



Awareness, Accessibility and Utilization of Digital Assistive Technologies in the 21st Century Pedagogy of the Hearing Impaired Students in Federal College of Education (Special) Oyo

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Abstract

The acquisition of 21st century learning skills leaves no exemption for learners with challenges in the society. Given this, this study assesses the awareness, accessibility, and utilization of digital assistive technologies (DAT) by the hearing impaired students as well as the challenges they encounter using them in a special college of education. The study samples 52 hearing impaired students, and it was guided by 5 research questions and 3 null hypotheses. Two instruments were used: a checklist measuring awareness and accessibility of digital assistive technologies and a questionnaire measuring utilisation of DAT, challenges and remedies to the use of DAT. Both instruments were validated by two specialists in special education. While the checklist's reliability was established using Cohen's Kappa inter-rater agreement, which yielded a coefficient of 0.71, indicating substantial agreement, the questionnaire's reliability coefficient of 0.78 was established using Cronbach's Alpha. Data were analyzed using simple percentages, mean calculations and independent sampled T-tests. The findings reveal that above 50% of the sampled students is aware of the checked digital devices and software and can access them but only hearing aids, automatic subtitles, learning applications, cell-phones/lpads and computers are utilised. Also, the study reveals that accessibility and utilization are not gender biased. From the stance of challenges, the Hearing Impaired students establish that most of the software and applications are not easily accessed, and they have little knowledge about the use of some of them. Thus, the study recommends, among other things, that stakeholders and the government should prioritize the provision of digital assistive technologies as well as subsidize the cost for the challenged students, and ensure that adequate technical supports are given to the hearing impaired students while using some of the digital devices.

Keywords: Assistive Technology, Digital Assistive Technology, Hearing Impairment, 21st Century Skills

Introduction

Pedagogy for learners with disabilities in the 21st century has undergone a significant transformation to the extent that special educators no longer see it as a difficult task to meet the educational needs of learners with disabilities. This transformation evolves from advancement in technology via integration of technological tools, devices, software applications or equipment that are designed to assist learners with disabilities in performing tasks, improving their function capabilities, and enhancing their overall independence when interacting with their physical and digital environment. These devices, tools and software applications are classified as assistive technology (AT). Fernandez-Batenero et.al (2022) assert that AT has significantly impacted on academic engagements of learners with disabilities, improved their social skills,

and developed and promoted autonomy, motivation and increased attention span. Tamakloe and Agbenyega (2017) describe assistive technology as any item product system or equipment, which is customised, modified or made commercial, applied to enhance or improve functional capabilities of children with disabilities. By implication, educational experiences and learning outcomes for special students are significantly enhanced by the integration of assistive technology.

Remarkably, the 21st century society with its attendant challenges has a revolutionary impact on the education of learners with special needs. The impact puts students with special needs in the position of yawning for the acquisition of the 21st century knowledge and skills just like their non-challenged



counterparts. The 21st century skills, which Kumbhakar and Kumar (2025) define as the abilities one requires to perform successfully in the rapidly changing 21st century environment, obviously impose some limitations on the already existing assistive technology. These skills are categorised into three: learning and innovative skills (critical thinking, creativity, collaboration and communication); information, media and technology skills (digital literacy, information literacy, and media literacy), and life and career skills (flexibility, adaptability, initiative, social and cross-cultural skills, productivity and leadership) (Partnership for 21st Century Learning, 2009). Looking at the classification of these skills, there is no doubt that there is need to add assistive functionality to products or create smart devices that will enhance or enable their uses by persons with disabilities, or to add features that target those with disabilities beyond the original scope of the devices. The additional features to assistive technology enabled by advancement in technology, offer a digital identity to assistive technology.

Digital Assistive Technology (DAT) refers to the use of new algorithm or application to solve a problem (Banes, 2023). DAT defines electronic tools; systems devices and software modified and customised to enable special individuals meet the demands of the 21st century. Bane (2023) adds that it encompasses digital devices, systems, and resources that help to create, store, and manage data such as social media, online games, multimedia and mobile phones. The author avers a more comprehensive definition by describing DAT as any item, piece of equipment, or product system whether bespoke or available readily and acquired commercially, modified or customised, that is produced in digital form or integrates the use of digital signals or data, and used to increase, maintain or improve functional capabilities of individuals with disabilities. Invariably, the functional capabilities of individuals with disabilities expected to be harnessed by these technologies include access to information, effective communication, mobility, control, decision making, collaboration, creativity and productivity. Among groups of individuals with disabilities who benefit from the assistive functionality of digital assistive technology is the hearing impaired learners/students.

Hearing Impaired (HI) learners are a group of learners whose abilities to perceive and interpret sounds are affected as a result of partial or complete difficulty in hearing. Hearing impairment according to Geer (2016), is perceived as all abnormalities, disorders and

deviations in the ear mechanism, and it is critical to speech and language development, communication and hearing of affected individuals. This group of learners are expected to develop in line with the demands of the 21st century, and at such, a customised and modified channel is needed for their education. The Nigerian government, in one of her policy provisions for this set of individuals, stipulates that the society should raise the expectations of persons with disabilities to assume their full responsibilities as members of the society (Federal Government of Nigeria, 2018). However, unlike the non-challenged individuals, acquisition of knowledge and skills for HI learners is limited to their senses of sight and feeling, and this makes their primary mode of learning to be dependent on sign language and assistive tools or devices. In other words, effective pedagogy for the HI learners is heavily dependent on assistive technology and sign language. Skoglund (2020) avers that using either low or high technology devices enables HI learners to engage, participate, and benefit from the teaching and learning process. Hopkins (2010) buttresses that digitisation of devices like iPads, tablets and Smartphone has improved the academic performance of learners with hearing impairment in schools.

Significantly, the use of assistive technology in the pedagogy of HI learners cannot be deemphasised. Ferguson et.al (2017), in a study, establish that there is transformative potential of technology and assistive development for individuals with hearing impairment, and the HI learners' experiences in the world could be affected by such developments. This suggests that effective utilisation of assistive technology has a tremendous impact on the acquisition of knowledge and skills among HI individuals. Oloaku (2017) cited in Mbazi et.al (2025) affirms that effective utilisation of hearing assistive technologies facilitate learning as it extends learning engagement and participation in instructional procession. In the same vein, Drelick et.al (2022) confirms that hearing aid and cochlear implants have created new chances for social interaction and successful communication. Numerous benefits are interlocked in the use of assistive technology by HI individuals, and more benefits are abound particularly when more assistive functions and smart features are added to these technologies as defined by digitalisation.

Today, a lot of assistive technologies are available for hearing impaired learners. Wisconsin, as cited by Kong and Soon (2024), identify three categories of assistive technology: hearing technology, alert devices and communication support technology.



Hearing technology includes hearing aids, cochlear implants; alert technologies are: vibro-tactile and signalling devices using sound and visual amplification or vibrators to send signals, communication technology includes cell-phone, amplified and captioned telephones, pagers, web cameras, computer-assisted note-taking devices (CAN), real-time captioning and voice-to-text devices. Mbazi et.al (2025) add that software connected to Android via local network and WIFI, and Google Instructor Speaks(voice) that records and converts to text are currently developed for HI individuals. Other available devices include optical devices like television with caption, laptop, tablets, Ipads, audiometer, television decoder, FM amplification system and telecommunication device for the deaf, computer-assisted real time transcription (CART) (Eliuteri & Lema, 2022; Mae & Tequero, 2023; Soetan et.al, 2020, and Bell,2015). Most of these devices and applications are digitally customised to absorb the functional capabilities of conventional technological devices like pictures, graphic organisers, and reading tracker that were previously used as well as the role of sign interpreters.

It is important to note that the existence or availability of these technologies is expected to be in parallel with their awareness by HI individuals; but where they exist and the HI individuals are not aware, access to them becomes difficult. Ezema (2015), as cited by Yemi-Peter et.al (2022), affirm that resources may be available for use and even identified as relevant to ones subject of interest but may not be accessed. There is always a positive relationship between awareness and access to resources: awareness mutually reinforce access vice-visa. Awareness of digital assistive technologies can increase the demand for their use, and enhance the knowledge of how to use them. On the other hand, access to DATs gives or demonstrates more value attached to them and enhances a profound knowledge about the functionality of the devices/tools. The relationship between accessibility and utilisation resources, which includes digital assistive technologies, has never cease to raise concerns among researchers.

Murithi et.al (2022) in a study reported that low utilization of assistive devices is linked to the poor academic performance of hearing impaired learners in schools. Vincent et.al (2024) made an investigation on the use of assistive technology for students with disabilities in Technical Colleges, and reported that many AT were not utilised, which included text-to-speech, speech-to-text, optical character recognition, graphic organisers, annotation tools, display control,

graphic tools, closed captioning on television etc. The researchers equally identified the following challenges: lack of professional development and training for teachers and students; inadequate funding and failure to provide supports and guidance to teachers and students. In another study, Basigi et.al (2024) revealed that the unavailability of assistive technology resources challenged the learning of Mathematics among hearing impaired students. On the other hand, Olumorin et.al (2022) reported that assistive technologies for all special students were available in the study sampled school in Kwara State, and a significant difference existed in the level of utilisation of these assistive technologies for learning among special students based on gender and age. In a similar study, Nzewike et.al (2025) examined the effectiveness of digital assistive technologies (DATs) for supporting students with disabilities in the South East Nigeria, and reported that screen readers, speech-to-text software, hearing aids, digital note-taking Apps were available. They also reported highly effective utilisation of DATs, and some challenges among educators, which included difficulty in integrating DATs in instruction, unawareness of existences of DAT and lack of technical skills. In addition to the challenges, Anyuabaga (2024) includes lack of maintenance of devices due to limited access to qualified technicians and spare parts; social stigma surrounding loss of hearing; lack of awareness about available AT options, and high cost of procurement and limited insurance. The authors, who reported availability above, did not specify the availability according to classes of disabilities (visually impaired, hearing impaired, physically impaired etc.), and also Nzewike et.al focused on educators. This gap gives the present study a base. More so, the current study targets a Special College of Education where studies and students are grouped according to their various levels of disabilities, and assessment of availability and utilisation is limited to the hearing impaired learners' pedagogy.

Research Questions/Hypotheses

1. What are the digital assistive technologies hearing impaired students are aware of their existence?
2. What are the digital assistive technologies accessible to hearing impaired students in the college?
3. To what extent do hearing impaired students use digital assistive technologies for their studies?

4. What are the challenges faced by hearing impaired students while using digital assistive technologies?
5. What are the likely remedies to the challenges of using digital assistive technologies?

Hypotheses

1. Male hearing impaired students’ access to digital technologies does not differ significantly from their female counterparts.
2. Female hearing impaired students’ usage of digital assistive technologies does not differ significantly from their male counterparts.
3. Male hearing impaired students’ challenges in the use of digital assistive technologies do not differ significantly from their female counterparts.

Methodology

The study adopted a descriptive survey approach to give a snapshot of the trend of awareness, accessibility and utilisation of digital assistive technologies (DATs) among hearing impaired (HI) students. It sampled 52 (male 31 and female 21) students purposively, given that they formed a population of 200 level HI students in the college under study, and it was expected that they had been exposed to some digital assistive technologies in the college aside from their personal assistive devices. An

instrument that combined a checklist with a questionnaire was used for data collection. The checklist, which contained a list of DATs, was used to assess HI students’ awareness and accessibility to DATs, while the questionnaire was used to assess their utilisation of DATs and challenges HI students encounter accessing and utilising the technologies. The instrument was subjected to face and content validity through the appraisal of experts in the department of Hearing Impairment. Also, two reliability coefficients were established: the checklist had a coefficient of 0.71, indicating a substantial agreement, which was established using Cohen’s Kappa Inter-rater agreement statistics, while the questionnaire had 0.78 using Cronbach’s Alpha statistics. Data collected from the instrument were analysed using simple percentage for HI students’ awareness and accessibility to DATs (unaware/inaccessible < 50% >= aware/accessible); mean calculation for utilisation on a three-scaled response format (not utilised < 2.0 >= utilised), and for challenges encountered using DATs on a four-scaled response format (unacceptance < 2.5 >= acceptance of statement items). The three hypotheses in the study were tested using independent sample T-tests at 0.05 alpha level of significance. The p-values were compared with 0.05 alpha level for the acceptance or rejection of the hypotheses (rejection <= 0.05 > acceptance)

Results

Research Question 1: What are the digital assistive technologies Hearing Impaired students are aware of their existence?

Table 1: Awareness of Digital Assistive Technologies (DATs)

S/N	Digital Assistive Technologies	Awareness (%)	
		Aware	Not Aware
1	Hearing Aids	86.5	13.5
2	Cochlear Implants	75.0	25.0
3	Hearing Loop systems	86.5	13.5
4	FM System	61.5	38.5
5	Infrared System	78.8	21.2
6	Personal Amplified System	78.8	21.2
7	Bluetooth Systems	76.9	23.1
8	Text Transcription System (Voice-to-Text)	84.6	15.4
9	Speech Synthesis	76.9	23.1
10	Sign Language Interpreters /Translators	90.4	9.6
11	Automatic Subtitles	75.0	25.0
12	Communication Applications	86.5	13.5

13	Note-taking Applications	73.1	26.9
14	Learning Applications	86.5	13.5
15	Alerting Devices	59.6	40.4
16	Computer Assisted Real Time Transcription	69.2	30.8
17	Cell-phones/I pads	94.2	3.8
18	Computers/Laptops	88.5	9.5

Table 1 represents Hearing Impaired students’ awareness of existing Digital Assistive Technologies (DATs). All the DATs on the table recorded above 50% under “Aware”, which reveals that the |HI students claimed awareness of the listed DATs.

Research Question 2: What are the digital assistive technologies accessible to hearing impaired students in the college?

Table 2: Accessibility to Digital Assistive Technologies (DATs)

S/N	Digital Assistive Technologies	Accessibility (%)	
		Access	No Access
1	Hearing Aids	65.4	32.7
2	Cochlear Implants	63.5	36.5
3	Hearing Loop systems	59.6	40.4
4	FM System	51.9	46.2
5	Infrared System	61.5	36.5
6	Personal Amplified System	63.5	36.5
7	Bluetooth Systems	55.8	44.2
8	Text Transcription System (Voice-to-Text)	65.4	30.8
9	Speech Synthesis	61.5	36.5
10	Sign Language Interpreters /Translators	73.1	25.0
11	Automatic Subtitles	61.5	36.5
12	Communication Applications	67.3	30.8
13	Note-taking Applications	51.9	46.2
14	Learning Applications	71.2	28.8
15	Alerting Devices	46.2	53.8
16	Computer Assisted Real Time Transcription	57.7	40.4
17	Cell-phones/I pads	90.4	7.7
18	Computers/Laptops	92.3	5.8

Table 2 represents Hearing Impaired students’ accessibility to DATs. All the items on the table recorded above 50% under “Access” with the exception of alerting devices that had 46.2 %. This indicates that the Hearing Impaired students claimed access to the listed DATs except access to alerting devices.

Research Question 3: To what extent do hearing impaired students use digital assistive technologies for their studies?

Table 3: Utilisation of Digital Assistive Technologies (DATs)

S/N	Digital Assistive Technologies	Mean (X)	SD	Decision
1	Hearing Aids	2.0	.907	Utilised
2	Cochlear Implants	1.63	.793	Not utilised
3	Hearing Loop systems	1.92	.904	Not utilised
4	FM System	1.71	.776	Not utilised
5	Infrared System	1.67	.785	Not utilised
6	Personal Amplified System	1.87	.908	Not utilised
7	Bluetooth Systems	1.85	.937	Not utilised
8	Text Transcription System (Voice-to-Text)	1.73	.888	Not utilised
9	Speech Synthesis	1.92	.947	Not utilised
10	Sign Language Interpreters /Translators	1.94	.938	Not utilised
11	Automatic Subtitles	2.04	.949	Utilised
12	Communication Applications	1.92	.926	Not utilised
13	Note-taking Applications	1.60	.870	Not utilised
14	Learning Applications	2.02	.918	Utilised
15	Alerting Devices	1.78	2.946	Not utilised
16	Computer Assisted Real Time Transcription	1.50	.700	Not utilised
17	Cell-phones/I pads	2.57	.637	Utilised
18	Computers/Laptops	2.28	.776	Utilised

Note: N = 52, SD = Standard deviation, Decision based on 2.0 criterion mean.

Table 3 represents Hearing Impaired (HI) students' utilisation of the listed DATs. A comparison of the DATs items' mean scores with the utilisation criterion mean 2.0 reveals that all DATs items that recorded mean scores above 2.0 which include hearing aids, automatic subtitles, learning applications, cell-phones/iPads and computers/laptops are utilised by the

HI students, while the others with mean scores less than 2.0 were assumed not utilised by the HI students. Also, a comparison of the items' mean scores with their standard deviation reveals that all the items recorded a low standard deviation with the exception of alerting devices, and this suggests a high level of consistency and reliability of the HI students' responses.

Research Question 4: What are the challenges faced by hearing impaired students while using digital assistive technologies

Table 4: Challenges of using Digital Assistive Technologies

S/N	Statements on Challenges faced using Digital Assistive Technologies (DAT)	Mean (X)	SD	Decision
1	I have limited knowledge about many digital assistive devices and their uses.	3.19	.930	Agree
2	I do not know any other digital assistive device/application except the one I use.	2.77	.877	Agree
3	Most digital assistive technology devices and applications are not easily accessed.	2.83	.901	Agree
4	A lot of assistive technologies available and accessible are of low quality or fake.	2.71	1.035	Agree
5	I do not always get the needed support/assistance from my instructors while using some assistive technologies	2.73	1.190	Agree
6	The use of digital assistive technologies is optional to students in our department	2.90	.934	Agree
7	The use of digital assistive technologies is not demonic and artificial.	2.88	.900	Agree

Note: N = 52, SD = Standard deviation, Decision based on 2.5 criterion mean.

Table 4 shows HI students responses on the challenges they encounter using assistive technologies. The respondents recoded mean scores above 2.5 criterion-mean on all the statements of challenges. This reveals that the sampled HI students lack technical and manipulative skills of some digital assistive devices/applications; their knowledge of DATs is

constrained to the ones available to them; they find it difficult to access DATs; a lot of devices within their reach are of low quality or fake; they lack technical supports from instructors, and are not encouraged to use available DATs in their departments. Also they do not have negative impression about the use of DATs.

Research Question 5: What are the likely remedies to the challenges of using digital assistive technologies?

Table 5: Remedies to the Challenges of Accessing and Utilising Digital Assistive Technologies

S/N	Statements on likely Remedies to Accessibility and Utilisation of Digital Assistive Technologies	Mean (X)	SD	Decision
1	Workshops/sensitization programmes on how to access and use digital assistive technologies should be organised at periodic interval for hearing Impaired students.	3.44	.539	Agree
2	A variety of digital assistive technologies should be used for teaching hearing impaired students.	3.25	.653	Agree
3	Hearing impaired students should be given tasks or learning activities that encourage the use of different digital assistive technologies.	3.19	.627	Agree
4	Provision of digital assistive technologies requires collaborative efforts of parents, government, stakeholders and the college management.	2.92	.710	Agree
5	Production and importation of digital assistive technologies should be regulated by the government to ensure conformity with standards and quality assurance.	3.40	.721	Agree



6	An enabling and digital friendly environment should be created for hearing Impaired students in the college to promote their interest in the use of digital assistive technologies.	3.25	.682	Agree
7	Sensitization programmes on the relevance of digital assistive technologies should be regularly mounted in the college.	3.50	.505	Agree
8	Technical assistance unit/control should be established in the department of Students with Hearing Impairment.	3.42	.499	Agree

Note: N = 52, SD = Standard deviation, Decision based on 2.5 criterion mean.

Table 5 represents the likely remedies to the challenges of access and utilisation of DATs. All the statements recorded mean scores above 2.5 criterion-mean which indicate that the respondents accepted all the remedies proffered. In other words, they acknowledged that workshops/sensitization programmes on how to access and use DATs should be organised periodically; a variety of DATs should be adopted for the pedagogy of the HI students; HI students should be given learning activities that encourage the use of different DATs; provision of DATs requires collaborative efforts of

parents, government and others; government should regulate the production and importation of DATs to conform with standards; enabling and digital friendly environment should be created for the HI students; awareness of the relevance of DATs should be created regularly, and technical assistance unit/control should be established for the HI students. The table equally reveals a low standard deviation across all the statements when compared with their mean scores, and this indicates that their responses were consistent and reliable.

Table 6: Independent T-test on Gender Comparisons of HI Students on Accessibility and Utilisation of Digital Assistive Technologies

Digital Assistive Technologies	Gender	N	ACCESSIBILITY			UTILISATION		
			Mean	P-value	Decision	Mean	P-value	Decision
Hearing Aids	male	31	2.2903	.763	NS	2.0968	.356	NS
	Female	21	2.3333			1.8571		
Cochlear Implants	male	31	2.4516	.111	NS	1.5806	.564	NS
	Female	21	2.2381			1.7143		
Hearing Loop systems	male	31	2.3226	.160	NS	2.0645	.175	NS
	Female	21	2.5238			1.7143		
FM System	male	31	2.5484	.073	NS	1.7097	.983	NS
	Female	21	2.2857			1.7143		
Infrared System	male	31	2.3871	.480	NS	1.6452	.752	NS
	Female	21	2.2857			1.7143		
Personal Amplified System	male	31	2.3548	.852	NS	1.9677	.328	NS
	Female	21	2.3810			1.7143		
Bluetooth Systems	male	31	2.3871	.344	NS	2.0645	.030	S
	Female	21	2.5238			1.5238		
Text Transcription System (Voice-to-Text)	male	31	2.2258	.464	NS	1.7419	.914	NS
	Female	21	2.3333			1.7143		



Speech Synthesis	male	31	2.3548	.882	NS	1.9677	.679	NS
	Female	21	2.3333			1.8571		
Sign Language Interpreters /Translators	male	31	2.1935	.490	NS	1.9032	.724	NS
	Female	21	2.2857			2.0000		
Automatic Subtitles	male	31	2.4194	.199	NS	1.1935	.154	NS
	Female	21	2.2381			1.8095		
Communication Applications	male	31	2.2903	.974	NS	1.8710	.622	NS
	Female	21	2.2857			2.0000		
Note-taking Applications	male	31	2.3871	.367	NS	1.6774	.408	NS
	Female	21	2.5238			1.4762		
Learning Applications	male	31	2.3226	.517	NS	1.9032	.278	NS
	Female	21	2.2381			2.1905		
Alerting Devices	male	31	2.5484	.855	NS	1.2903	.230	NS
	Female	21	2.5238			2.5238		
Computer Assisted Real Time Transcription	male	31	2.3871	.300	NS	1.4516	.571	NS
	Female	21	2.6190			1.5714		
Cell-phones/I pads	male	31	2.0645	.860	NS	2.5806	.960	NS
	Female	21	2.0476			2.5714		
Computers/Lapto ps	male	31	2.0645	.438	NS	2.2581	.737	NS
	Female	21	2.0000			2.3333		

Note: NS = Not Significant, S = Significant, N = Number

Table 6 above shows the mean comparisons of male and female HI students on accessibility and utilisation of DATs as demanded in the following hypotheses: Ho.1 Male HI students' access to DATs does not differ significantly from their female counterparts, and Ho.2 Male HI students' utilisation of DATs does not differ significantly from their female counterparts. A comparison of the P-values of all the DAT items in the

table with 0.05 alpha levels of hypothesis significance reveals that no significant difference exists in male and female HI students' access to DATs. Also in their use of DATs, with exception of Bluetooth systems, no significant difference in the use of all the devices and applications listed in the table. Thus, access and utilisation of DATs are not gender biased.

Table 7: Independent T-test of Comparison of Male and Female HI students’ Challenges on the Use of Digital Assistive Technologies

Challenges	Gender	N	Mean	Std. Deviation	P-Value	Decision
I have come across many digital assistive devices and applications but I do not know what and how they are used.	Male	31	3.2903	.82436	.386	NS
	Female	21	3.0476	1.07127		
I do not know any other digital assistive device/application except the one I use.	male	31	2.5484	.88840	.022	S
	Female	21	3.0952	.76842		
Most digital assistive technology devices and applications are not easily accessed.	male	31	2.7419	.89322	.418	NS
	Female	21	2.9524	.92066		
A lot of assistive technologies available and accessible are of low quality and some are fake.	male	31	2.7419	1.09446	.795	NS
	Female	21	2.6667	.96609		
I do not always get the needed support/assistance from my instructors while using some assistive technologies	male	31	2.5161	1.20750	.110	NS
	Female	21	3.0476	1.11697		
The use of digital assistive technologies is optional to students in our department	male	31	2.8710	.95715	.760	NS
	Female	21	2.9524	.92066		
The use of digital assistive technologies is demonic and artificial.	male	31	3.0645	.85383	.085	NS
	Female	21	2.6190	.92066		

Note: NS = Not Significant, S = Significant, N = Number

Table 7 shows a test of Ho. 3: Male hearing impaired students’ challenges in the use of digital assistive technologies do not differ significantly from their female counterparts. A comparison of the P-values of challenged –items with 0.05 alpha levels of significance reveal that male HI students’ challenges do not differ significantly from their female HI counterparts except in item two which assesses their awareness of other devices aside the ones they use.

Discussion

The findings of the study reveal that HI students are aware of the existence of many digital assistive technologies. Their responses recording above 50% on all the listed DATs proves that they know about

them. This awareness of the existence of learning resources agrees with the report of Odunewu and Aluko-Arowolo (2018), who equally revealed from a study of postgraduate students’ awareness of electronic information resources, that most students are aware of e-resources available for use in pursuit of their studies. Complementarily, with the exception of alerting devices, HI students recording above 50%, acknowledged that they can have access to the DATs investigated though the condition of accessibility was not established in the study. The relationship between the HI students’ awareness and accessibility corroborates with the one of the findings of Arowosola et.al (2022) in a study on the influence of awareness and accessibility on electronic information resource use



among student, which established that awareness has a significant positive relationship with accessibility of electronic information resources. Invariably, awareness of DATs reinforces their accessibility.

On the other hand, the results indicate that their utilisation of DATs does not reflect their awareness and accessibility. This justifies the position of Ezema (2015) cited in Yemi-Peter (2022) who points out that resources may be available for use and even identified relevant to ones subject of interest but may not be used. Among the DATs investigated, HI students only accepted the use of hearing aids, automatic subtitles, learning applications, cell-phones/iPads and computers/laptops. This result aligns with the findings of Eluiteri and Lema (2022), Soetan et.al (2020), Khalid and Ashram (2021) and Nzewike et.al (2025), who respectively reported utilisation of a few assistive technologies among challenged students which include the ones aforementioned. Also, the present study establishes no significant difference between male and female HI students' access and utilisation of DATs. This result disagrees with the findings of Olumorin et.al (2022) who reported that utilisation of assistive technology is gender and age biased. Probably, the disagreement could result from the fact that Olumorin et.al studied all the special students while the present study concentrated on the hearing impaired students.

From the stance of challenges, the findings of the study reveal the following constraints: lack of technical and manipulative skills of some of the DATs; low quality and fake DATs within the reach of HI students; difficulty in accessing DATs; a lack of technical supports, limitation to the knowledge of only available DATs and a lack of encouragement/motivation to use DATs. The findings concur with the findings of Anyuabaga (2024) and Vincent et.al (2024) that equally identified lack of professional development/training for special students/educators in the use of assistive technology, lack of technical supports and others. Also, a comparison of male and female HI students' challenges reveals that no significant differences exist with the exception of HI students' limitations to the knowledge of DATs, where female students had a higher mean score. The difference in the mean scores, though not the focus of this study, could be attributed to some factors such as parental background, nature of impairment (deaf or hard of hearing), and provision of funds/devices.

In a bid to remedy some of the challenges, HI students acknowledged that organisation of

workshops/sensitisation programmes on how to access and use DATs should be done periodically for the HI students, as well as programmes on their relevance. They also agreed that HI students should be exposed to a variety of DATs during class instructions, and should be given learning activities that will promote or encourage the use of DATs. Other remedies proffered include provision of DATs for HI students through a collaborative approach; ensuring that production and importation of DATs are regulated by the government to maintain standards and quality; creation of enabling and digital friendly environment for the use of DATs as well as establishment of technical assistance unit/control for the HI students to access. Relatively, organisation of workshops/sensitisation programmes on accessibility and utilisation of DATs concurs with the postulation of Anyuabaga (2024) who sees equipping HI people with the knowledge and skills for effective use of assistive devices as a crucial medium for maximising the benefits of assistive technologies and ensuring long term user satisfaction. Also, adopting a collaborative approach and government's regulation of production and importation, as well as creating enabling digital environment conform with the position of Afolabi et.al (2019) who emphasise the importance of government intervention and policy change to promote a wider access to assistive technologies in developing countries.

In sum, the study reveals that many digital assistive technologies are known by HI students and can be accessed for utilisation just as Olumorin et.al (2022) reported in their study but their utilisation is limited to some devices/applications. Relatively, lack of technical skills and supports, as well as difficulty in accessing the devices/applications could be the major causes of the limitations. However, a consideration to the proffered remedies above may change the narrative.

Conclusion

Given the findings of the study, access and utilisation of digital assistive technologies should not be undermined as long as education of the HI students is tailored to meet the 21st Century societal demands. There should be a complementary relationship between access/availability and utilisation of DATs especially in this century of advancement in technology and advancement in the functionality of assistive technology. It will guarantee the relevance and functionality of education of the HI individuals as well as enhance their acquisition of the 21st century skills. Special educators and stakeholders need to re-examine



the assistive capabilities/functionalities of available assistive technologies in the institutions that offer special education in line with the desired expectations of the 21st century education for the HI students.

Recommendations

Based on the findings of the study, the following are recommended:

1. Government and stakeholders in special education should prioritise provision of DATs and ensure that there is adequate provision through intervention and subsidization of the cost of procurement to enhance access to DATs for HI students.
2. Stakeholders in special education including special educators should create adequate awareness of the developed DATs and their functional capabilities through workshops and utilisation in pedagogy, and emphasise their relevance in the development of HI students.
3. Government should make a strong policy on production and importation of quality and original DATs, and ensure effective implementation of the policy so that good quality products will be available and accessible to HI students.
4. Special educators should ensure effective integration of DATs in pedagogy of the HI students, and should also be abreast with the advancement in the functional capabilities of many of these devices/applications to enable their productive use in instructions. This will, on the other hand, motivate HI students to yawn for the acquisition of the devices/software

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