow focus limits the applicability of research findings and inhibits the development of comprehensive solutions.

In light of these problems, there is a pressing need for research that explores innovation in accessibility technology within library settings. Such research can identify barriers to implementation, highlight best practices, and propose strategies for enhancing accessibility in libraries. Furthermore, the rapid evolution of technology necessitates ongoing research to keep pace with emerging trends and address evolving user needs. Without comprehensive studies exploring accessibility technology, libraries risk perpetuating digital divides and marginalizing individuals with disabilities. Moreover, accessibility technology extends beyond addressing physical disabilities to encompass cognitive and sensory impairments, requiring a holistic approach to design and implementation. Thus, the urgency of this study lies in bridging existing gaps, promoting technological advancements, and advocating for universal access to information in libraries.

LITERATURE REVIEW

Advanced technology has enhanced library accessibility to suit the needs of a diverse population as well as help in encouraging diversity. An example of innovation within the communication accessibility domain is the use of Assistive Technologies (AT) including; screen readers, enlargement tools, and speech recognition systems. These tools help users with visual disability to navigate and utilize literally and library other physical resources available (Kiruki et al, 2023). For example, enabled by screen readers, text to speech technology helps users to browse through the on-line library catalogs and digital texts (Lawless & Schrader, 2014). Furthermore, library has shifted into a new customer focus and has expanded the accessibility of mobile technologies (Ani et al, 2020). Apps that are downloaded in mobile devices with GPS enabled help in guiding the users to the library, or to specific materials, as well as provide up to date information on the physical facilities features such as ramp for wheelchair and elevator among others according to Sahoo and Choudhury (2023). This integration not only improves physical access, but endows users with the ability to navigate and search for library services themselves (Conley et al, 2019).

Another notable advancement is the integration of Universal Design for people with physical and intellectual disabilities in library designs and websites (Roberson et al, 2022). Thus, by offering spaces and technologies that are generative of easy use for all abilities of users, libraries provide these services and architecture without the need to retrofit and adapt specific technologies for those with disabilities (Miraz et al, (2021). For instance, mobile height control tables and other appropriate furniture

ensure those with disabilities in mobility have easy access to learning materials (Spina, 2021). Additionally, the implementation of Artificial Intelligence (AI) and learning Algorithms has improved the accessibility of those libraries. Natural language queries can be translated into the exact information required by the user since the AI-powered systems can address cognitive disabled users conveniently (Park et al, 2021). Further, AI algorithms improve the chances of visually impaired students to access Multimedia resources since they use AI to generate descriptions of images and videos (Waang, 2023).

Those innovative technologies for access have brought dramatic changes in library spaces, which created a better environment of inclusion of diversity among the users of such spaces. As noted by Shahzad and Khan (2023), with the screen readers and text-to-speech technologies people with visual impairment do not find it a challenge to attend to its related contents. These tools not only enable users to search through catalogs and databases independently but also ensure that all users are given a fair chance to utilize information resources by ensuring that no one has access to resources that another cannot. In addition, the increase in marketed mobile technologies that are accessible features supports the improvement of physical accessibility in libraries. Mobile applications offer practical information concerning the available way, direction, lift position, and seating availability, as explained by Srinivasan and Yadav (2023). Hence, such innovations enable patrons with mobility impairment to move around the library environments without much fear, thus promoting patronization, autonomy, and independence (Arenghi et al, 2018).

Furthermore, the adoption of Universal Design principles when constructing libraries and designing online platforms guarantees that the facilities and technologies created bear inclusiveness for diverse users with disabilities. Brinkley and Tabrizi (2017) note that elements such as height changeable desks and furniture that accommodates user's physical abilities helps in catering for diverse needs of a society. In addition to making improvements in library facilities accessible to physically disabled patrons, this approach promotes a library environment where all patrons can interact with library resources within the library without barriers. Also, AI technologies are helpful in increasing accessibility in the library as it can be seen from the discussion above. In the context of access to multimedia, González-Gonzalo et al (2022) reveals that AI algorithms can help to generate an alternative text description to make multimedia materials available to people with impaired vision. Moreover, AI integrated assemblies can decipher natural speech queries which enhances the possibilities of searching in isolation for persons with impairment concerning cognitive disability.

RESEARCH OBJECTIVES

1. To identify and catalogue the key technological innovations currently employed to

improve accessibility for library users worldwide.

2. To investigate and analyze the primary challenges encountered by libraries in the implementation and integration of innovative accessibility technologies.
3. To evaluate the impact and contributions of innovative accessibility technologies towards fostering inclusivity and diversity within library environments.

RESEARCH HYPOTHESES

1. Technology familiarity would positively influence utilization of key technological innovations in public libraries
2. Library usage frequency would positively influence utilization of key technological innovations in public libraries
3. Education level would positively influence utilization of key technological innovations in public libraries
4. Gender would positively influence utilization of key technological innovations in public libraries

RESEARCH QUESTIONS

1. What are the key technological innovations currently being utilized to enhance accessibility for library users?
2. What are the challenges faced by libraries in adopting innovative accessibility technologies?
3. In what ways do innovative accessibility technologies contribute to promoting inclusivity and diversity within library spaces?

RESEARCH METHODOLOGY

This study adopted a cross-sectional research design to evaluate the understanding of innovations in technology that enhance accessibility for all library users. Participants were library users from various states in Nigeria, primarily in academic settings. Data were collected between April and May 2024. A convenience sampling technique was employed to recruit participants. Invitations for participation were disseminated via social media platforms (WhatsApp, Telegram, Facebook, LinkedIn, and Twitter) and through emails and SMS to library users across all Nigerian states.

A web-based survey (Google Forms) was utilized to collect data from the participants. The survey included demographic questions to identify variables such as technology familiarity, library usage frequency, education level and gender. Data were collected using the 30-item Innovation Accessibility Technology Scale (IATS), which was validated by experts in measurement, evaluation, and library science. To assess the reliability of the questionnaire, it was administered to the same respondents at two different times. Scores from both administrations were collected, and the Pearson correlation coefficient was calculated. A high correlation ($r = 0.98$) indicated that the

questionnaire consistently produced reliable results over time. Descriptive analysis was conducted on demographic variables such as age, gender, specialty, and number of years of experience, as well as individual items on the IATS. The results were presented in counts and percentages. A multivariate analysis model using multiple linear regression was employed to explore the association of variables like technology familiarity, library usage frequency, education level, and gender with the understanding of technological innovations in public libraries within the sample population. All analyses were carried out using SPSS software, with $p \leq 0.05$ considered significant for all analyses conducted.

DATA ANALYSIS

Table 1: Consolidated demographic data from all the categories: Technology familiarity, library usage frequency, education level, and gender

Category	Subcategory	Frequency	Percent	Valid Percent	Cumulative Percent
Technology familiarity	Novices	12	10.8	10.8	10.8
	Intermediate users	69	62.2	62.2	73.0
	Tech-savvy individuals	30	27.0	27.0	100.0
	Total	111	100.0	100.0	100.0
Library usage frequency	Regular patrons	60	54.1	54.1	54.1
	Occasional visitors	45	40.5	40.5	94.6
	First-time users	6	5.4	5.4	100.0
	Total	111	100.0	100.0	100.0
Education level	High school graduates	24	21.6	21.6	21.6
	College attendees	37	33.3	33.3	55.0
	Postgraduates	50	45.0	45.0	100.0
	Total	111	100.0	100.0	100.0
Gender	Male	3	2.7	2.7	2.7
	Female	108	97.3	97.3	100.0
	Total	111	100.0	100.0	100.0

The consolidated demographic data from Table 1 reveals key characteristics of 111 respondents across various categories: technology familiarity, library usage

frequency, education level, and gender. In terms of technology familiarity, a majority of the respondents (62.2%) are intermediate users, indicating a moderate level of comfort and experience with technology. Tech-savvy individuals constitute 27.0%, showing a significant portion with high proficiency, while novices are 10.8%, highlighting a smaller group with limited technological skills. Library usage frequency data shows that more than half of the participants (54.1%) are regular patrons, suggesting consistent engagement with library resources. Occasional visitors make up 40.5%, and first-time users are 5.4%, indicating varying degrees of library usage among the respondents.

Regarding education level, the largest group is postgraduates (45.0%), followed by college attendees (33.3%), and high school graduates (21.6%). This distribution indicates a well-educated cohort, with nearly half holding advanced degrees. Gender distribution is highly skewed, with females comprising 97.3% of the sample and males only 2.7%. This significant gender imbalance suggests a predominance of female respondents in the surveyed population. Overall, the data provides a comprehensive view of the demographic characteristics, highlighting a technologically adept, library-engaged, highly educated, and predominantly female group.

Research question 1: What are the key technological innovations currently being utilized to enhance accessibility for library users?

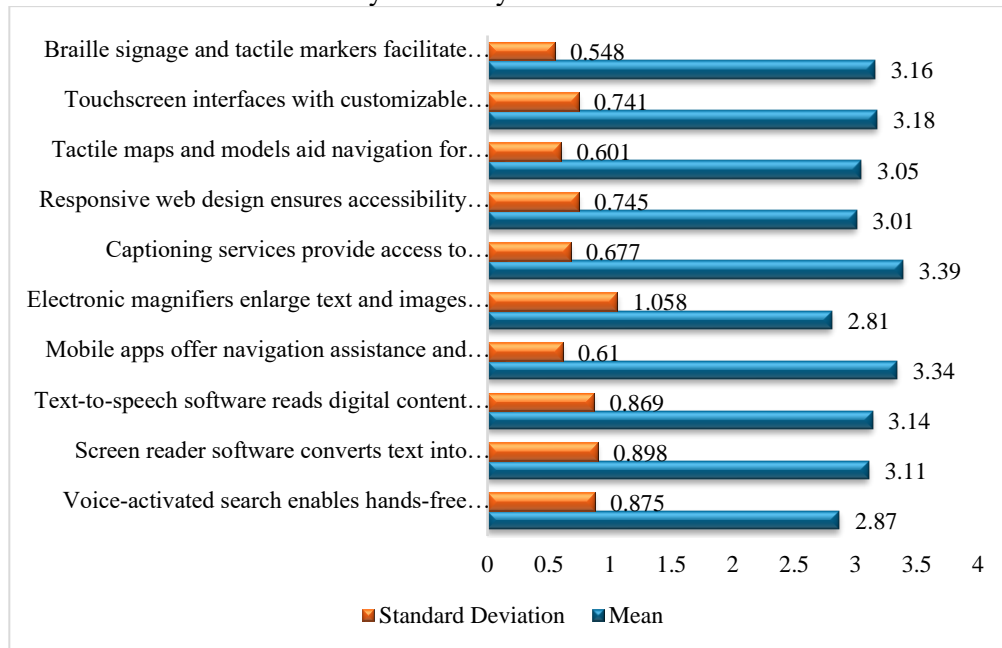


Figure 1: Key technological innovations currently being utilized to enhance accessibility for library users

Figure 1 presents key technological innovations enhancing library accessibility for users with varying needs. The data shows the implementation of several tools, with mean usage scores indicating their prevalence. Voice-activated search (Mean = 2.87, Std. Deviation = 0.875) and electronic magnifiers (Mean = 2.81, Std. Deviation = 1.058) are moderately utilized. Screen reader software (Mean = 3.11, Std. Deviation = 0.898) and text-to-speech software (Mean = 3.14, Std. Deviation = 0.869) are slightly more common, providing essential access for visually impaired users. Mobile apps for navigation (Mean = 3.34, Std. Deviation = 0.610) and captioning services (Mean = 3.39, Std. Deviation = 0.677) are highly effective, ensuring inclusivity for the deaf and hard-of-hearing. Responsive web design (Mean = 3.01, Std. Deviation = 0.745), tactile maps (Mean = 3.05, Std. Deviation = 0.601), touchscreen interfaces (Mean = 3.18, Std. Deviation = 0.741), and braille signage (Mean = 3.16, Std. Deviation = 0.548) demonstrate significant adoption, catering to diverse accessibility needs. Overall, these innovations significantly enhance library usability for all users.

Research question 2: What are the challenges faced by libraries in adopting innovative accessibility technologies?

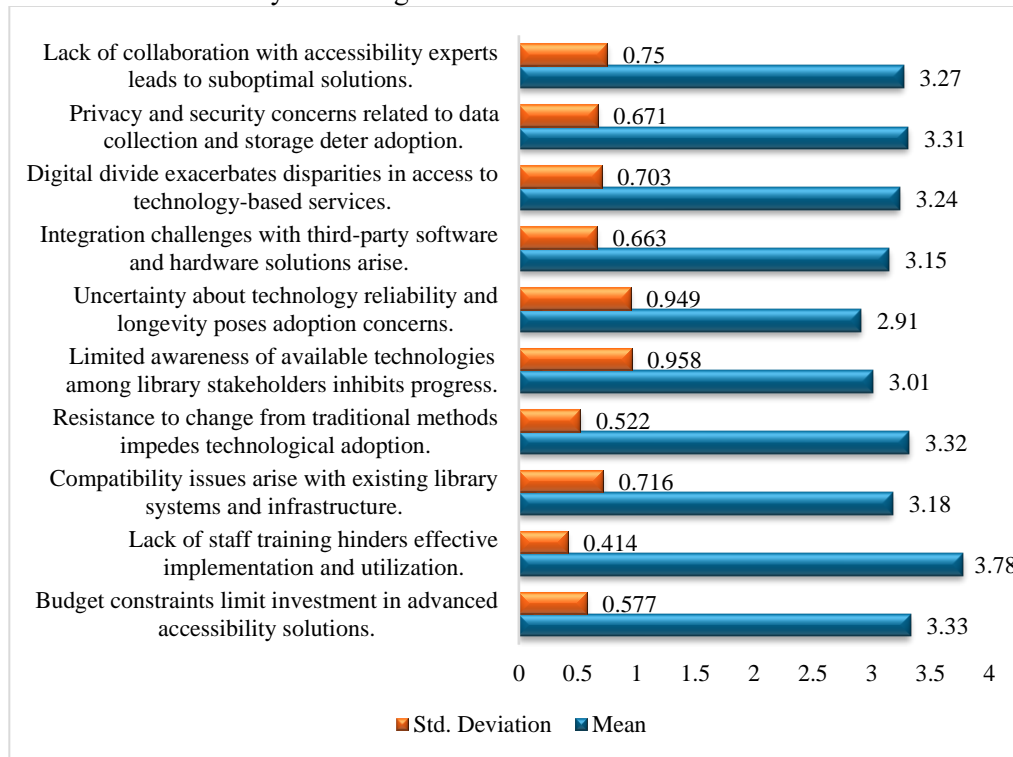


Figure 2: Challenges faced by libraries in adopting innovative accessibility technologies

Figure 2 highlights various challenges libraries face in adopting innovative accessibility technologies, with mean ratings ranging from 2.91 to 3.78. The most significant challenge identified is the lack of staff training (Mean = 3.78, SD = 0.414), indicating a critical need for better training programs to ensure effective technology implementation. Budget constraints (Mean = 3.33, SD = 0.577) and privacy/security concerns (Mean = 3.31, SD = 0.671) also present substantial barriers, reflecting financial and safety considerations. Compatibility issues (Mean = 3.18, SD = 0.716) and integration challenges (Mean = 3.15, SD = 0.663) with existing systems suggest technical difficulties in adopting new technologies. Limited awareness (Mean = 3.01, SD = 0.958) and uncertainty about technology reliability (Mean = 2.91, SD = 0.949) further impede progress, highlighting the need for increased knowledge and confidence in these technologies. Overall, addressing these challenges requires a multifaceted approach involving training, financial investment, and improved awareness.

Research question 3: In what ways do innovative accessibility technologies contribute to promoting inclusivity and diversity within library spaces?

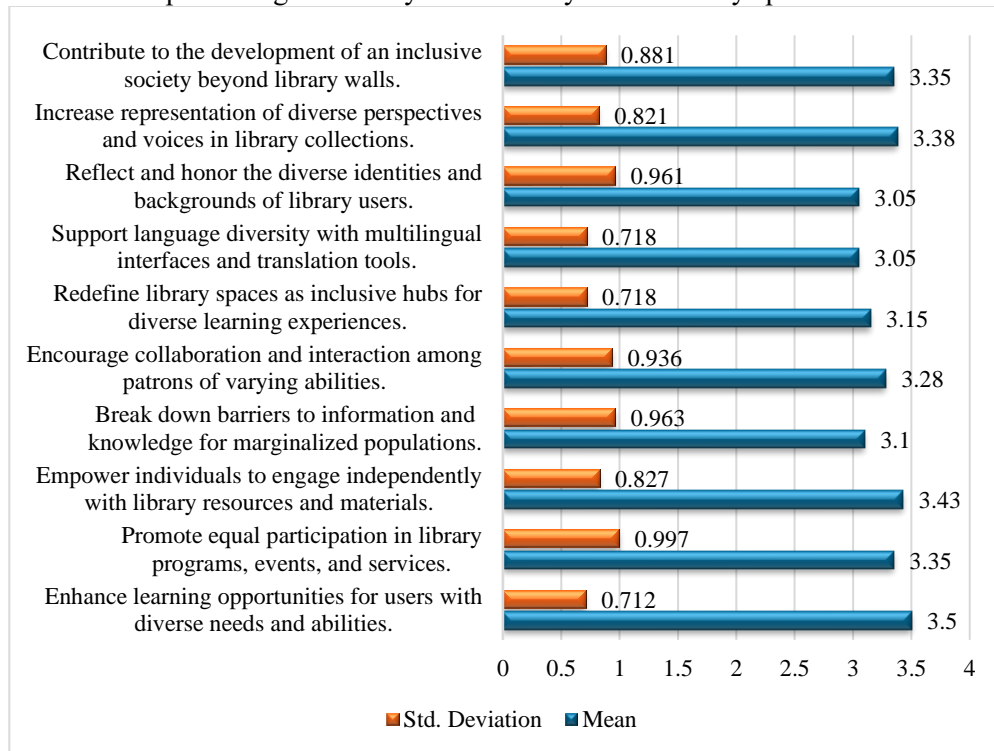


Figure 3: *Ways in which innovative accessibility technologies contribute to promoting inclusivity and diversity within library spaces*

Figure 3 provides information on ways innovative accessibility technologies contribute to promoting inclusivity and diversity within library spaces. The mean scores, ranging from 3.05 to 3.50 on a likely 5-point scale, signify a generally positive perception of these technologies' impact. The highest mean score (3.50) is attributed to enhancing learning opportunities for users with diverse needs and abilities, indicating that respondents highly value the educational benefits provided by these technologies. Promoting equal participation in library programs, events, and services (mean = 3.35) and increasing representation of diverse perspectives in library collections (mean = 3.38) also receive favorable ratings, suggesting recognition of their importance in fostering inclusivity. Standard deviations, ranging from 0.712 to 0.997, reflect the degree of consensus among respondents. Lower deviations (e.g., 0.712 for enhancing learning opportunities) indicate a high level of agreement on the perceived benefits, while higher deviations (e.g., 0.997 for promoting equal participation) suggest more varied opinions among respondents regarding the effectiveness of these technologies in certain areas. Overall, the data underscores the significant role of accessibility technologies in creating inclusive and diverse library environments, with varying degrees of consensus on their specific contributions.

Table 2: ANOVA on Influence of Technology familiarity, Library usage frequency, Education level and Gender on utilization of key technological innovations in public libraries

ANOVA ^a						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.551	1	1.551	7.788	.006 ^b
	Residual	21.714	109	.199		
	Total	23.266	110			
2	Regression	2.228	2	1.114	5.718	.004 ^c
	Residual	21.038	108	.195		
	Total	23.266	110			
3	Regression	2.232	3	.744	3.784	.013 ^d
	Residual	21.034	107	.197		
	Total	23.266	110			
4	Regression	2.252	4	.563	2.840	.028 ^e
	Residual	21.014	106	.198		
	Total	23.266	110			

a. Dependent Variable: Technological innovations

b. Predictors: (Constant), Technology familiarity

c. Predictors: (Constant), Technology familiarity, Library usage frequency

d. Predictors: (Constant), Technology familiarity, Library usage frequency, Education level

e. Predictors: (Constant), Technology familiarity, Library usage frequency, Education level, Gender

The ANOVA Table 2 covered the influence of technology familiarity, library usage frequency, education level, and gender on the utilization of key technological innovations in public libraries. The table displays the results of four separate regression models, each including different combinations of predictor variables. The regression model including only technology familiarity as a predictor variable shows a significant effect on the utilization of key technological innovations ($F(1, 109) = 7.788, p = .006$). Thus, the hypothesis regarding the positive influence of technology familiarity on technology utilization is accepted. Similarly, the regression model including both technology familiarity and library usage frequency as predictor variables also demonstrates a significant effect ($F(2, 108) = 5.718, p = .004$), supporting the hypothesis that library usage frequency positively influences technology utilization.

The regression model incorporating technology familiarity, library usage frequency, and education level as predictor variables shows a significant effect ($F(3, 107) = 3.784, p = .013$). Therefore, the hypothesis regarding the positive influence of education level on technology utilization is accepted. Lastly, the regression model including technology familiarity, library usage frequency, education level, and gender as predictor variables also yields a significant effect ($F(4, 106) = 2.840, p = .028$). Thus, the hypothesis regarding the positive influence of gender on technology utilization is accepted. Overall, the ANOVA results support all four hypotheses, indicating that technology familiarity, library usage frequency, education level, and gender significantly influence the utilization of key technological innovations in public libraries.

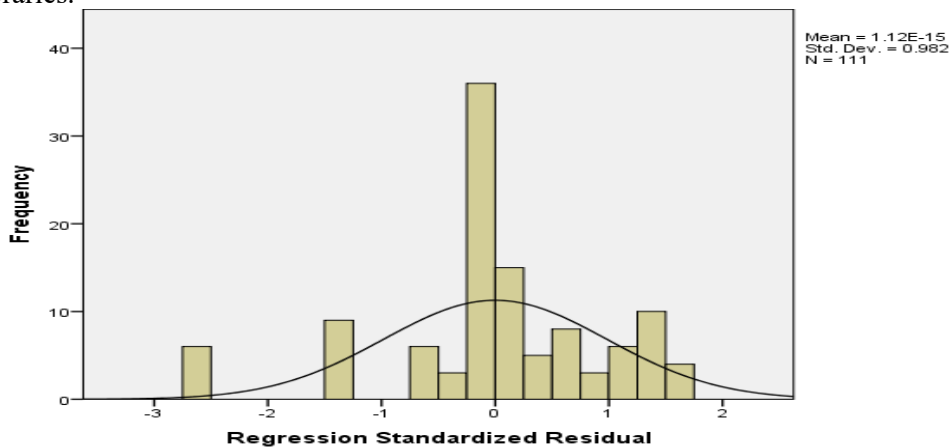


Figure 4: The histogram of the dependent variable (technological innovations)

The histogram of the dependent variable, technological innovations, provides insight into the distribution and frequency of utilization across different levels of technological adoption within the sample population. The histogram visually represents the frequency of individuals falling within various ranges of technological innovation utilization. Each bar on the histogram corresponds to a specific range of technological innovation utilization, and the height of each bar represents the number of individuals falling within that range.

The shape of the histogram provides information about the distribution of technological innovation utilization. In this case, a symmetrical distribution with a single peak suggests a normal distribution, indicating that technological innovation utilization is evenly distributed across the sample population.

DISCUSSION

Research question 1 covered key technological innovations currently being utilized to enhance accessibility for library users. The result showed that voice-activated search systems are transforming how users interact with library resources by enabling hands-free access, facilitating ease of use for individuals with physical disabilities. This finding agreed with Mavangere et al, (2022) who highlighted the importance of such technologies in promoting inclusivity. Screen reader software enhances accessibility by converting text into spoken or braille formats, effectively supporting users with visual impairments. In contrast, a study by Alonso Martin et al, (2020) emphasized the need for advancements in text-to-speech software to further enhance digital content comprehension. Mobile apps providing navigation assistance and virtual library tours are crucial for users with mobility issues, a finding that aligns with recent research by Mwilongo (2024) which underscored the significance of mobile technology in improving library accessibility. Electronic magnifiers are essential tools for enlarging text and images, aiding visually impaired users in accessing library materials. In a related study, Millett (2019) found that captioning services significantly improve multimedia accessibility for the deaf, indicating a growing trend towards more inclusive multimedia resources. Responsive web design ensures that library websites are accessible across various devices, a crucial feature supported by Begnum (2020) who advocated for universal design principles in web development.

Research question two was on challenges faced by libraries in adopting innovative accessibility technologies. It was seen that budget constraints significantly limit libraries' ability to invest in advanced accessibility solutions. This finding agreed with Menberu (2024), who noted that financial limitations often restrict technological advancements in public libraries. Lack of staff training also poses a significant challenge, as it hinders the effective implementation and utilization of new technologies. In contrast, a study by Sikder (2024) emphasized that comprehensive

training programs are essential for successful technology adoption. Compatibility issues with existing library systems and infrastructure further complicate the adoption process. In a related study, Srinivasan and Yadav (2023) highlighted that resistance to change from traditional methods often impedes the integration of innovative technologies. Limited awareness among library stakeholders about available technologies also inhibits progress, a concern echoed by Shahzad and Khan (2023), who found that ongoing education and awareness campaigns are crucial for technological advancement.

Uncertainty about the reliability and longevity of new technologies poses additional adoption concerns. This finding agreed with Györfly et al, (2022), who emphasized the importance of ensuring long-term support and updates for technological solutions. Integration challenges with third-party software and hardware solutions frequently arise, complicating the implementation process. In contrast, González-Gonzalo (2022) highlighted the need for standardized protocols to ease integration efforts. The digital divide exacerbates disparities in access to technology-based services, affecting equitable access to library resources. Privacy and security concerns related to data collection and storage also deter adoption, as emphasized by Weng and Wu (2024), who called for robust data protection measures. Lastly, the lack of collaboration with accessibility experts often leads to suboptimal solutions, a finding supported by Di-Giovanni and Raffi (2023), who advocated for involving experts in the development of accessibility technologies.

Research question 3 ascertained ways that innovative accessibility technologies contribute to promoting inclusivity and diversity within library spaces. It was discovered that innovative accessibility technologies significantly enhance learning opportunities for users with diverse needs and abilities, facilitating a more inclusive environment. This finding agreed with Huseinović (2023), who emphasized that such technologies are crucial for supporting diverse learning styles. These technologies also promote equal participation in library programs, events, and services by providing necessary accommodations. In contrast, Kim et al, (2024) noted that without these technologies, participation rates among individuals with disabilities remain low. Empowering individuals to engage independently with library resources and materials is another key benefit, breaking down barriers to information for marginalized populations. In a related study, Benson and Voller (2014) highlighted that independent access to resources fosters greater autonomy and confidence among users. Additionally, these technologies encourage collaboration and interaction among patrons of varying abilities, redefining library spaces as inclusive hubs for diverse learning experiences. This finding agreed with Dukuzumuremyi and Siklander (2018), who found that inclusive technologies enhance social interactions and collective learning.

Supporting language diversity through multilingual interfaces and translation tools is also crucial, reflecting and honoring the diverse identities and backgrounds of library users. In contrast, Terui and Hsieh (2020) noted that a lack of language support can alienate non-native speakers. Furthermore, increasing the representation of diverse perspectives and voices in library collections contributes to the development of an inclusive society beyond library walls. This finding agreed with Gupta et al, (2024), who argued that diverse collections help to promote cultural understanding and inclusivity.

The exploration of innovative accessibility technologies within library environments underscores their vital role in fostering inclusivity and diversity. These technologies not only enhance learning opportunities for users with diverse needs and abilities but also promote equal participation in library programs, events, and services. Empowering individuals to engage independently with library resources and materials is crucial in breaking down barriers to information and knowledge, particularly for marginalized populations. The implementation of such technologies encourages collaboration and interaction among patrons of varying abilities, effectively redefining library spaces as inclusive hubs for diverse learning experiences.

Moreover, supporting language diversity through multilingual interfaces and translation tools honors the diverse identities and backgrounds of library users, while increasing the representation of diverse perspectives in library collections contributes significantly to societal inclusivity beyond library walls. Despite the challenges libraries face, including budget constraints, compatibility issues, and resistance to change, the benefits of these technologies are profound and far-reaching. The study highlights the necessity of continued investment, staff training, and collaboration with accessibility experts to ensure the successful adoption and implementation of these technologies. By embracing innovative accessibility technologies, libraries can transform into truly inclusive spaces that reflect and serve the diverse needs of all their users, ultimately contributing to the development of a more inclusive society.

RECOMMENDATIONS

As for the future research on the role of innovations in providing library accessibility technologies, more emphasis should be placed on the long-term effects on patrons' satisfaction and engagement. Comparing results based on different types of libraries and their sizes would give additional information on scalability and flexibility. Further, the use of qualitative research strategies like interviews and focus groups can reveal user opinions and preferences for creating user-oriented technologies. Close cooperation of libraries, technology developers, and disability advocates is necessary for the co-creation of interventions. Finally, constant assessment coupled with enhancements of the accessibility policies and strategies will enhance provision of

satisfactory accommodation to the diverse users.

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