Assistive Technologies for Inclusion of Deaf and Hard-of-Hearing (DHH) Students and Academic Staff: A Call to Action for Library and Information Science Professionals in Uganda

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Abstract: Assistive technology (AT) is "any product whose primary purpose is to maintain or improve an individual's functioning and independence and thereby promote their well-being. For people with disabilities, AT has the potential to improve functioning, reduce activity limitations, promote social inclusion, and increase participation in education. University libraries are mandated to provide assistive technologies, adequate space, resources, and services suitable to support and meet teaching, learning, and research needs for all users, including persons with disabilities. However, it was hitherto unknown how university libraries in Uganda facilitate accessibility to library facilities services to meet the unique needs of deaf or hard-of-hearing students and academic staff. The current paper aimed to generate rich insights into the digital inclusion needs of Deaf and Hard-of-Hearing (DHH) students and academic staff, and to explore how university libraries in Ugandan higher education institutions facilitate the accessibility, adoption, and application of assistive technologies for teaching, learning, and research. Employing a mixed-methods design, the study utilized two semi-structured questionnaires and two interview guides to gather data from DHH students, academic staff, and librarians at four public universities in Uganda. The

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recruitment of DHH participants was conducted using purposive and snowball sampling techniques. Ethical clearance was granted by the Aids Support Organisation (TASO) Research Ethics Committee on July 27, 2023 (Ethics reference number: TASO-2023-237). Quantitative data were analysed using the Statistical Package for Social Scientists (SPSS ver. 21), while qualitative data underwent thematic analysis, with selected verbatim quotations used to corroborate the quantitative findings.
This paper has unearthed digital inclusion needs of DHH Students and Academic Staff, including access to high-speed internet, sufficient bandwidth, university websites with captions, software that translates a signer's words into text, captioning software, video editing software, multimedia mobile phone applications, LCD Projectors, personal computers, mobile phones, assistive technology technical support, digital and assistive technology training, and sign language interpretation which must be met for them to taking advantage of library resources as services that are available to all other users. In addition, the paper has revealed that Libraries are inaccessible because DHH Students and Academic Staff cannot afford the hardware, software, and peripheral equipment and data required to access technology-supported resources, systems, content, and services; the majority of Libraries did not conduct staff capacity building on basic knowledge of assistive technologies, digital and assistive technology training. Furthermore, the libraries did not train DHH students and academic staff in accessing databases, using Google Suite, and Mendeley, Endnote, and Zotero to manage citations and references. Libraries also did not identify and evaluate the Digital literacy training needs and lacked a clear strategy for meeting the digital literacy needs of DHH academic staff and students. Together these hindered the DHH Students and Academic Staff from effectively adopting and applying these technologies for teaching, learning, and research. Overall, the finding revealed a great mismatch between the existing library-related assistive technology services and resources and the digital inclusion needs of students and staff with hearing impairments. Given the important role of academic libraries in promoting digital inclusion, especially for Deaf and Hard of Hearing (DHH) academic staff and students, the paper recommends that University Libraries prioritize the development of a digital inclusion policy to guide the design and implementation of initiatives that improve access to library resources and services for DHH individuals.

Keywords: Assistive Technology, Digital Inclusion, Digital Spaces, Academic Libraries, Deaf, Hard-of-Hearing, Higher Institutions of Learning, Uganda

1.0 Background

Technological advancement and digital transformation have changed every aspect of human life and increased the need to embed Information and Communications Technology (ICT) and the Internet in teaching, learning, and

research. Although research reveals that digital technologies and Assistive technologies (ATs) have become more deeply rooted in people's lives, the discussion about the consequences of Technological advancement and digital transformation to persons with disability has been limited despite the growing number of persons with disabilities. Noteworthy, at least 1.3 billion of the world's population experience significant disability of whom 80% live in developing countries (Larsson-Lund & Nyman, 2020; McNicholl et al., 2021). Disability has been described as a complete or partial state of physical or mental condition that prohibits individuals from using their bodies (Phukubje & Ngoepe, 2017, p. 182).

Research has revealed that assistive technologies have the potential to enhance academic success and the completion of challenging educational tasks that would otherwise be difficult to undertake (Vosloo 2018; McNicholl et al. 2021a). Despite the impressive opportunities that assistive technologies offer to persons with disabilities, the majority of vulnerable individuals, including DHD students and academic staff, grapple with digital exclusion from education opportunities in digital spaces as soon as they are admitted or recruited in higher institutions of learning in Uganda (Busuulwa, 2015). This is contrary to the Universal Declaration of Human Rights, where education is a human right that every individual is entitled to lead a quality life. Also, the Sustainable Development Goal (SDG) 4 calls for governments and policymakers to establish an environment that enables people with disabilities to freely access educational facilities if they are to lead a quality life (UN-DESAD, 2023).

On a positive note, digital technologies can create equitable education opportunities for persons with disabilities, particularly the deaf. For instance, research reveals that people who have access to digital technologies as well as skills and knowledge and the necessary digital expertise to use digital technologies can easily navigate the digital spaces and equitably participate in community activities such as education, leisure, business, and travel (Douglas, Corcoran & Pavey, 2007; Hilbert 2020; McNicholl et al., 2021). Research reveals that Digital inclusion and assistive technologies, particularly purposefully designed solutions have the potential to help people– even those with very low literacy levels and low technology skills to navigate digital spaces and benefit from relevant applications, including those for teaching, learning, and research (Vosloo, 2018). For instance, research on students and staff with special needs has provided evidence that Assistive Technologies (AT) can improve academic performance, promote learning and engagement with educational materials, enhance academic success and independence in scholarly

activities, and the completion of some challenging educational tasks that staff and students would otherwise be unable to undertake (McNicholl et al., 2021)

Unfortunately, this potential is not yet fully utilised, as the majority of the most vulnerable individuals, such as people with disabilities, are still grappling with rude exclusion from digital spaces despite the UN's commitment to incorporate digital technology among the vulnerable, marginalised, those living in poverty, and people suffering from discrimination to address the growing digital gap (Larsson-Lund & Nyman, 2020; McNicholl et al., 2021). Consequently, the Sustainable Development Goal (SDG) 4 theme calls for governments and policymakers to establish an environment that enables people with disabilities to freely access educational and recreational facilities, including schools (Alabi & Mutula, 2020).

Research reveals most libraries have not considered focusing particular attention on the provision of services to persons who are deaf. Deafness has been called, with good reason, the "invisible handicap" because deaf people are not identifiable as deaf by casual observation and they tend to blend into the larger community. Research reveals that libraries and deaf people have mostly been unaware of each other yet libraries have a responsibility to ensure that their collections and services are accessible to deaf people and that deaf people are aware of the services libraries can provide them (Day 2004).

Although the National Council of Higher Education (NCHE) mandates university libraries in Uganda to support education by providing technologies, adequate space, resources, and services that support teaching, learning, and research for all users, including persons with disabilities, more emphasis was put on physical access by providing ramps and lifts to facilitate accessibility for persons with physical impairment (The Universities and Other Tertiary Institutions Act, 2005). It is still unclear how university libraries in Uganda have facilitated digital access for deaf and hard-of-hearing students. This paper is part of a wider postdoctoral study whose objectives were;

1. To identify the Digital Inclusion (DI) and Assistive Technology (AT) needs for academic engagement and independence of students and academic staff with disabilities.
2. To establish the degree to which universities facilitate accessibility, adoption, and application of digital technologies for teaching, learning, and research by students and staff with disabilities.
3. To examine the barriers to accessibility, adoption, and application of Assistive technologies for teaching, learning, and research.
4. To examine the digital technology competencies that academic staff and students with disabilities employ to take advantage of the multiple

functionalities of assistive technologies for teaching, learning, and research in Higher Institutions of Learning (HIL) in Uganda.

5. To design a comprehensive Special Needs Assistive Technology (SNAT) Inclusion framework for Digital inclusion and Assistive technology accessibility, adoption, and application for online teaching and learning of staff and students with disabilities in HIL in Uganda.

This paper is based on objectives one and two with a special focus on deaf and hard-of-hearing library users. The results and findings of objectives three to five and also persons with visual and physical impairment will be reported in our subsequent publications.

2.0 Related works

Article 19 of the United Nations (1948) Universal Declaration of Human Rights declares that equitable access to information is a human right, which affirms the right to seek, receive, and share information and ideas via any medium. The Lack of access to information disproportionately affects vulnerable groups, including people with disabilities. Censorship, digital divides, language barriers, and media freedom restrictions must all be addressed to ensure equitable access to information (Reid, 2020). It is critical to ensure inclusivity and accessibility in library services to align with the core values of librarianship, i.e., equity, diversity, and social responsibility (Leko Šimić et al., 2018).

Libraries are community hubs that play a vital role in promoting lifelong learning, fostering intellectual freedom, and facilitating access to information for all individuals, regardless of background or disability (Day 2004; Ayoung, Baada & Baaye, 2021). This suggests that libraries ought to promote inclusivity and accessibility by ensuring that their buildings, services, and products are inclusive to bridge the access gaps. For example, they should facilitate physical accessibility by providing ramps, elevators, and accessible restrooms (Chiscano, 2021). Research further suggests that library spaces should be designed to accommodate diverse needs by providing adjustable furniture, quiet areas (Ilako, 2023), and sensory-friendly spaces (DuBroy, 2019). With these services and products in place, libraries could uphold the principles of equal opportunity and non-discrimination, ensuring that everyone, including persons with disabilities, feel welcomed and empowered to fully participate in library programmes, and access services, and resources (Ayoung et al., 2021). Moreover, these strategies contribute to more inclusive societies by breaking down barriers while promoting understanding and acceptance of diversity.

Although dominant institutional views towards people with disabilities may impede true inclusion, libraries are called upon to consider users with disabilities alongside other users when they invest in ICTs. For example, they are called upon to incorporate assistive technologies and devices that support users with disabilities (Botelho, 2021). Assistive technologies are products, devices, or equipment that enhance the functional capabilities of individuals with disabilities to access traditional resources and services (Koulikourdi, 2008). As libraries invest in ICTs, they need to consider users with disabilities alongside other users of these services. Literature suggests that librarians and information specialists must improve access for all patrons while also becoming knowledgeable about assistive technologies and their market.

In an increasingly connected world, digital accessibility is critical to ensuring that people with disabilities can fully participate in online activities, access information, and use digital services (Jaeger et al., 2015). Digital accessibility focuses on access to technology products, resources, and services across hardware and software (Kulkarni, 2019). This form of access implies the removal of digital access barriers by making the interface, navigation of, and contribution to the online space easier for people with disabilities (PWDs) (Botelho, 2021).

Research has highlighted several challenges affecting digital access. For instance, (Ayoung et al., 2021) indicates that most of what is available for access does not support the needs of PWD users. (Ilako, 2023) highlights architectural restrictions, non-available resource formats, and inadequate assistive technologies as major challenges to accessibility. Some Libraries have numerous physical access barriers, such as inaccessible library sites, poorly planned interiors, poor signage, insufficient or inappropriate stock, unhelpful opening hours, and unfriendly access policies and regulations. These fixed features have the potential to influence physical non-use, under-usage, or inefficient library use on an individual or collective level (Bossaller et al., 2020). Without a clear understanding of the impact of access barriers, librarians may be unable to meet users' needs and requirements. Several studies have looked at library use or library building in this context in terms of inaccessibility. For example, Irvall & Nielsen (2005) discovered that access to library services was limited, particularly for users with disabilities, at universities in many developing countries. Additionally, Bodaghi and Zainab (2013) discovered that users with disabilities in public and university library buildings in Zanjan province, Iran, did not rate the accessibility conditions as 'good'. Moreover, limitations of the institutional setting, affect digital access. For example, many institutions have ignored the United Nations Convention on

the Rights of Persons with Disabilities (UNCRPD), which calls for the need to provide persons with disabilities access to new information and technology (Assembly 2006).

It is estimated that Uganda has more than 300,000 deaf children, a population that is expected to enrol in schools and universities and use different learning resources such as library resources to support their education (Omugur, 2023). However, many libraries have not prioritised providing services, including communication and provision of services tailored towards Deaf and Hard-of-Hearing (DHH needs for various reasons implying that libraries have ignored the needs of their deaf users (Day, 2004). This is the gap the current paper set out to address. The current paper is important because research reveals that advancements in ICTs have the potential to provide new opportunities for Deaf and Hard-of-Hearing (DHH) persons to participate and access information (Sanaman & Kumar, 2014). Research further reveals that libraries have a responsibility to collect and provide information to their DHH users by ensuring equal access to all programmes and services available and integrating deaf individuals into the library's overall audience hence allowing them to access all collections, programs, and services (Playforth, 2004). However, Deaf and Hard-of-Hearing (DHH) people find different forms of library barriers, i.e., environmental barriers— no visual indication, glass screens and grilles, background noise, poor lighting; and backgrounds with patterns or poor contrast, making lipreading and following British Sign Language (BSL) difficult or impossible (Playforth, 2004). These factors limit access and use of library resources especially since deaf and hard of hearing users will require individual assistance from librarians, who in most cases do not have the skills to offer to these special users.

On the other hand, assuming Deaf and Hard-of-Hearing people can find their way into the different library spaces, represents another barrier to information with most of the information presented verbally, therefore students particularly those who use sign language, are excluded from library programmes such as user education and information literacy programmes thus creating a divide between the deaf, hard-of-hearing and hearing students (Playforth, 2004).

Despite the frequent library use by Deaf and Hard-of-Hearing students and academic staff, there has been scant attention to their digital inclusion and accessibility needs in libraries in higher institutions of learning in Uganda. This paper explores ways in which academic libraries take into account the special

needs of the Deaf and Hard-of-Hearing students and academic staff. The aim in so doing is to generate rich insights that can help academic libraries in Uganda to ensure that they facilitate and support Deaf and Hard-of-Hearing students and academic staff to use these enabling technologies for teaching learning and research and also make informed choices as their hearing counterparts.

3.0 Materials and Methods

The current research adopted an "emancipatory" disability research model, which challenges the ontological foundations that construct academic staff and students with disabilities as having needs that are "special," but acknowledges that they are academic staff and students like any other whose needs are currently not met by the education system (Barnes & Sheldon 2007). Furthermore, previous emancipatory researchers such as Triano (2000) and Barnes & Sheldon (2007) also provided a lens through which to mainstream digital inclusion for persons with disabilities, particularly the Deaf and Hard-of-Hearing students and academic staff.

The emancipatory disability research model helped to investigate the dynamics of digital inclusion and exclusion from the perspective of deaf and hard-of-hearing (DHH) Students and Academic Staff. The Social Model of disability which seeks to change society to accommodate the Persons with disabilities not change Persons with disabilities to accommodate the world provided a lens through which to view digital inclusion, particularly library services for the Deaf and Hard-of-Hearing students and academic staff (Barnes, 2004; Kitchin, 2005; Moriña, 2018; Noel, 2016). The Social Model of Disability, which emphasises conducting research with, rather than research on persons with disabilities, as the foundational ontology, provided a framework for the investigation of ways in which university libraries facilitate accessibility, adoption, and application of assistive technologies for teaching, learning, and research for the Deaf and Hard-of-Hearing students and academic staff in higher institutions of learning in Uganda.

This study adopted the mixed-methods approach, incorporating both qualitative and quantitative methods of data collection. Two semi-structured questionnaires and interview schedules for deaf and hard-of-hearing (DHH) Students and Academic Staff as well as Library staff were used to collect data on digital inclusion and assistive technologies for online learning and teaching. The instruments were used to generate rich insights into the digital inclusion needs of Deaf and Hard-of-Hearing students and academic staff for teaching, learning, and research as well as accessibility, adoption, and application of

assistive technologies for online learning, teaching, and research of Deaf and Hard-of-Hearing students and academic staff. All instruments were pilot-tested with a small group of deaf and hard-of-hearing students and academic staff. As a result, changes were made.
In addition, document review methods were employed to inform the design of data collection instruments to widen understanding of the phenomena under study.

Purposive and snowball sampling techniques were employed to recruit deaf and hard-of-hearing (DHH) students and academic staff for this study. Ethical clearance from the Aids Support Organisation (TASO) Research Ethics Committee was received on July 27, 2023 (Ethics reference number: TASO-2023-237). Quantitative data was analysed using the Statistical Package for Social Scientists (SPSS ver. 21). Descriptive statistics, including (frequency/counts, percentages, means, and standard deviations) were generated using SPSS ver. 21, for each of the closed-ended questions. The outputs from SPSS were summarised and presented in tables in Ms. Office to generate a holistic picture of the issues under investigation. Weighted means were obtained for items with many elements to ascertain the importance and/ or rating of each element. Thematic analysis was employed to analyse qualitative data and selected verbatim quotations were used to corroborate the quantitative findings of the study.

4.0 Findings

The findings reported here primarily focus on two objectives: the first one is to find out what digital inclusion (DI) and assistive technology (AT) students and academic staff with disabilities need to participate in teaching, learning, and research activities effectively independently and the second one is to find out how much universities help students and staff with disabilities access, adopt, and use digital technologies for teaching, learning, and research. The findings include both quantitative and qualitative responses from students and academic staff who are Deaf and hard of hearing as well as Library staff who support teaching learning and research in Public University Libraries in Uganda. Details of the findings are presented in sections 4.1-4.3 below.

4.1 Demographics

Responses were received from sixteen (16) students who are deaf and hard of hearing, one (1) academic staff who is deaf, four (4) University Librarians, four (4) Reference Librarians, one (1) Librarian working in a Special Needs Library and one (1) Librarian working in an ICT laboratory for Persons with Disabilities.

4.2 Digital Inclusion and Assistive Technology (AT) Needs for Academic Engagement and Independence of deaf and hard-of-hearing (DHH) Students and Academic Staff

This section presents findings on digital inclusion and assistive technology needs for academic engagement and independence from the point of view of deaf and hard-of-hearing (DHH) Students and Academic Staff. The findings are presented under two main subsections: ICT needs of deaf and hard-of-hearing (DHH) Students and Academic Staff (4.2.1) and Digital Inclusion Service needs of deaf and hard-of-hearing (DHH) Students and Academic Staff (4.2.2).

4.2.1 ICT needs of deaf and hard-of-hearing (DHH) Students and Academic Staff

The findings on the ICT needs of deaf and hard-of-hearing (DHH) Students and Academic Staff, including students and academic staff, revealed high levels of perceived necessity. A weighted mean of 4.34 and above indicated that the ICT equipment and software were highly rated as essential by both DHH academic staff and students. These included access to high-speed internet, sufficient bandwidth, university websites with captions, software that translates a signer's words into text, captioning software, video editing software, multimedia mobile phone applications, LCD Projectors, personal computers, and mobile phones. On the other hand, sign language-generating devices, and assistive listening devices (ALDs) were moderately needed while cochlear implants were rated low as illustrated in Table 1 below:

Table 1: Perceived Internet and Communication Technologies Needs of deaf and hard-of-hearing (DHH) Students and Academic Staff

Items	***Always Needed (A/N)***	***Often Needed (O/N)***	***Sometimes Needed***	***Rarely Needed (R/N)***	***Never Needed (N/N)***	***Mean***	***Std.***	***Perceived Leve***

					(S/N)								***l of Need***
	Freq.	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***			
Access to high-speed Internet	9	52.9	8	47.1							4.53	0.514	High
Sufficient band width	14	82.4	3	17.6							4.82	0.393	Very high
Wireless connection	10	58.8	7	41.2							4.59	0.507	High
University website with captions on or graphics or pictures	11	64.7	6	35.3							4.65	0.493	Very high
Software that translates a signer's words into	14	82.4	1	5.9			1	5.9	1	5.9	4.53	1.179	High

text													
Captioning software	12	70.6	3	17.6	2	11.8					4.59	0.712	High
Video editing software	14	82.4	2	11.8	1	5.9					4.76	0.562	Very high
Multimedia mobile phone application	10	58.8	3	17.6	3	17.6	1	5.9			4.29	0.985	High
LCD Projector	11	64.7	2	11.8	2	11.8			2	11.8	4.18	1.380	High
Personal computer	15	88.2	1	5.9					1	5.9	4.71	0.985	Very high
Sign language-generating devices	10	58.8	2	11.8	2	11.8			3	17.6	3.94	1.560	Moderate
Mobile phone	15	88.2	1	5.9					1	5.9	4.71	0.985	Very high
Cochlear implants	5	29.4	1	5.9	1	5.9	4	23.5	6	35.3	2.71	1.724	Low
Assistive	9	52.	3	17.	1	5.9			4	23.	3.76	1.67	Mod

listening devices (ALDs): Hearing aids with a telecoil		9		6						5		8	erate

Source: Primary Data

Key :5= Always needed 4= Often needed 3= Sometimes needed 2=Rarely needed 1= Never needed

The interview extracts below were selected to corroborate the seriousness of the need for ICT equipment and software by students and academic staff who are deaf or hard of hearing:

> *"I need internet and a strong personal computer, and space in the cloud because if I am teaching a class of 50 deaf students, each of them has to sign and record, and submit a three-minute video. I mark each video and give feedback to each student. You know …videos require fast internet and storage space which is not provided. The internet is irregular, … I buy my data and it is quite expensive…".* [001 *Deaf Participant*]

Other respondents reported that they needed specialized mobile phones and personal computers to effectively undertake academic tasks.

> *"As a student with hearing impairment, I would be grateful to acquire digital hearing aids with an iPhone because it works better with them. This would help…me receive information appropriately, especially in research. I would also like to have a personal computer to conduct E-learning to progress in my academics" [005 Deaf Participant]*

Furthermore, the participants expressed the need for ICT equipment, Internet services, and other assistive technologies to effectively engage in learning and research:

> *"I need a laptop, smartphone and other assistive devices, sign language interpreter to meet or enhance my engagement in learning & research. I need internet services also to aid my learning" [003 Deaf Participant]*.

These findings have unearthed the ICT needs of deaf and hard-of-hearing (DHH) Students and Academic Staff which ought to be met for them to effectively engage in teaching, learning, and research in the digital e-learning environment.

4.2.2 Digital Inclusion Service Needs deaf and hard-of-hearing (DHH) Students and Academic Staff

Efficiently incorporating information and communication technology (ICT) to aid students and academic staff with hearing impairments is crucial for

promoting digital inclusion in educational settings. Using the weighted mean of 4.63, the findings indicate that text messaging is a very highly rated service for digital inclusion among Deaf and Hard-of-Hearing (DHH) students and staff. Other needed services such as assistive technology technical support, digital and assistive technology training, and sign language interpretation were also highly rated. Table 2 presents the responses from students and academic staff with hearing impairment and their perception of Service needs.

Table 2: Digital Inclusion Service Needs deaf and hard-of-hearing (DHH) Students and Academic Staff

Items	***Always Needed (A/N)***		***Often Needed (O/N)***		***Sometimes Needed (S/N)***		***Rarely Needed (R/N)***		***Never Needed (N/N)***		***Mean***	***Std.***	***Perceived Level of Need***
	Freq.	***%***	***Freq.***	***%***	***Freq***	***%***	***Freq.***	***%***	***Freq.***	***%***			
Text messaging	17	100									5.00	0.000	Very high
Assistive technology technical support	12	70.6	4	23.5	3	5.9					4.65	0.606	High
Digital &Assistive technology training	11	64.7	5	29.4	1	5.9					4.59	0.618	High
Sign language	14	82.4	1	5.9	2	11.8					4.71	0.686	Very high

interpreter													
Access to databases and e-resources	8	47.1	6	35.3	2	11.8			1	5.9	4.18	1.074	Low

Key :5= Always needed 4= Often needed 3= Sometimes needed 2=Rarely needed 1= Never needed

Although participants' rating of digital inclusion needs was very high, the findings revealed that these services required to meet the needs were not provided by the library as illustrated by the extract below:

"*…when the library organizes training, they do not provide for sign language interpreters. I wish they could video record, add captions, and share the presentations. This practice hinders my ability to participate in the training. … they need to know that our eyes are our ears…*" [004-Deaf respondent]

The above findings are corroborated in Table 3 which revealed that the majority of Library and Information Science professionals rated themselves low as far as conducting staff capacity building on basic knowledge of assistive technologies, digital and assistive technology training, as well as training the deaf and hard-of-hearing (DHH) Students and Academic Staff on accessing databases and e-resources is concerned.

Table 3: Library staff capacity building for digital inclusion of students and academic staff with disabilities

Items	***N***		***R***		***S***		***O***		***A***		***Mean***	***Std.***	***Perceived Level***
	Freq	***%***	***Freq***	***%***	***Freq***	***%***	***Freq.***	***%***	***Freq***	***%***			*Library staff capacity build*

													ing
Serving students and academic staff with disabilities for new employees	7	35.0	3	15.0	3	15.0	3	15.0	4	20.0	2.70	1.593	Low
Basic disability politeness	7	35.0	5	25.0	3	15.0	3	15.0	2	10.0	2.40	1.392	Low
Basic knowledge of assistive technologies and services	6	30.0	3	15.0	5	25.0	3	15.0	3	15.0	2.70	1.455	Low
Training the deaf and hard-of-hearing	6	30.0	3	15.0	5	25.0	3	15.0	3	15.0	2.70	1.455	Low

(DHH) Students and Academic Staff on accessing databases and e-resources													
Specific types of disabilities and implications for service delivery	6	30.0	1	5.0	4	20.0	5	25.0	4	20.0	3.00	1.556	Low

Source: Primary Data
Key: N= Never, R=Rarely, S=Sometimes, O=often, A=Always

These findings have not only highlighted the Digital Inclusion Service needs of deaf and hard-of-hearing (DHH) Students and Academic Staff, but have also revealed the service gaps from the point of view of Library and information service professionals as far as supporting the deaf and hard-of-hearing (DHH) Students and Academic Staff to effectively engage in teaching, learning, and research is concerned.

4.3 Accessibility, Adoption, and Application of Assistive Technologies for Teaching, Learning, and Research

The data presented in this section addresses objective 2: to determine how effectively universities support the accessibility, adoption, and application of digital technologies for teaching, learning, and research by students and staff with disabilities. In the context of this study digital inclusion and accessibility entails affordability, availability of ICT infrastructure, and design for inclusion. On the other hand, adoption of Assistive Technologies refers to the uptake of such technologies. It's crucial to highlight that the adoption of assistive technologies can only occur when individuals with disabilities are aware of digital options and opportunities, are digitally literate, and feel comfortable using digital technologies safely (Institute of Museum and Library Services, 2012; Maggie, 2020). Lastly, application refers to the use of digital technologies for teaching, learning, and research activities. The perceptions of deaf and hard-of-hearing (DHH) Students and Academic Staff on the accessibility of Library services are presented in subsections 4.3.1-4.3.4

4.3.1 Affordability and Accessibility to ICT Equipment, Software and Services

The results on participants' capacity to afford ICT Equipment, Software, and Services, revealed that participants rated their perceived affordability as very low with a weighted mean of 2.5. This data reveals that most of the participants are unable to afford the hardware, software, and peripheral equipment and data required to access technology-supported resources, systems, content, and services. Table 4 presents the deaf and hard-of-hearing (DHH) Students and Academic Staff's perception of their level of Affordability and Accessibility to ICT Equipment, Software, and Services.

Table 4: Affordability and accessibility of ICT equipment, software, and services

Items	***Strongly Agree (SA)***		***Agree (A)***		***Neural (N)***		***Disagree (DA)***		***Strongly Disagree (SD)***		***Mean***	***Std.***	***Perceived Level of affordability and accessibility***
	Freq.	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***			
I can afford the cost of equipment needed to access technology-supported resources, systems, content and services.	1	5.9	1	5.9	3	17.6	6	35.3	6	35.3	2.12	1.166	Very low
I can afford the to buy the data needed to	2	11.8	2	11.8	5	29.4	5	29.4	3	17.6	2.71	1.263	Very low

access to technology-supported resources, systems, content and services.													
Internet Service Providers (ISP) provide uniform pricing information to enable students with disabilities to easily comp	1	5.9	2	11.8	3	17.6	5	29.4	6	35.3	2.24	1.251	Very low

are plans available for them.													
Programs that subsidise monthly Internet subscription costs are available to students with disabilities	1	5.9	4	23.5	6	35.3	6	35.3			2.06	1.088	Very low
The university avails assistance with hardware, software, and peripheral equipment purch	3	17.6	6	35.3	4	23.5	3	17.6	1	5.9	3.41	1.176	Low

ases and maint enanc e to studen ts with disabi lities													

Source: Primary data ***Key:*** SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly agree

The extract below was selected to corroborate the quantitative results:

"It is sometimes difficult to access online services at the university because it has inadequate technological equipment and the ones for PWDs are specifically for Visually Impaired students [004-Deaf respondent]

The results suggest a very high need for the university library to establish and equip spaces where students and academic staff who are deaf and hard of hearing can access hardware, software, and other equipment they need to effectively engage in teaching, learning, and research.

4.3.2 Design for Inclusion and Availability of Library Infrastructure, Services, and Materials

The results on access to Library infrastructure, services, and materials (see Table 5) revealed that overall, accessibility to library services was rated low with a weighted mean of 3.06. For instance, the respondents rated library services and infrastructure as inaccessible to DHH persons because there was no use of sign language to interpret the oral information, the library websites did not meet requirements for text descriptions of graphics and pictures, and the university libraries did not provide online support to students with disabilities. On the other hand, academic staff and students highly rated their ability to communicate with students with or without disabilities, which could be attributed to their ability to use text messaging services.

Table 5: Design for Inclusion and Availability Library Infrastructure, Services, and Materials for the deaf and hard-of-hearing (DHH) Students and Academic Staff

Items	***Strongly Agree (SA)***		***Agree (A)***		***Neural (N)***		***Disagree (DA)***		***Strongly Disagree (SD)***		***Mean***	***Std.***	***Perceived Level of accessibility***
	Freq.	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***			
Auxiliary aids and services, are accessible	4	23.5	1	5.9	3	17.6	3	17.6	6	35.3	3.53	1.231	Moderate
Effective communication systems are accessible.	1	5.9	4	23.5	8	47.1	1	5.9	3	1.7	2.94	1.144	Low
Information in alternative formats that can be understood by students, hearing	3	17.6	2	11.8	4	23.5	1	5.9	7	41.2	3.47	1.231	Moderate

impairment is accessible.													
Information that is presented orally is also available in writing for people who are deaf or hard of hearing.	3	17.6	1	5.9	5	29.4	3	17.6	5	29.4	2.65	1.455	Low
Staff can promptly respond to requests for materials in accessible formats	5	29.4	2	11.8	2	11.8	5	29.4	3	17.6	3.41	1.502	Moderate
The library website meets	1	5.9	1	5.9	3	17.6	6	35.3	6	35.3	2.71	1.448	Low

requirements for text descriptions of graphics and pictures													
The library website meets requirements for equivalent alternatives for information presented in audio or video formats	1	5.9	3	17.6	4	23.5	4	23.5	5	29.4	2.71	1.312	Low
The university website meets requirements for filling out online forms using assistive	1	5.9	4	23.5	4	23.5	4	23.5	4	23.5	2.65	1.272	Low

technology													
The university provides access to high-speed Internet	2	11.8	3	17.6	5	29.4	4	23.5	3	17.6	2.82	1.286	Low
The university library provides IT online support to students with disabilities	3	17.6	3	17.6	1	5.9	3	17.9	7	41.2	2.65	1.618	Low
The university library provides spaces for learning, research and other facilities for	5	29.4	1	5.9	5	29.4	2	11.8	7	41.2	3.53	1.463	Moderate

students with disabilities													
I am able to effectively communicate with students with disabilities.	8	47.1	3	17.6	3	17.6	3	17.6			3.94	1.197	Very high
I am able to effectively communicate with students without disabilities	4	23.5	4	23.5	4	23.5	4	23.5	1	5.9	3.35	1.272	Very high

Source: Primary data Key***:*** SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly agree

These findings suggest the need for libraries to design and make available library infrastructure, services, and materials for the deaf and hard-of-hearing (DHH) Students and Academic Staff. They should also incorporate communication systems such as oral translation, text description of graphics and pictures in library websites, and provide alternative information for audio and video to increase accessibility.

4.3.3 Adoption of Assistive Technologies (Promotion of Library Services and Digital Literacy)

In the context of this paper, adoption of assistive technologies is expected to occur when users are fully aware of the existing options and also have the necessary competencies to use the technologies. Promotion of Assistive

Technologies and Digital Literacy Training are avenues for increasing accessibility to Assistive Technologies. The respondents' rating of libraries' engagement in the promotion of assistive technologies and the conduct of digital literacy training is presented in sections 4.3.3.1 and 4.3.3.2 below.

4.3.3.1 Promotion of Assistive Technologies

The results showed most of the respondents rated the promotion of assistive technologies low when asked to rate the extent to which the library provided specially designed awareness activities and targeted content to engage students with disabilities in using ICT, e-resources, and assistive technologies for teaching, learning, and research. See Table 6 below for details.

Table 6: Promotion of Assistive Technologies

Items	***Strongly Agree (SA)***		***Agree (A)***		***Neural (N)***		***Disagree (DA)***		***Strongly Disagree (SD)***		***Mean***	***Std.***	***Perc Leve prom of Li servi***
	Freq.	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***			
My university (library) conducts campaigns to raise awareness about using Assistive technologies for students with disabilities	2	11.8	2	11.83	3	17.6	5	29.4	5	29.4	3.24	1.480	Low
Specially designed awareness activities and targeted content are	1	5.9	8	47.1	5	29.4	2	11.8	1	5.9	3.35	0.996	Low

developed to engage students with disabilities in using ICT and Assistive technologies.													
My university (library) supports the creation of multimedia content and promote use of digital technologies for students with disabilities.	3	17.6	1	5.9	1	5.9	9	52.9	4	23.5	3.47	1.007	Low

Source: Primary data
Key: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly agree

The findings suggest that libraries need to create awareness of the services libraries offer to the deaf and hard-of-hearing (DHH) Students and Academic Staff.

4.3.3.2 Digital Literacy Training

The results on the extent to which libraries engage in the identification and evaluation of Digital Literacy Training needs revealed that the majority of the students and Academic staff who are deaf and hard of hearing reported that Libraries did not identify and evaluate their Digital literacy needs. Furthermore, libraries did not have a clear strategy for meeting their digital literacy needs and did not train students with disabilities to learn how to search and find electronic information and evaluate digital resources for online learning and research. Table 7 below provides a summary of the findings.

Table 7: Perceived Level of Engagement in Digital Literacy Training

Items	***Strongly Agree (SA)***		***Agree (A)***		***Neural (N)***		***Disagree (DA)***		***Strongly Disagree (SD)***		***Mean***	***Std.***	**Perceived Level of engagement in Digital Literacy Training**
	Freq.	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***			
My university (Library) identifies and evaluates Digital literacy training needs of students	5	29.4	3	17.6			1	5.9	7	41.2	4.24	2.223	High

with disabilities													
My university (library)has a clear strategy for meeting the digital literacy needs of students with disabilities	2	11.8	5	29.4	6	35.3	4	23.5	6	35.3	3.29	0.985	Low
The university (library) helps students with disabilities learn to search and find electr	2	11.8	2	11.8	3	17.6	4	23.5	6	35.3	3.12	1.269	Low

onic information and evaluate digital resources for online learning and research													

Source: Primary data

Key: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly agree

The lack of digital literacy training for deaf students and academic staff was further confirmed during interviews. For instance, the respondents expressed frustration about digital exclusion tendencies which have tremendously limited their competency to independently navigate the academic and social digital terrain:

"*So far, I have no digital competencies… It is the whole university you may find that we students with disabilities are always given less access to E-learning though we use the same computers and learn the same things" [009 Deaf respondents]*

The findings suggest the need for digital literacy training for the deaf and hard-of-hearing (DHH) Students and Academic Staff.

4.3.4 Application of Assistive Technology for Online Learning Teaching and Research

The findings for the application of assistive technology for online learning teaching and research revealed that most of the participants had a high perception of their ability to use WhatsApp and YouTube for teaching, learning, and research. However, they had a low perception of digital literacy to effectively search, find, critically evaluate, and use digital information from the World Wide Web and databases. They also reported a low perception of their ability to use tools like Google Docs, Google Meet, and Google Forms, and reference management tools such as Mendeley, Zotero, and Endnote. Perhaps this low application of essential technologies confirms the previous findings where libraries were rated low on digital literacy training needs identification, and evaluation training and support. Please see Table 8 below for more details:

Table 8: Perception about the application of assistive technology for online learning teaching and research.

Items	***Strongly Agree (SA)***		***Agree (A)***		***Neural (N)***		***Disagree (DA)***		***Strongly Disagree (SD)***		***Mean***	***Std.***	***Perceived Level of application of Assistive Tech.***
	Freq.	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***	***Freq.***	***%***			
I have applied Technology Assistive Technology to work	3	17.6	5	29.4	2	11.8	1	5.9	6	35.3	3.35	1.222	Low

independently in the academic environment													
The students are trained by qualified instructors on the use of Assistive technology.	2	11.8	5	29.4	2	11.8	4	23.5	4	23.5	2.82	1.425	Low
I have employed Digital Information Literacy skills to effectively search, find, critically evaluate and use digital	1	5.9	1	5.9	3	17.6	1	5.9	11	64.7	1.82	1.286	Very low

information from the world wide web and databases.													
Google docs (for collaborative learning)	1	5.9	1	5.9	2	11.8	2	11.8	11	64.7	1.76	1.251	Very low
Google meet (to attend meetings and classes)	1	5.9	1	5.9	3	17.6	1	5.9	11	64.7	1.82	1.286	Very low
Google Calendar (schedule events)	2	11.8	1	5.9	2	11.8	1	5.9	11	64.7	1.94	1.478	Very low
WhatsApp (Communication and sharing and receiving resource materials and lecture notes)	13	76.5	1	5.9	2	11.8			1	5.9	4.47	1.125	Very high

YouTube	9	52.9	5	29.4	1	5.9			2	11.8	4.12	1.317	Very high
Google forms (to design data collection instruments like questionnaires)	2	11.8	1	5.9	2	11.8	1	5.9	11	64.7	1.94	1.478	Very low
Mendeley	1	5.9	1	5.9	3	17.6	1	5.9	11	64.7	1.82	1.286	Very low
Zotero	1	5.9	1	5.9	2	11.8	2	11.8	11	64.7	1.76	1.251	Very low
Endnote	2	11.8	1	5.9	2	11.8	1	5.9	11	64.7	1.94	1.478	Very low

Source: Primary data ***Key:*** SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly agree

These findings have highlighted the low perception of the deaf and hard-of-hearing (DHH) Students and Academic Staff on the application of assistive technology for online learning, teaching and research.

5.0 Discussion and Implications of Findings

This section synthesises the findings which have not only generated rich insights about the digital inclusion needs of the deaf and hard-of-hearing students and academic staff but unearthed the accessibility gaps as far as digital inclusion of students and academic staff who are deaf and hard-of-hearing is concerned. The emancipatory' disability research model provided a framework through which

the digital inclusion needs of DHH students and academic staff as well as the extent to which libraries facilitated access, adoption, and application of assistive technologies for teaching, learning, and research were discussed (Oliver 2002). Thus, the discussion of findings is presented under two main themes: the first theme focuses on the digital inclusion needs of DHH students and academic staff. The second theme focuses on accessibility to library and information Services. This is in line with our research objectives one and two (see section 1.0).

As presented in Table 1, DHH students and staff strongly feel that access to high-speed Internet, Sufficient bandwidth, and Wireless connection as well as captions on graphics or pictures and university websites that are accessible to deaf and hard-of-hearing (DHH) Students and Academic Staff were highly perceived as enablers of participation and inclusion in digital spaces. The results of the current study are consistent with those of Sanaman and Kumar (2014), who reported that enabling technologies are important in facilitating access to information and promoting digital inclusion. Besides, reliable connectivity is essential for DHH students and academic staff as it allows them to easily use assistive technologies like live captioning, video conferencing with sign language interpretation, and online resources. The findings of this study suggest that by offering extensive connectivity, universities can cultivate an inclusive learning environment, effectively closing the digital gap and advocating for digital inclusion. This underscores the significance of high bandwidth, robust WiFi, and access to high-speed internet as essential prerequisites for utilizing digital services and assistive technologies. Prior research aligns with the current findings and demonstrates that digital accessibility is critical to ensuring that people with disabilities can fully participate in online activities, access information, and use digital services (Jaeger et al., 2015; Kulkarni, 2019).

In addition, the results show that deaf and hard-of-hearing (DHH students and academic staff showed high interest in multimedia mobile phone applications, LCD projectors, personal computers, and sign language-generating devices with text messaging being the most popular service that DHH persons desired as a form of communication. This finding confirms the finding of Saar and Arthur-Okor (2013) which revealed the need for a variety of communication options to support deaf and hard-of-hearing users. The lowest-rated communication Assistive technologies were the Cochlear implants and Assistive listening devices (ALDs). The low rating of these technologies could be attributed to a lack of exposure to these essential technologies. This points to a need to introduce these assistive technologies in academic libraries.

The findings on Digital Inclusion Service Needs for deaf and hard-of-hearing (DHH) Students and Academic Staff, particularly communication preferences suggest that a broad array of choices should be provided to DHH persons including Sign language interpretation, accessible website interfaces, and assistive technology support. These services provide DHH users with a variety of services to choose from for example, they may have the option to consult with the librarians, use e-resources, or text and instant messaging. These findings reveal that DHH persons require the ability to rely on themselves when they express frustration due to the lack of Digital and Assistive technology training and sign language interpretation which hinder access to resources. These findings have extended our understanding of digital inclusion for the deaf and Hard of hearing students and academic staff by highlighting the digital inclusion service needs that ought to be met for them to engage in meaningful teaching, learning, and research. Given that the deaf and hard-of-hearing (DHH) Students and Academic Staff like all other students and staff need to engage in online inquiry-based learning to meet their career aspirations, particularly in the ever-changing digital and competitive terrain, the need for Libraries to proactively mainstream inclusive service provision cannot be overemphasised.

The results on Library staff capacity building to meet the digital inclusion needs of deaf and hard-of-hearing (DHH students and academic staff, Table 3 indicated that most of the libraries do not conduct staff capacity building on basic knowledge of assistive technologies, and services and training the deaf and hard-of-hearing (DHH) Students and Academic Staff on accessing databases and e-resources. Consequently, they lacked the competence to help students and academic staff with disabilities in using the available assistive technologies and e-resources. These findings extend Chaputula & Mapulanga's (2017) research which revealed that despite an increase in the number of people with disabilities, the majority of the libraries do not offer specialised training such as induction sessions by unearthing the need for strategic capacity-building programmes based on unique disabilities and beyond basic induction. Adopting this strategy will go a long way in equipping library staff capacity with the knowledge and skills required to support the teaching, learning, and research digital inclusion needs of the deaf and hard-of-hearing (DHH) students and academic staff. These findings call for library and information Science educators to incorporate courses on special needs and inclusive library service

provision in the curriculum. The findings also suggest that University Librarians ought to revise their staff development programme to include staff capacity building that focuses on equipping the existing staff with knowledge and skills required to plan, select, acquire, as well support persons with disabilities on the use of assistive technologies and other library resources. The findings further suggest that all Library staff should proactively enrol for online tutorials, and webinars on the subject of providing library services to persons with Disabilities.

The findings on affordability and accessibility of library services and resources, in Table 4, revealed that most of the Deaf and hard-of-hearing (DHH) students and academic staff find it hard to afford and access ICT equipment, software, and services which limits their potential to take advantage of the opportunities that ICT offers. This finding is consistent with research that reported the growing digital gap among the vulnerable, the marginalized, those living in poverty, and people suffering from discrimination due to the persistent inability to afford technology equipment and services (Douglas et al. 2007; Hilbert 2020; McNicholl et al. 2021a). The findings point to a need for university libraries to have earmarked budgets for the acquisition of essential ICT equipment, software and services and make them accessible to academic staff and students who are deaf and hard of hearing. The study suggests the need for Libraries to be proactive and intentional in strategically budgeting for and investing in ICT solutions and assistive technologies, such as software for interpreting sign language, and applications that convert speech to text in real-time, to enhance the accessibility for students and academic staff who are deaf and hard of hearing. Given the unprecedented budget cuts, the study recommends that Universities establish strategic collaborative partnerships with suppliers of ICT equipment and software for persons with hearing impairment to help reduce the cost of these essential gadgets to enable students and academic staff to have their gadgets instead of always finding and accessing them only in lecture rooms, libraries, or computer laboratories. Furthermore, a consortium on assistive technologies should be established to negotiate favorable prices in to make assistive technologies affordable for students and academic staff with hearing impairment. Providing the essential ICT equipment, software and assistive technologies will increase accessibility to library resources and services which would otherwise be unaffordable. This will not only guarantee that DHH students and academic staff can actively access scholarly materials but will also facilitate independent engagement in teaching, learning and research.

The findings on access to library ICT infrastructure, services, and materials in Table 5 revealed that the majority of DHH academic staff and students

perceived library services and resources inaccessible. Furthermore, the rating of library staff's response to the needs of DHH academic staff and students as well as the library's capacity to provide online support to students and academic staff with hearing impairment was rated very low. The findings also revealed that the university website did not meet the requirements for text descriptions of graphics and pictures, requirements for providing equivalent alternatives for information presented in audio or video formats and the requirements for filling out online forms using assistive technology for DHH academic staff and students. The finding of this study not only build on the existing body of research such as Bodaghi & Zainab (2013), whose research discovered that persons with disabilities in public and university library buildings in Zanjan province, Iran, did not rate the accessibility conditions as good, but also extends the body of research by generating rich insights into digital accessibility gaps in libraries that are associated with the library ICT infrastructure, services, and materials that DHH academic staff and students experience. These findings imply that managers of university libraries should ensure that materials that are presented orally are also presented in formats that are accessible and understood by the deaf and hard-of-hearing students and staff. They should also ensure that students and staff with hearing impairment are supported with online assistive technologies and they should provide adequate space for learning and research for students and staff with hearing impairment.

The findings on promotion in Table 6 revealed that most of the university libraries were not actively involved in conducting awareness campaigns about the available assistive technologies yet the adoption and use of Assistive technologies greatly depend on the promotion and training on the use of assistive technologies. Thus, the respondents intimated that libraries did not provide specially designed awareness activities and targeted content to engage them in using ICT, e-resources, and assistive technologies for teaching, learning, and research. This finding is consistent with Chaputula & Mapulanga (2017) who reported that libraries in Malawi did not market services that cater for those with disabilities. The findings suggest a need for library managers to conduct awareness campaigns about assistive technologies to promote the adoption of digital technologies.

The findings on Digital Literacy Training in Table 7 revealed that the majority of the libraries did not identify and evaluate the Digital literacy training needs, and lacked a clear strategy for meeting the digital literacy needs of DHH academic staff and students. Similarly, the majority of the libraries did not train DHH academic staff and students on effective searching, finding, and evaluating

digital resources for online learning and research. These findings not only confirm previous research such as Saribanon et al. (2020) which underscored the importance of digital literacy in access to, and use of, assistive technologies, but it has extended our understanding of the need to identify and evaluate the Digital literacy training needs, and also have a clear strategy for meeting the digital literacy needs of DHH academic staff and students. It is highly recommended that a clear digital literacy strategy for the DHH academic staff and students be incorporated into the overall library strategy.

The findings on the application of assistive technology for online learning teaching and research in Table 8 revealed that most of the DHH academic staff and students had a high perception of their ability to use WhatsApp and YouTube for teaching, learning, and research. However, they had a low perception of their capacity to effectively search, find, critically evaluate, and use digital information from the World Wide Web and Scholarly databases. Similarly, they reported a low perception of their ability to use tools like Google Docs, Google Meet, and Google Forms, and reference management tools such as Mendeley, Zotero, and Endnote. This finding is not only consistent with Kaunda, N., & Chizwina, S. (2021) who reported a lack of training opportunities as a serious challenge but also extends our understanding of the urgent need for libraries to train DHH academic staff and students on the use of Google Suite elements for teaching, learning and research as well as reference management tools for scholarly writing.

6.0 Conclusion

The study on digital inclusion needs of the deaf and hard-of-hearing students and academic staff as well as accessibility to academic libraries is the first of its kind in Uganda. The study is important because it has not only generated rich insights about the digital inclusion needs of the deaf and hard-of-hearing students and academic staff but also unearthed the accessibility gaps as the majority of DHH academic staff and students reported that library services and facilities were inaccessible for teaching, learning, and research. Given that academic libraries have an important role to play in the promotion of digital inclusion, especially for the DHH academic staff and students, the paper highly recommends that University Libraries prioritize the development of an overarching digital inclusion policy and strategy to provide a framework (with principles and practices) to guide the design and implementation of initiatives that facilitate accessibility to library resources and services to respond to the digital inclusion needs of the DHH academic staff and students.

7.0 Limitations

Some of the limitations associated with this research include a small sample so the findings cannot be generalized to all the deaf and hard-of-hearing students and academic staff. In addition, the data collection instrument was lengthy, yet the interaction was facilitated by a sign language interpreter which could have hindered honest responses. In response to this limitation, the researcher explained the benefits of the study to the participants which increased their motivation to participate and give truthful responses.

8.0 Future Research

This report predominantly focused on the quantitative findings from the questionnaire filled out by Deaf and Hard-of-Hearing students and academic staff and Library staff. Responses to open-ended questions were used as illustrative quotes where appropriate in the report. An in-depth analysis of all open-ended data will be conducted. Furthermore, the findings reported in this paper will also be used to identify relevant areas for another phase of research, particularly the Artificial intelligence and digital inclusion of students and academic staff with hearing impairment.

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The authors confirm that there is no conflict of interest

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Appendix 1

DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGIES: ACCESSIBILITY, ADOPTION, AND APPLICATION FOR ONLINE LEARNING, TEACHING, AND RESEARCH

DATA COLLECTION INSTRUMENT FOR STUDENTS WITH DISABILITIES

Dear Respondent,

I am a post-Doctoral fellow in the Carnegie Consolidating Early-Career Academics Programme (CECAP), 2022-2024.

The study seeks to explore lived experiences of academic staff and students with disabilities on digital inclusion and Assistive technology accessibility, adoption, and application for online learning, teaching, and research. The results of the study will generate insights that will inform the design of digitally inclusive teaching, learning, and research environments. Since you are one of the key stakeholders at this university, I kindly request you to provide responses to questions in this questionnaire as your views and responses will be vital in furthering the purpose of the study. All the information you provide will be used for academic purposes only and will be kept confidential. The session will last for about 45 Minutes.

I sincerely appreciate your interest and willingness to share your experiences. I am eager to learn about your experiences on Digital Inclusion and Assistive Technologies: accessibility, adoption, and application for online learning, teaching, and research well as your recommendations for any improvements on the design of digitally inclusive teaching, learning, and research environments.

Thank you for accepting to take part in this study.

A. Demographic information

			✓ **Tick all that apply**
Gender	1	Male	
	2	Female	
Age	1	25—34	
	2	35—44	
	3	45—54	
	4	55-64	
	5	65 and above	
Level	1	Bachelors	
	2	Masters	
	3	PhD	
Institution	1	Makerere University	

	2	Kyambogo University	
	3	Mbarara University of Science and Technology	
	4	Uganda Martyrs University Nkozi	
	5	Makerere University Business School	
Type of disability	1	Visual impairment	
	2	Hearing impairment	
	3	Physical impairment	

B: DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS
B1: DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS FOR STUDENTS WITH VISUAL IMPAIRMENT (VI)
Please select and rate the Assistive Technologies (AT) you need to fully engage in learning and research. [Probe for details regarding needs based on specific impairment (Visual Impairment)]

5= Always needed 4= Often needed 3= Sometimes needed 2=Rarely needed 1= Never needed

Code	DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS OF **STUDENTS** WITH **VISUAL IMPAIRMENTS (VI)**	***Always needed***	***Often needed***	***Sometimes***	***Rarely needed***	***Never needed***
		5	4	3	2	1
VICT	**INTERNET &COMMUNICATION TECHNOLOGIES NEEDS OF STUDENTS WITH VI**					
VICT1	Access to high-speed Internet					
VICT2	Sufficient bandwidth					
VICT3	Wireless connection					
VICT4	University website that is accessible to students who require screen readers					
VICT5	University website that is accessible to students who require captions or graphics					

	or pictures					
	OTHER: PLEASE SPECIFY AND RATE					

VIRE	**READING TECHNOLOGY NEEDS OF STUDENTS WITH VI**					
VIRE1	Optical devices such as magnifiers and telescopes					
VIRE2	Optical Character Recognition (OCR) systems					
VIRE3	Screen readers (Jaws, NVDA, Voice Over and systems Access)					
VIRE4	Text in large font (Low Vision)					
VIRE5	Handheld Magnifiers					
VIRE6	Video Magnifier					
VIRE7	Braille					
VIRE8	Braille displays					
VIRE9	Audio Books					
	OTHER: PLEASE SPECIFY AND RATE					
VIMA	**MOBILE APPLICATIONS NEEDS OF STUDENTS WITH VI**					
VIMA1	TapTapSee					
VIMA2	Lookout (by Google)					
VIMA3	Seeing AI					
VIMA4	Supersense					
VIMA5	Be My Eyes					
VIMA6	Bespecular					
VIMA7	NotNav GPS Accessibility for the blind					
VIMA8	Supervision (portable electronic magnifier)					
VIMA9	Perfect key board					
	OTHER: PLEASE SPECIFY AND RATE					
VISW	**SOFTWARE NEEDS OF STUDENTS WITH VI**					
VISW1	Screen-reading Software					
VISW2	Magnification Software					

VISW4	Specialist OCR software package with voice output to utilize this technology.					
VIEQ	**EQUIPMEMT NEEDS OF STUDENTS WITH VI**					
VIEQ1	Digital TV					
VIEQ2	Canes (Ray Electronic Mobility Aid)					
VIEQ3	A Personal Computer with a suitable sound card					
VIEQ4	Smart Phones					
VIEQ5	Modem					
VIEQ5	IPAD					
VIEQ6	Flatbed Scanners					
VIEQ7	E-book reader					
VIEQ8	Optical scanner					
	OTHER: PLEASE SPECIFY AND RATE					
VISE	**SERVICE NEEDS OF STUDENTS WITH VI**					
VISE1	Assistive technology technical support					
VISE2	Training on using various Assistive technologies					
VISE3	Access to e-resources and databases					
VISE4	Digital & Assistive technology training					
	OTHER: PLEASE SPECIFY AND RATE					
	1.					
	2					
	3					

B2: DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS FOR STUDENTS WITH HEARING IMPAIRMENT (HI)

Please select and rate the Assistive technologies you need to fully engage in learning and research. [Probe for details regarding needs based on specific impairment (Hearing Impairment) [Probe for details regarding needs based on specific impairment (Hearing Impairment)]

5= Always needed 4= Often needed 3= Sometimes needed 2=Rarely needed 1= Never needed

	DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS FOR ACCESSIBILITY, ADOPTION, AND APPLICATION FOR ONLINE LEARNING AND RESEARCH OF STUDENTS WITH **HEARING IMPAIRMENT (HI)**	***Always needed***	***Often needed***	***Sometimes***	***Rarely needed***	***Never needed***
Code		5	4	3	2	1
HEAS	**HEARING NEEDS OF STUDENTS WITH HI**					
HEAS1	Hearing Aids					
HEAS2	Hearing Loops: Audio induction loop systems					
HEAS3	Infrared systems (use infrared light to transmit sound)					
HEAS4	FM Systems (which help to amplify the sounds you want to hear, especially where there's a lot of background noise)					
HEAS5	Alerting devices (connected to a doorbell, telephone, or alarm that emits a loud sound or blinking light to let someone with hearing loss know that an event is taking place)					
	OTHER: PLEASE SPECIFY AND RATE					
HIEQ	**EQUIPMENT NEEDS OF STUDENTS WITH HI**					
HIEQ1	Assistive listening devices (ALDs): Hearing aids with a telecoil					
HIEQ2	Augmented and Alternative Communication (AAC) devices: (a picture board or touch screen that uses pictures or symbols of typical items and					

	activities that make up a person's daily life)					
HIEQ3	Keyboards and touch screens					
HIEQ4	Personal amplifiers					
HIEQ5	LCD Projector					
HIEQ6	Personal computer					
HIEQ7	Speech-generating devices					
HIEQ8	Telephone Devices					
HIEQ9	Cochlear implants					
HIEQ10	Apple assistive touch					
	OTHER: PLEASE SPECIFY AND RATE					
HISO	**SOFTWARE NEEDS OF STUDENTS WITH HI**					
HISO1	Voice recognition software (translates a signer's words into text or computer-generated speech in real time. It is also able to translate spoken words back into sign language or text.)					
HISO2	Eye tracking software					
HISO3	Captioning software					
	OTHER: PLEASE SPECIFY AND RATE					
HIMA	**MOBILE APPLICATIONS NEEDS OF STUDENTS WITH HI**					
HIMA1	Dragon Naturally speaking (Dictation software)					
HIMA2	Graphic mobile phone application					
HIMA3	Text mobile phone application					
HIMA4	Multimedia mobile phone application					
HIMA5	Sign language interpreter					
	OTHER: PLEASE SPECIFY AND RATE					

HISE	**SERVICE NEEDS OF STUDENTS WITH HI**					
HISE1	Captioning					
HISE2	Text messaging					
HISE3	Assistive technology technical support					
HISE4	Digital &Assistive technology training					
HISE5	Sign language interpreter					
HISE6	Voice recognition software					
HISE7	Access to databases and e-resources					
	OTHER: PLEASE SPECIFY AND RATE					

B3: DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS FOR STUDENTS WITH PHYSICAL IMPAIRMENT (PI)

Please select and rate the Assistive technologies you need to fully engage in learning and research. [Probe for details regarding needs based on specific impairment (Physical Impairment)]

5= Always needed 4= Often needed 3= Sometimes needed 2=Rarely needed 1= Never needed

CODE	DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS FOR ACCESSIBILTY, ADOPTION AND APPLICATION FOR ONLINE LEARNING AND RESEARCH OF **STUDENTS** WITH PHYSICAL IMPAIREMENT (PI)	***Always needed***	***Often needed***	***Sometimes***	***Rarely needed***	***Never needed***
		5	4	3	2	1
PICT	**COMMUNICATION TECHNOLOGIES NEEDS OF STUDENTS WITH PI**					
PICT1	Mouse4fall accessibility software (with interfaces between switch and the electronic device (smartphone or tablet) to operate it with relative ease without needing to touch its screen)					
PICT2	Automatic page turners or book holders can also help PWDs to read					
PICT3	**Eye tracking devices** which include communication and control systems that follow the					

	movement of the eyes and allow individuals with disabilities that restrict speech to navigate through their computer or mobile devices with only eye movements					
PICT4	Captioning					
PICT5	Voice recognition					
PICT6	Screen reader					
PICT7	Apple assistive					
	OTHER: PLEASE SPECIFY AND RATE					
PIEQ	**EQUIPMENT NEEDS OF STUDENTS WITH PI**					
PIEQ 1	Personal Computer					
PIEQ 2	Smart Phones					
PIEQ 3	IPAD					
PIEQ 4	MODEM					
PIEQ 5	**Adaptive keyboards** that enable learners with physical disabilities that impair reliable muscle control in the hands to do precision movements					

PIEQ6	***Speech generation and voice recognition devices for people with physical disabilities who cannot enter instructions intended for computers with keyboards or touch screens.***					
PIEQ7	***Accessibility features on devices where morbidity impairment hinders ability to interact with a device such as a computer, tablet or mobile phone e.g Voice control to dictate messages, access menus and search for information***					
PIEQ8	***Railings, Lifts and access ramp***					
PIEQ9	Wheelchairs					
PIEQ10	Walkers					
PIEQ11	Scooters					
PIEQ12	Crutches					
PIEQ13	Canes					
	OTHER: PLEASE SPECIFY AND RATE					
PISE	**SERVICES NEEDED BY STUDENTS WITH PI**					
PISE1	Assistive technology technical support					
PISE2	Assistive technology training					
PISE3	Personal Assistant					
	OTHER: PLEASE SPECIFY AND RATE					

C: BARRIERS TO ACCESSIBILITY, ADOPTION, AND APPLICATION OF ASSISTIVE TECHNOLOGIES FOR LEARNING AND RESEARCH

Kindly rate the following barriers based on what you consider to be the most serious hindrances to accessibility, adoption, and effective application of assistive technologies in the context of online learning and research.

5= Always serious 4= Often serious 3= Sometimes serious 2=Rarely serious 1= Never serious

	BARRIERS TO DIGITAL INCLUSION AND ACCESSIBILITY FOR LEARNING AND RESEARCH	***Always serious***	***Often Serious***	***Sometimes***	***Rarely Serious***	***Never serious***
Code		5	4	3	2	1
BAR 1	Technology anxiety/Phobia					
BAR 2	Poverty					
BAR 3	High cost of technology equipment and services					
BAR 4	Low technology skills to navigate digital spaces					
BAR 5	Limited digital literacy skills					
BAR 6	Inadequate AT training					
BAR 7	Lack of ICT support					
BAR 8	The challenge of negotiating multiple information sources					
BAR 9	Incompatibility of AT with E-learning platforms					
BAR 10	System failure					
BAR 11	Lack of knowledge of available Assistive technologies					

BAR 12	Complexity of my disability					
BAR 13	Inadequate assistive technologies					
BAR 14	Inadequate Internet connectivity					
BAR 15	Misconceptions and stereotypes about disability					
BAR 16	Information over load					
BAR 17	Rapidly changing technology					
BAR 18	Inaccessible services and facilities					
BAR 19	Inaccessible website					
BAR 20	Inaccessible curricular					
	OTHER: PLEASE SPECIFY AND RATE					

D: ACCESSIBILITY, ADOPTION, AND APPLICATION OF ASSISTIVE TECHNOLOGIES FOR LEARNING AND RESEARCH

D1:ACCESSIBILTY TO TECHNOLOGY-SUPPORTED SYSTEMS, RESOURCES, CONTENT, AND SERVICES FOR LEARNING AND RESEARCH OF **STUDENTS** WITH DISABILITIES.

Please note that ACCESSIBILITY in the context of digital inclusion refers to AFFORDABILITY, AVAILABILITY OF ICT INFRASTRUCTURE, AND DESIGN FOR INCLUSION

Kindly indicate your level of agreement in relation to access to technology-supported resources, systems, content, and services at your university.

5= Strongly Agree (SA) 4= Agree (A) 3=Neutral (N)2= Disagree (D) 1=Strongly Disagree (SD)

ACCESSIBILTY TO TECHNOLOGY-SUPPORTED SYSTEMS, RESOURCES, CONTENTAND SERVICES		SA	A	N	D	SD
		5	4	3	2	1
Affordability						
AFF1	I can afford the cost of equipment needed to access technology-supported resources, systems, content and services.					
AFF2	I can afford the to buy the data needed to access to technology-supported resources, systems, content and services.					
AFF3	Internet Service Providers (ISP) provide uniform pricing information to enable students with disabilities to easily compare plans available for them.					
AFF4	Programs that subsidize monthly Internet subscription costs are available to students with disabilities					
AFF5	The university avails assistance with hardware, software, and peripheral equipment purchases and maintenance to students with disabilities					
	OTHER: PLEASE SPECIFY AND RATE					
ACCESSIBILITY OF ICT INFRASTRUCTURE AND MATERIALS IN ALTERNATE FORMATS						
ACT1	Auxiliary aids and services, including equipment and interpreting services needed for effective communication to ensure equal opportunity for students with disabilities to participate learning and research are accessible					
AICT2	Effective communication systems for students with speech and hearing impairments are accessible.					
AICT3	Information in alternative formats that can be understood by students with					

	physical, hearing and visual impairments is accessible.					
AICT4	Information that is presented orally is also available in writing for people who are deaf or hard of hearing, people whose learning style requires reinforcement of items in writing and others in need of or desiring materials in writing.					
AICT5	Staff can promptly respond to requests for materials in accessible formats (e.g., Braille, large print, audio visual etc)					
AICT6	The university website meets requirements for screen readers					
AICT7	The university website meets requirements for text descriptions of graphics and pictures					
AICT8	The university website meets requirements for equivalent alternatives for information presented in audio or video formats					
AICT9	The university website meets requirements for filling out online forms using assistive technology					
AICT10	The university provides access to high-speed Internet					
AICT11	The university provides IT online support to students with disabilities					
AICT12	The university provides spaces for learning, research and other facilities for students with disabilities					
AICT13	I am able to effectively communicate with students with disabilities.					
AICT14	I am able to effectively communicate with students without disabilities					
	OTHER: PLEASE SPECIFY AND RATE					

D4I	**DESIGN FOR INCLUSION** (commitment to erasing the boundaries and reducing the obstacles to utilizing technology through principles of effective design).					
D4I1	The curriculum is inclusive and accessible to students with disabilities					
D4I2	The e-learning platform is accessible and compatible with the Assistive technologies used by students with disabilities					
D413	The University Website includes accessibility for students with disabilities					
D4I4	The e-learning environment contains some non-accessible tools that prevent students with disabilities from using the e-learning platform for learning and research.					
D4I5	The e-learning platform does not meet my VI needs					
D4I6	The e-learning platform does not meet my HI needs					
D4I7	The e-learning platform does not meet my PI needs					
D4I6	The e-learning platform is not inclusive because the interface is predominantly for students without disabilities.					
D4I7	The library e-resources, systems and services are accessible to students with disabilities					
D4I8	I have access to the full range of services available to all members of the University community regardless of my disability					

D4I9	Facilities are designed so that they are accessible and usable by students with disabilities.					
D420	Facilities are constructed, so that they are accessible and usable by students with disabilities.					
D421	Facilities are altered so that they are accessible and usable by students with disabilities.					
	OTHER: PLEASE SPECIFY AND RATE					

D2: ADOPTION OF ASSISTIVE TECHNOLOGIES BY STUDENTS WITH DISABILITIES FOR ONLINE LEARNING AND RESEARCH

In the context of this study adoption of assistive technology can take place when persons with disabilities are:

i) Informed about digital options and opportunities (**awareness**)
ii) Know how to use digital technologies (**digital literacy**), and
iii) Are not afraid of using digital technologies (**online safety**).

Please indicate your level of agreement regarding the adoption of digital technology-supported resources, systems, content, and services available at your university.
5= Strongly Agree (SA) 4= Agree (A) 3=Neutral (N)2= Disagree (D) 1=Strongly Disagree (SD)

ADOPTION OF ASSISTIVE TECHNOLOGIES (Awareness, digital literacy, and online safety)		SA	A	N	D	SD
		5	4	3	2	1
AWARENESS						
REL1	I am aware of the relevance and benefits of using Assistive technologies for learning and research					
REL2	My university conducts campaigns to raise awareness about using Assistive technologies for students with disabilities					
REL3	My university provides students with disabilities with support to make informed choices about acquisition of ICT equipment and Assistive technologies					
REL4	Specially designed awareness activities and targeted content are developed to engage students with disabilities in using ICT and Assistive technologies.					
REL5	My university supports the creation of multimedia content and promote use of digital technologies for students with					

	disabilities.					
DIGITAL LITERACY						
DIL1	My university identifies and evaluates Digital literacy training needs of students with disabilities					
DIL2	My university has a clear strategy for meeting the digital literacy needs of students with disabilities					
DIL3	Digital literacy instruction is embedded in all aspects of the curriculum for academic engagement and lifelong learning					
DIL4	The university helps students with disabilities learn to search and find electronic information and evaluate digital resources for online learning and research					
DIL5	The University has programs aimed at training students with disabilities on the purchase, maintenance, and repair/recovery of technology equipment and services.					
	OTHER: PLEASE SPECIFY AND RATE					
ONLINE SAFETY FOR STUDENTS WITH DISABILITIES						
ONS1	I have adequate knowledge to create strong and easy to remember passwords for my email and student portal to prevent unauthorised access					
ONS2	I use anti viruses to detect and remove viruses and other malicious software from my devices.					
ONS3	Affordable software and technical assistance are available to protect me against all forms of online abuse.					
ONS4	My university provides a secure network.					
ONS5	I can identify potential threats in the online space					

ONS6	I regularly change my passwords to safeguard against fraud					
	OTHER: PLEASE SPECIFY AND RATE					

D3: APPLICATION OF ASSISTIVE TECHNOLOGIES FOR LEARNING AND RESEARCH

Please select your level of agreement in relation to APPLICATION of digital technologies for learning and research

5= Strongly Agree (SA) 4= Agree (A) 3=Neutral (N)2= Disagree (D) 1=Strongly Disagree (SD)

The application of technology occurs once students digitally literate and are able to take advantage of the benefits of ICT and Assistive technologies in practical and tangible ways.		SA	A	N	D	SD
		5	4	3	2	1
APICT	**APPLICATION OF ASSISTIVE TECHNOLOGIES FOR EDUCATION**					
APICT1	I have applied Technology to discover educational opportunities					
APICT2	I have applied Technology Assistive Technology to enhance my quality of learning and research and enhanced my academic growth					
APICT3	I have applied Technology Assistive Technology to work independently in the academic environment.					
APICT4	The students are trained by qualified instructors on the use of Assistive technology.					
	OTHER: PLEASE SPECIFY AND RATE					

DCA	**DIGITAL COMPETENCIES APPLIED FOR LEARNING AND RESEARCH**					
DCA1	I have used antiviruses and passwords to avoid loss of information and also stay safe online					
DCA2	I have used technologies like the Google suite tools like calendar google drive, google forms and google meet to access, store, organize, share and protect digital information					
DCA3	I have employed Digital Information Literacy skills to effectively search, find, critically evaluate and use digital information from the world wide web and databases.					
	OTHER: PLEASE SPECIFY AND RATE					
DLT	**DIGITAL COLLABORATION TECHNOLOGIES (**I have used following digital collaboration tools for learning and research**)**					
DLT1	Google docs (for collaborative learning)					
DLT2	Google meet (to attend meetings and classes)					
DLT3	Google Calendar (schedule events)					
DLT4	WhatsApp (Communication and sharing and receiving resource materials and lecture notes)					
	OTHER: PLEASE SPECIFY AND RATE					

DMT	**DIGITAL MEDIA TECHNOLOGIES (**I have used following digital media technologies learning and research**)**					
DMT1	YouTube					
DMT2	Google slides					
DMT3	Google forms (to design data collection instruments like questionnaires)					
	OTHER: PLEASE SPECIFY AND RATE					
CRM	**REFERENCE MANAGEMENT SOFTWARE (*I have used reference management software when writing my assignments and research projects)***					
CRM1	Mendeley					
CRM2	Zotero					
CRM3	Endnote					
	OTHER: PLEASE SPECIFY AND RATE					

DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGIES: ACCESSIBILITY, ADOPTION, AND APPLICATION FOR ONLINE LEARNING, TEACHING, AND RESEARCH

IN-DEPTH INTERVIEW GUIDE FOR STUDENTS WITH DISABILITIES.

Dear Participant,
I am a post-doctoral fellow in the Carnegie Consolidating Early-Career Academics Programme (CECAP),
2022-2024.

I am conducting a study on "*Digital Inclusion and Assistive Technologies: accessibility, adoption, and Application for online learning, teaching and Research among academic staff and Students with Disabilities*". The results of the study will generate insights that will inform the design of digitally inclusive teaching, learning, and research environments.
Since you are one of the key stakeholders at this university, I kindly request you to fill in this questionnaire as your views and responses will be vital in furthering the purpose of the study. All the information you provide will be used for academic purposes only and will be kept confidential. Please provide answers to the questions in this tool as exhaustively as you can.
Thank you for agreeing to take part in this study.

1. **DIGITAL INCLUSION AND ASSISTIVE TECHNOLOGY NEEDS**
   1.1 Please tell me about your Digital inclusion and AT needs that ought to be met to facilitate digital inclusion and enhance your engagement in learning and research. [Probe for details regarding needs based on specific impairment (Physical, hearing, and visual]……
   ……
   ……
   ……
   ……
   ……
   ……
   ……

2. ACCESSIBILITY AND COMPATIBILITY OF ASSISTIVE TECHNOLOGIES

2.1 Please tell us about accessible services and facilities that your university provides to support learning and research (Probe for overall accessibility).

……
……
……
……
……
……

2.2. Please tell me about the compatibility of Assistive technologies with online learning platforms
……
……
……
……
……
……

DIGITAL COMPETENCIES

3. Please describe the digital competencies you have employed to harness the multiple functionalities of assistive technologies for learning, and research.
……
……
……
……
……
……

BARRIERS TO ACCESSIBILITY, ADOPTION, AND APPLICATION OF ASSISTIVE TECHNOLOGIES FOR LEARNING AND RESEARCH

4. Please tell me about the barriers to accessibility, adoption, and application of Assistive technologies for learning and research. [Probe for accessibility challenges specific to different disabilities (e.g, the

cost of using the digital tools to join e-learning, the usability of the digital tools, adaptive technology used, lack of digital skills, etc.]

……
……
……
……
……
……

UNIVERSITY POLICIES

5. Please describe ways in which university policies on Disabilities inclusion have facilitated accessibility, adoption, and application of ATs for online learning and research.

……
……
……
……
……
……

WAYS OF IMPROVING ACCESSIBILITY, ADOPTION, AND APPLICATION OF ASSISTIVE TECHNOLOGIES

6. Please suggest ways of improving accessibility, adoption, and application of Assistive technologies for learning and research.

……
……
……
……
……
……