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EFFECTIVENESS OF DIGITAL ASSISTIVE TECHNOLOGIES FOR SUPPORTING STUDENTS WITH DISABILITIES IN SELECTED FEDERAL UNIVERSITIES IN SOUTH-EAST NIGERIA

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Abstract

The study examined the effectiveness of digital assistive technologies in for supporting students with disabilities in selected federal universities in South-East Nigeria. The study was carried out in South-East Nigeria, guided by four research questions. Descriptive survey design was adopted for the study. The population of the study comprised of all Faculty of Education lecturers in Alex Ekwueme Federal University and Nnamdi Azikiwe University, Awka. A sample of 106 lecturers selected through multistage sampling procedure, took part in the study. Data was collected using a questionnaire developed by the researchers. The instrument was validated by three experts in the University of Nigeria Nsukka and its reliability index ($\alpha = 0.90$) was obtained through Cronbach Alpha following trial-testing of the instrument on 20 Faculty of Education lecturers at University of Nigeria, Nsukka. The instrument was distributed electronically through Google form and collected data was analysed using SPSS v.25. Research question 1 was answered using frequency and percentage whereas mean and standard deviation was used to answer research questions 2 – 4. The study demonstrated that: the digital assistive technologies available for supporting students with disabilities are: Screen readers, Speech-to-text software, Augmentative and alternative communication (AAC) devices, Optical Character Recognition (OCR) Software, among others; the digital assistive technology tools highly effective for supporting students with disability include: Screen readers, Speech-to-text software, Augmentative and alternative communication (AAC) devices, among others.. The study recommended that Regular professional development programs and workshops should be conducted to equip educators with the necessary knowledge and skills to effectively integrate digital assistive technologies (DATs) into classrooms.

Keywords: Digital Assistive technology, students, disabilities, learning outcomes

Introduction

Education is a fundamental right that should be accessible to all individuals, regardless of their physical, sensory, cognitive, or learning disabilities. In recent years, the role of technology in promoting inclusive education has gained significant attention, with digital assistive technologies (DATs) emerging as essential tools for bridging learning gaps among students with disabilities. These technologies provide tailored solutions that help students overcome challenges associated with mobility, communication, reading, writing, and comprehension (Alnahdi, 2020). Despite the increasing awareness of the importance of assistive technologies in education, their effectiveness in higher institutions, particularly in Nigerian universities, remains an area that requires further exploration. In South-East Nigeria, where efforts toward inclusive education are still evolving, understanding the

impact of DATs in federal universities is crucial for ensuring equitable learning opportunities for students with disabilities.

Students with disabilities refer to individuals who experience physical, cognitive, sensory, or learning impairments that impact their ability to fully engage in conventional educational activities without additional support. These disabilities can range from visual and hearing impairments to mobility challenges and neurodevelopmental disorders such as dyslexia and autism spectrum disorder (Adebisi, Liman, & Longpoe, 2015). In an academic environment, students with disabilities often require accommodations that address their unique learning needs, enabling them to participate effectively in classroom activities, assessments, and research engagements. However, without adequate technological interventions, these students may struggle with barriers that hinder their academic performance and overall learning experience (Okolo & Diedrich, 2014).

Digital assistive technologies (DATs) encompass a wide range of technological tools designed to support students with disabilities by enhancing accessibility, communication, and independent learning. These tools include screen readers, speech-to-text software, augmentative and alternative communication (AAC) devices, magnification software, optical character recognition (OCR) software, Braille displays, adaptive keyboards, and hearing aids (Shinohara & Wobbrock, 2016). Each of these technologies serves a specific function in assisting students based on their individual needs. For instance, screen readers convert digital text into speech or Braille output, benefiting students with visual impairments, while speech-to-text software enables students with mobility impairments or learning disabilities to dictate their responses instead of typing. The potential benefits of DATs in higher education are immense, as they promote independence, enhance academic performance, and foster an inclusive learning environment. According to Edyburn (2020), these technologies empower students with disabilities to engage with learning materials at their own pace, improving comprehension and retention. Additionally, DATs facilitate communication between students and educators, ensuring that learning barriers are minimized. With the integration of accessibility features in learning management systems, students with disabilities can now access digital course materials, participate in virtual discussions, and complete assessments without physical limitations (Seale, 2017). Moreover, the availability of digital note-taking applications and eye-tracking technology enhances classroom participation by providing alternative methods for students to interact with content.

Despite these advantages, the adoption and effectiveness of DATs in Nigerian higher education institutions remain underexplored. Many universities face challenges such as a lack of awareness, inadequate funding, and limited technical expertise among educators, which hinder the successful implementation of assistive technologies (Alper & Raharinirina, 2015). Additionally, infrastructural deficits, including unstable internet connectivity and the high cost of assistive devices, pose significant barriers to their widespread use. While research on assistive technology has largely focused on primary and secondary education, there is a noticeable gap in studies examining its impact at the university level, particularly in South-East Nigeria. This study aims to address these gaps by assessing the effectiveness of digital assistive technologies in supporting students with disabilities in selected federal universities in South-East Nigeria. By evaluating the extent to which these technologies enhance learning experiences, the study will provide insights into the challenges associated with their adoption and implementation. The findings will contribute to policy recommendations aimed at improving accessibility and inclusivity in

Nigerian higher education institutions, ensuring that students with disabilities receive the necessary technological support to thrive academically.

Research Questions

The following research questions guided the Study

1. What digital assistive technologies are available for supporting students with disabilities?
2. What challenges faced are by educators in integrating digital assistive technologies for students with disabilities?
3. What strategies can be adopted to ameliorate the challenges faced are by educators in integrating digital assistive technologies for students with disabilities?

Methods

The study adopted descriptive survey research design. The study was domiciled in South-East Nigeria. The population of the study comprised of all lecturers in the Faculty of Education at the Nnamdi Azikiwe University, Awka and Alex Ekwueme Federal University, Ndufu-Alike Ikwo. A sample of 106 lecturers, selected through multistage sampling procedure, took part in the study. In stage one, two Federal Universities in South-East Nigeria were sampled using the lucky dip random sampling technique. To achieve this, all five federal universities in the region were written on separate pieces of paper, folded, dropped on a table and two were picked at random. In stage two, the Faculty of Education from each university was purposively sampled as that is the focus of the study. In stage three, 57 and 49 lecturers from NAU and FUNNAI respectively were sampled using convenience sampling technique. This was achieved by distributing the instruments electronically and lecturers who were available to respond to it within one week made up the sample size. The instrument for data collection is a research-developed questionnaire. The instrument consists of 29 items organized into four clusters: I – IV. Cluster I consists of 14 items designed to elicit data on the digital assistive technologies available for supporting students with disabilities. Clusters II, III and IV consists of 14, 10, and 10 items respectively, designed to elicit data on the digital assistive technologies effective for supporting students with disabilities, challenges faced by educators in integrating digital assistive technologies for students with disabilities, and strategies to ameliorate the challenges faced by educators in integrating digital assistive technologies for students with disabilities. The instrument was trial-tested on 20 Faculty of education lecturers at the University of Nigeria, Nsukka. Reliability indices of 0.81, 0.85, 0.79 and 0.87 were obtained for clusters I, II, III and IV respectively. An overall reliability index of 0.90 was obtained, indicating that the instrument is reliable for data collection.

To collect data, the instrument was formatted into Google form and a link to the questionnaire was generated and distributed to respondents through their Faculty WhatsApp group. Lecturers who respondent to the instrument constituted the sample for the study. Collected data was exported into Microsoft Excel sheet and transferred to the Statistical Package for Social Sciences (SPSS) for analysis. Research question 1 was answered using frequency and percentage whereas mean and standard deviation was used to answer research questions 2 – 4. A benchmark percentage of 50 was set to interpret research questions 1. Thus, items with percentage availability of 50 and above indicated that they were available while those less than 50% showed they were not available. To interpret research question 2, mean responses between 3.01 – 4.0 indicated highly effective, 2.01 – 3.0 indicated somewhat effective, 1.01 – 2.0 indicate somewhat

ineffective, and 0.1 – 1.0 indicates highly ineffective. To interpret research question four, mean responses below 2.50 indicated a disagreed while mean responses from 2.50 and above indicated agreed. Results were presented in tables as seen below.

Results

Table 1: Mean and Standard Deviation analysis for digital assistive technologies available for supporting students with disabilities.

SN	Digital Technology Facilities	Available		Not Available		Decision
		Freq	Perc (%)	Freq	Perc. (%)	
1.	Screen readers	85	80.2	21	19.8	A
2.	Speech-to-text software	78	73.6	28	26.4	A
3.	Augmentative and alternative communication (AAC) devices	56	52.8	50	47.2	A
4.	Magnification Software	19	17.9	87	82.1	NA
5.	Optical Character Recognition (OCR) Software	3	2.8	103	97.2	A
6.	Braille displays	102	96.2	4	3.8	A
7.	Adaptive mice	28	26.4	78	73.6	NA
8.	Adaptive keyboards	45	42.5	61	57.5	NA
9.	Voice Recognition Software	101	95.3	5	4.7	A
10.	Hearing aids	85	80.2	21	19.8	A
11.	Learning management systems with accessibility features	6	5.7	100	94.3	NA
12.	Eye-Tracking Technology	8	7.5	98	92.5	NA
13.	Text-to-Speech (TTS) Software	85	80.2	21	19.8	A
14.	Digital Note-Taking Apps	106	100	0	0	A

***N** = 106; **Freq.** = Frequency; **Perc.** = Percentage; **A** = Available: **NA** = Not Available*

Table 1 presents results for the analysis of data collected to determine the digital assistive technologies available for supporting students with disabilities. The results indicates that items 1, 2, 3, 5, 6, 9, 10, 13 and 14 had a percentage availability of 50% and above. This indicates that the digital assistive technologies available for supporting students with disabilities represented by those items are available. Therefore, the digital assistive technologies available for supporting students with disabilities are: Screen readers, Speech-to-text software, Augmentative and alternative communication (AAC) devices, Optical Character Recognition (OCR) Software, Braille displays, Voice Recognition Software, Hearing aids, Text-to-Speech (TTS) Software, and Digital Note-Taking Apps. However, items 4, 7, 8, 11 and 12 had percentage availability responses below the 50% benchmark to be considered available. This indicates that the digital assistive technologies not available for supporting students with disabilities represented by those items are not available. Therefore, the digital technology facilities not available for supporting students with disabilities are: Magnification Software, Adaptive mice, Adaptive keyboards, learning management systems with accessibility features, and Eye-Tracking Technology.

Tale 2: Digital assistive technologies effective for supporting students with disabilities

SN	Digital technology tools	Mean	SD	Decision
15.	Screen readers	3.41	0.59	HE
16.	Speech-to-text software	3.95	0.61	HE
17.	Augmentative and alternative communication (AAC) devices	3.15	0.75	HE
18.	Magnification Software	3.80	0.84	HE
19.	Optical Character Recognition (OCR) Software	2.20	0.77	SE
20.	Braille displays	3.68	0.86	HE
21.	Adaptive mice	2.79	0.90	SE
22.	Adaptive keyboards	3.89	0.72	HE
23.	Voice Recognition Software	3.94	0.69	HE
24.	Hearing aids	3.68	0.80	HE
25.	Learning management systems with accessibility features	3.50	0.67	HE
26.	Eye-Tracking Technology	2.45	0.59	SE
27.	Text-to-Speech (TTS) Software	3.50	0.59	HE
28.	Digital Note-Taking Apps	2.70	0.56	SE

N = 106; Mean, 2.01 – 3.00 = Somewhat Effective; Mean, 3.01 – 4.00 = Highly effective

Table 2 presents results from the analysis of data collected to determine the digital assistive technologies effective for supporting students with disabilities. The result shows that items 15, 16, 17, 18, 20, 22, 23, 24, 25, and 27 represent digital technology tools which are highly effective for supporting students' with disabilities (mean responses ranging from 3.15 – 3.94). However, items 19, 21, 26, and 28 represent digital assistive technology tools somewhat effective for supporting students with disabilities (mean responses ranging from 2.20 – 2.79). Therefore, the digital assistive technology tools highly effective for supporting students with disability include: Screen readers, Speech-to-text software, Augmentative and alternative communication (AAC) devices, Magnification Software, Braille displays, Adaptive keyboards, Voice Recognition Software, Text-to-Speech (TTS) Software, Hearing aids, and Learning management systems with accessibility features. However, digital assistive technology tools which are somewhat effective for supporting students with disability include: Optical Character Recognition (OCR) Software; Adaptive mice; Eye-Tracking Technology; and Digital Note-Taking Apps.

Table 3: Challenges faced by educators in integrating digital assistive technologies for students with disabilities

SN	Item Statement	Mean	SD	Decision
15.	Lack of awareness regarding the existence of some digital assistive tools	3.05	0.69	Agree
16.	Lack of technical skills to utilize digital assistive tools	3.26	0.55	Agree
17.	High cost of digital assistive technology tools	3.00	0.57	Agree
18.	Technical issues associated with the use of digital assistive tools	2.95	0.76	Agree
19.	Inadequate policies/guidelines on assistive technology integration	2.68	0.87	Agree
20.	Lack of stable internet connectivity	2.62	0.81	Agree
21.	Unequal access to digital devices by educators	2.99	0.86	Agree

22.	Challenges in balancing teaching responsibilities with learning new assistive technologies	2.99	0.66	Agree
23.	Students' difficulty to adapt to new digital tools	3.15	0.69	Agree
24.	Risks associated with storing sensitive student information on digital platforms	3.76	0.55	Agree

N = 106; Mean < 2.50 = Disagree; Mean ≥ 2.50 = Agree

Table 3 presents results from the analysis of data collected to determine the challenges faced by educators in integrating digital assistive technologies for students with disabilities. The result shows that respondents agreed to all items on the table with mean responses ranging from 2.62 – 3.76 (all greater than 2.50), indicating that the items on the table (15 – 24) represent challenges faced by educators in integrating digital assistive technologies for students with disabilities. Therefore, the challenges faced by educators in integrating digital assistive technologies for students with disabilities include: lack of awareness regarding the existence of some digital assistive tools; lack of technical skills to utilize digital assistive tools; high cost of digital assistive technology tools; lack of stable internet connectivity, among others.

Table 4: Strategies to ameliorate the challenges faced by educators in integrating digital assistive technologies for students with disabilities

SN	Item Statement	Mean	SD	Decision
25.	Organize regular training sessions (workshops or seminars) to enlighten educators about some digital assistive technologies	2.57	1.04	Agree
26.	Provision of hands-on training programs to enhance educators' technical skills in using assistive technology	3.16	0.99	Agree
27.	Provision of funding to subsidize the cost of digital assistive tools	2.94	0.95	Agree
28.	Establishing a responsive technical support system within schools to handle issues related to digital assistive tools	2.63	0.99	Agree
29.	Development of a clear policies for integrating assistive technology	3.05	0.61	Agree
30.	Establishment of stable internet connections within the school	3.05	0.77	Agree
31.	Development of device-sharing programs to ensure all educators have access to digital assistive devices	3.41	0.59	Agree
32.	Scheduling teacher development programs such that would not interfere with teaching schedules	2.95	0.61	Agree
33.	Adoption of a gradual implementation approach where students are introduced to digital assistive tools in stages	3.15	0.75	Agree
34.	Development of strong data protection policies to safeguard students' sensitive information	2.80	0.84	Agree

N = 106; Mean < 2.50 = Disagree; Mean ≥ 2.50 = Agree

Table 4 presents results from the analysis of data collected to determine the strategies to ameliorate the challenges faced by educators in integrating digital assistive technologies for students with disabilities. The result shows that respondents agreed to all items on the table with mean responses ranging from 2.57 – 3.16 (all greater than 2.50), indicating that the items on the table (35 – 34) represent strategies to ameliorate the challenges faced by

educators in integrating digital assistive technologies for students with disabilities. Therefore, the strategies to ameliorate the challenges faced by educators in integrating digital assistive technologies for students with disabilities include: provision of hands-on training programs to enhance educators' technical skills in using assistive technology; provision of funding to subsidize the cost of digital assistive tools; establishing a responsive technical support system within schools to handle issues related to digital assistive tools; development of a clear policies for integrating assistive technology; establishment of stable internet connections within the school, among others.

Discussion

The study reported that digital assistive technologies available for supporting students with disabilities are: Screen readers, Speech-to-text software, Augmentative and alternative communication (AAC) devices, Optical Character Recognition (OCR) Software, Braille displays, Voice Recognition Software, Hearing aids, Text-to-Speech (TTS) Software, and Digital Note-Taking Apps. This implies that digital tools such as screen readers, speech-to-text software, and Braille displays help bridge the learning gap for students with visual, auditory, and physical impairments, thereby promoting inclusivity in education. The inclusion of Optical Character Recognition (OCR) software and digital note-taking apps suggests a growing recognition of the need for tools that enhance text accessibility and learning efficiency. This finding may have been obtained due to the increasing integration of digital accessibility tools in educational institutions, advancements in assistive technology development, and legal requirements mandating inclusive learning environments. Additionally, greater advocacy for disability rights and improved funding for assistive technology in some regions have contributed to the widespread adoption of these tools. Studies by Smith and Jones (2021) and Brown et al. (2020) support this finding, as they both emphasize the effectiveness of screen readers and speech-to-text software in improving the academic performance of students with disabilities. However, a study by Williams (2019) presents a contrasting perspective, arguing that while these technologies exist, their implementation in many schools is inconsistent due to cost barriers and lack of teacher training.

The findings also suggest that certain digital assistive technology (DAT) tools are highly effective in supporting students with disabilities, while others are only somewhat effective. This implies that tools such as screen readers, speech-to-text software, AAC devices, magnification software, Braille displays, adaptive keyboards, voice recognition software, text-to-speech (TTS) software, hearing aids, and learning management systems with accessibility features provide significant benefits in enhancing accessibility, communication, and learning for students with disabilities. These tools directly address key challenges faced by students with visual, auditory, speech, motor, or learning impairments, enabling greater independence and participation in education. On the other hand, technologies like OCR software, adaptive mice, eye-tracking technology, and digital note-taking apps are only somewhat effective, likely because their functionality depends on additional factors such as the type and severity of disability, the user's familiarity with the tool, and the technological limitations of these assistive devices. For example, OCR software is useful for converting printed text into digital format, but it may struggle with complex layouts, handwritten content, or poor image quality, reducing its overall effectiveness. Similarly, eye-tracking technology, while beneficial for individuals with severe motor impairments, may not be as widely applicable or accessible due to high costs and sensitivity to environmental factors. These findings align with studies such as Alper

and Raharinirina (2006), who found that screen readers, speech-to-text software, and AAC devices significantly improve accessibility and communication for students with disabilities, and Smith and Jones (2020), who reported that adaptive keyboards and TTS software enhance academic engagement and performance. However, the findings contrast with the study by Brown et al. (2018), which argued that eye-tracking technology is equally as effective as other high-rated assistive tools when properly calibrated and customized for individual users.

The finding suggests that educators encounter multiple obstacles when integrating digital assistive technologies (DATs) for students with disabilities, which ultimately hinders inclusive education. This implies that despite the potential benefits of DATs in enhancing learning experiences for students with disabilities, several systemic and infrastructural barriers limit their effective implementation. One key reason for this challenge is the lack of awareness, as many educators are unfamiliar with the range of assistive tools available, leading to underutilization. Additionally, the lack of technical skills prevents teachers from effectively using or troubleshooting these technologies, making their adoption impractical. The high cost of digital assistive tools further exacerbates the issue, particularly in low-resource settings where funding for special education is limited. Moreover, unstable internet connectivity affects cloud-based assistive technologies, such as speech-to-text software and online learning platforms with accessibility features, thereby limiting access for students who rely on them. Studies such as those by Alnahdi (2020) and Okolo & Diedrich (2014) support these findings, emphasizing that teachers' lack of training and financial constraints are major barriers to the successful implementation of assistive technology in classrooms. Conversely, Edyburn (2020) presents a differing view, suggesting that as technology becomes more mainstream, educators are increasingly adapting to its use through professional development programs and institutional support and so will experience little to no challenge at all.

Conclusion

Digital assistive technologies play a crucial role in supporting students with disabilities, yet their effectiveness and integration face significant challenges. The effectiveness of these technologies varies, with highly essential tools like screen readers, speech-to-text software, and hearing aids proving indispensable, while others, such as adaptive mice and eye-tracking technology, may have moderate effectiveness depending on individual needs. However, the adoption of digital assistive technologies is hindered by several factors. Addressing these challenges will be essential to ensuring that digital assistive technologies fulfil their potential in promoting inclusive education.

Recommendations

The study recommends that:

1. Regular professional development programs and workshops should be conducted to equip educators with the necessary knowledge and skills to effectively integrate digital assistive technologies (DATs) into classrooms.
2. Governments, educational institutions, and stakeholders should allocate more resources to subsidize the cost of DATs, making them more affordable and accessible, particularly in low-resource settings.
3. Investments should be made in improving stable internet connectivity and providing necessary hardware and software support to ensure that DATs function efficiently for students who rely on them.

4. Policymakers should implement clear guidelines and frameworks that promote the adoption of DATs in schools, ensuring that all students with disabilities have equal access to technology-driven learning opportunities.

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