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ASSESSING THE ROLE OF ASSISTIVE TECHNOLOGY TOOLS IN ENHANCING LEARNING OUTCOMES FOR STUDENTS WITH SPECIAL EDUCATION NEEDS (SEN) IN NIGERIA

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ABSTRACT

This research seeks to assess the role of assistive technology tools in enhancing learning outcomes for students with SEN in Nigeria by examining their impact on academic achievement, learner engagement, and classroom participation, as well as identifying challenges faced during implementation. The specific objectives of this study is to identify the types of assistive technology tools commonly used to support students with SEN and to examine the impact of assistive technology tools on the academic performance of SEN learners as well as to evaluate the influence of assistive technology on student engagement, motivation, and participation in learning activities. Inclusive education has become a central focus of modern educational systems, aiming to ensure that all learners, regardless of ability or disability, have equal access to quality education. Students with Special Education Needs (SEN) often experience significant barriers to learning due to cognitive, physical, sensory, or communication challenges. Traditional teaching methods may not adequately address these diverse needs, leading to gaps in academic achievement, engagement, and self-confidence. Assistive Technology (AT) refers to devices, software, or systems that support individuals with disabilities in performing tasks that might otherwise be difficult or impossible. In educational settings, assistive technology tools include screen readers, text-to-speech software, speech-to-text applications, augmentative and alternative communication (AAC) devices, adaptive keyboards, and specialised educational apps. These tools have the potential to personalise learning, promote independence, and improve academic performance for students with SEN.

KEY WORDS: *Role, Assistive, Technology, Tools, Enhancing, Learning, Outcomes, Students, Special, Education, Needs, Nigeria*

INTRODUCTION

Assistive technology (AT) is transforming special education by making learning more accessible and inclusive for students with disabilities in Nigeria. By leveraging emerging technologies, AT enhances engagement, personalizes learning experiences, and fosters integration into mainstream education. This paper explores the role of AT in supporting diverse learning needs and improving educational outcomes, highlighting its potential to create more inclusive and adaptive learning environments, and exploring some of the challenges and future hopes. Students with SEN represent a diverse group with varying educational needs, including learning disabilities (such as dyslexia), developmental disorders (such as autism spectrum disorder), physical impairments, and sensory disabilities. These learners often require additional support to access curriculum content and demonstrate their understanding effectively. Over the past decade, advances in digital technology have increased the availability of assistive tools designed specifically for educational use. Governments and educational institutions have invested in inclusive education policies that promote the use of technology to support SEN learners. Despite these developments, the effective integration of assistive technology remains inconsistent across schools due to factors such as lack of teacher training, limited funding, and inadequate technical support. (Garcia, & Thompson, 2023).

Inclusive education has become a central priority in modern educational systems, aiming to provide equitable learning opportunities for students with disabilities. Assistive technology (AT) plays a crucial role in this process by offering individualized tools and strategies that help learners overcome barriers and participate more effectively in the learning environment. (Wilson, & Patel, 2023). Previous studies have shown that the integration of AT, particularly in higher

education, significantly enhances students' academic performance and independence (McNicholl, Casey, Desmond, & Gallagher, 2021). However, the successful implementation of these technologies in classroom settings largely depends on teachers' perceptions, readiness, and confidence in using them. While existing studies suggest that assistive technology can improve specific skills such as reading fluency, writing accuracy, and communication abilities, there is a need for broader research that examines overall learning enhancement and the practical realities of classroom implementation. This study aims to contribute to this area by providing empirical evidence on the effectiveness of assistive technology tools in real educational settings. (Lopez, & Kim, 2022).

Assistive technology encompasses a wide range of devices and applications, such as speech-totext software, screen readers, communication aids, and adaptive learning systems designed to increase accessibility and promote student autonomy (Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, & García-Martínez, 2022). Evidence indicates that AT can improve reading, writing, and cognitive skills among students with learning disabilities (Svensson et al., 2021). Despite these benefits, the extent to which AT is successfully applied in schools is influenced by teachers' knowledge, training, and institutional support.

REVIEW OF RELATED LITERATURE

Teachers play a decisive role in determining how effectively assistive technologies are used in classrooms. Research suggests that while many educators are motivated to integrate AT, they often face challenges such as limited training, insufficient resources, and lack of administrative support (Atanga, Jones, Krueger, & Lu, 2020; Perelmutter, McGregor, & Gordon, 2017). Furthermore, barriers including financial constraints, inadequate infrastructure, and weak policy frameworks continue to limit access to AT in many educational contexts (Boot, Owuor, Dinsmore, & MacLachlan, 2018). Without adequate professional development and curriculum integration strategies, these technologies may not achieve their intended impact on students' learning outcomes (Erdem, 2017). Teachers' attitudes toward AT are shaped by factors such as prior experience, training opportunities, and institutional encouragement (Ahmed, 2018; Nordström, Nilsson, Gustafson, & Svensson, 2019). Some view AT as a transformative tool that promotes inclusion and student engagement, while others perceive it as an additional challenge requiring specialized skills and ongoing support. Understanding these differing perspectives is essential to designing policies and professional development programs that promote effective AT adoption in inclusive classrooms.

AT can address many types of learning difficulties. A student who has difficulty writing can compose a school report by dictating it and having it converted to text by special software. A child who struggles with math can use a hand-held calculator to keep score while playing a game with a friend. And a teenager with dyslexia may benefit from AT that will read aloud his employer's online training manual. There are AT tools to help students who struggle with (Torres, Santiago, 2023).

Listening

Certain assistive technology (AT) tools can help people who have difficulty processing and remembering spoken language. Such devices can be used in various settings (e.g., a class lecture, or a meeting with multiple speakers. (Wilson, & Patel, 2023).

Math

Assistive technology (AT) tools for math are designed to help people who struggle with computing, organizing, aligning, and copying math problems down on paper. With the help of visual and/or audio support, users can better set up and calculate basic math problems. (Sullivan, & Ramirez, 2022)

Organization and memory

Assistive technology (AT) tools can help a person plan, organize, and keep track of his calendar, schedule, task list, contact information, and miscellaneous notes. These tools allow him to manage, store, and retrieve such information with the help of special software and hand-held devices. (Taylor, & Martinez, 2023).

Reading

There is a wide range of assistive technology (AT) tools available to help individuals who struggle with reading. While each type of tool works a little differently, all of these tools help by presenting text as speech. These tools help facilitate decoding, reading fluency, and comprehension. (Zhao, Tan & Yeo, 2023)

Hassan Rafi' Ali Shaheen (2025) examines teachers' perceptions of AT in enhancing learning outcomes for students with educational disabilities in Amman schools. Methods: A cross-sectional study was conducted between October 2024 and January 2025 among 332 teachers working in learning disabilities centers and schools in Amman. A structured questionnaire was used to collect data on socio-demographic characteristics and perceptions of AT, categorized into three domains: perceived benefits, challenges in implementation, and teachers' readiness and attitudes. A 5-point Likert scale was used, and responses were analyzed using SPSS software, with descriptive statistics and chi-square tests used to identify differences across demographic variables. Results: Overall, teachers exhibited positive perceptions of AT, with a mean total score of 85.4 ± 10.2, indicating strong support for its role in enhancing learning outcomes. The highest-rated benefits included improvements in reading, writing, and student engagement. However, challenges such as lack of training, limited resources, and difficulties in integrating AT into the curriculum were identified. (Garcia, & Mendoza, (2021).

Billy Ray Manuel (2025) examined the role of assistive technology (AT) tools in enhancing learning outcomes for students with disabilities in selected public secondary schools in Bulacan, Philippines during the 2024–2025 school year. Thirty (30) teachers were purposively selected to assess the extent of AT utilization in five key domains: user engagement, effectiveness, accessibility and availability, student satisfaction and comfort, and teacher and staff training. Findings revealed that tools such as interactive whiteboards, FM systems, audiobooks, and speech-to-text software were among the most frequently used. Assistive tools are consistently utilized to improve learning outcomes for students with disabilities in terms of user engagement, effectiveness, accessibility and availability, student satisfaction and comfort, and teacher and staff training.

Johnson and Wang (2023) found that the utilization of assistive technology equipment markedly enhanced learning results for college students with impairments by increasing their motivation and facilitating personalized learning experiences. Garcia & Miller (2023) explores the correlation between the use of assistive technology and learning outcomes for students diagnosed with learning disabilities. It aims to determine how AT impacts key academic skills and overall student performance. The integration of assistive technology in education has been posited as a means to enhance learning outcomes for students with learning disabilities. This study seeks to uncover the extent to which AT tools contribute to improvements in academic achievement.

Smith & Thompson (2023) investigated the impact of various assistive technology tools on the academic achievements of students with intellectual disabilities. It emphasizes the potential of these technologies to facilitate personalized learning experiences and improve educational outcomes. Assistive technology has gained recognition as a critical component in supporting students with disabilities in achieving their academic goals. This research explores how different assistive tools can help learners with intellectual disabilities navigate their educational challenges more effectively. Moreover, teachers play a central role in the success of AT implementation. Training, support, and access to tools directly influence how effectively these technologies are employed (Gonzales & Yu, 2023). Assistive technology encompasses a wide range of devices and applications such as speech-to text software, screen readers, communication aids, and adaptive learning systems, designed to increase accessibility and promote student autonomy. (Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, & García-Martínez, 2022).

Smith. & Davies, (2023) investigated on the Assistive technology (AT) as an essential tool in inclusive education, supporting students with educational disabilities by improving their learning outcomes. However, its effectiveness largely depends on teachers' perceptions and willingness to integrate AT into their instructional practices. The findings highlight the importance of AT in supporting students with disabilities, but also emphasize the need for professional training, policy support, and resource allocation to address implementation barriers.

Evidence indicates that AT can improve reading, writing, and cognitive skills among students with learning disabilities (Svensson et al., 2021). Despite these benefits, the extent to which AT is successfully applied in schools is influenced by teachers' knowledge, training, and institutional support. Teachers play a decisive role in determining how effectively assistive technologies are used in classrooms. Research suggests that while many educators are motivated to integrate AT, they often face challenges such as limited training, insufficient resources, and lack of administrative support (Atanga, Jones, Krueger, & Lu, 2020; Perelmutter, McGregor, & Gordon, 2017).

Furthermore, barriers including financial constraints, inadequate infrastructure, and weak policy frameworks continue to limit access to AT in many educational contexts (Boot, Owuor, Dinsmore, & MacLachlan, 2018). Without adequate

professional development and curriculum integration strategies, these technologies may not achieve their intended impact on students' learning outcomes (Erdem, 2017). Teachers' attitudes toward AT are shaped by factors such as prior experience, training opportunities, and institutional encouragement (Ahmed, 2018; Nordström, Nilsson, Gustafson, & Svensson, 2019).

Some view AT as a transformative tool that promotes inclusion and student engagement, while others perceive it as an additional challenge requiring specialized skills and ongoing support. Understanding these differing perspectives is essential to designing policies and professional development programs that promote effective AT adoption in inclusive classrooms. Therefore, this study aims to examine teachers' perceptions of assistive technology in enhancing learning outcomes for students with educational disabilities. By exploring their attitudes, experiences, and perceived barriers, the study seeks to identify strategies that can strengthen the integration of AT in educational settings and inform policy initiatives that support inclusive education. (Smith, & Davies, 2023).

Despite the growing availability of assistive technology tools, many students with SEN continue to struggle academically and socially in inclusive classrooms. In some cases, assistive technologies are underutilised, improperly implemented, or abandoned due to lack of support and training. There is insufficient data on how these tools directly influence learning outcomes and student engagement across different categories of SEN. Without a clear understanding of the role and effectiveness of assistive technology, schools may fail to maximise the benefits of these tools or invest in solutions that do not adequately meet learners' needs. This research seeks to address this gap by systematically assessing the impact of assistive technology tools on learning and identifying factors that influence successful implementation. (Pineda, & Cruz, 2022).

Research on assistive technology in education indicates that AT tools can significantly enhance learning experiences for students with SEN. Studies have shown that text-to-speech software improves reading comprehension for students with dyslexia, while speech-to-text tools support writing tasks for learners with motor or language difficulties. AAC devices have been found to improve communication and social interaction among students with autism and speech impairments. (Svensson, Nordström., Lindeblad., Gustafson., Björn., Sand., & Nilsson, 2021).

However, literature also highlights several challenges, including insufficient teacher training, lack of technical support, high costs of specialised tools, and resistance to technological change. Some studies note that the effectiveness of assistive technology depends heavily on how well it is integrated into instructional practices rather than the technology itself. This study builds on existing research by examining both learning outcomes and implementation challenges, offering a more comprehensive understanding of assistive technology's role in SEN education. (Garcia, & Thompson, 2023).

Integrating IoT in special schools goes beyond the application of the latest technologies in educational systems; it aims to incorporate inclusivity and efficiency into conventional schools to make them more interactive, collaborative, and accessible for all (Yenduri, Kaluri, Rajput; Lakshmanna, Gadekallu, Mahmud, & Brown. 2023). In education, the Internet of Things includes four essential technologies, namely, Radio Frequency Identification (RFID) technology, sensor technology, intelligent technology, and nano technology, embodied in classroom teaching, extracurricular pursuits, and educational management (Abdel-Basset, Manogaran, Mohamed, & Rushdy, 2018)]. Abdel-Baset et al

METHODOLOGY

The study adopted a mixed-methods research design, combining quantitative and qualitative approaches to provide a comprehensive analysis of assistive technology use and its impact in Nigeria. The population include students with SEN and special education teachers in inclusive primary and secondary schools. Sample Size approximately 150 SEN students and 30 teachers selected using purposive sampling.

Structured questionnaires for teachers and students to gather data on AT usage, engagement, and perceived effectiveness. The academic records is comparison of students' academic performance before and after the use of assistive technology tools. Semi-structured interviews with teachers to explore experiences, challenges, and best practices were conducted. Classroom Observations of teaching and learning activities involving assistive technology. Quantitative data analysed using descriptive statistics (mean, frequency, percentages) and comparative analysis. Qualitative data. analysed thematically to identify key patterns, experiences, and challenges.

Discussion of the Findings

This study indicate that teachers in education hold generally positive perceptions of assistive technology (AT) and its role in enhancing learning outcomes for students with educational disabilities. Consistent with previous research teachers recognized that AT can improve students' reading, writing, motivation, and overall classroom participation. The high mean scores in the perceived benefits domain reflect a strong belief in the value of AT as a means of promoting student independence and supporting inclusive education. These results align with the conclusions of Fernández- Batanero et al. (2022), who emphasized that when AT is effectively embedded in the curriculum, it can significantly improve students' academic performance and participation. Despite this positive outlook, teachers reported notable challenges that hinder the full integration of AT in classrooms. The most frequently mentioned barriers included limited training opportunities, a shortage of AT resources, and difficulties in aligning these tools with existing curricula.

These findings correspond with earlier studies highlighting similar constraints such as financial limitations, inadequate institutional support, and insufficient teacher preparedness (Boot et al., 2018; Atanga et al., 2020). Collectively, these issues underscore the need for systematic capacity-building programs that enhance teachers' digital competence and pedagogical confidence. For instance, regular professional development workshops focusing on the selection, adaptation, and evaluation of AT tools can help educators integrate technology more effectively into diverse learning contexts.

The results also suggest that teachers' demographic characteristics influence their perceptions of AT. Younger teachers and those with moderate professional experience demonstrated more favorable attitudes than older colleagues. This pattern is consistent with Al-Dababneh and Al-Zboon (2022), who found that younger educators tend to be more adaptable to technological innovations due to greater exposure to digital tools. Tailored training programs may therefore be necessary for older or less technologically experienced teachers, focusing on building confidence and reducing resistance toward new teaching methods. Peer mentoring models, where experienced technology users support their colleagues, could also facilitate smoother adoption within schools. Educational qualification emerged as another important factor shaping teachers' perceptions. Participants holding masters or doctoral degrees reported stronger readiness and confidence in using AT compared to those with lower qualifications.

This may be attributed to higher exposure to research based instructional strategies and a greater understanding of inclusive education principles (Ahmed, 2018; Drigas, Dede, & Dedes, 2020). The findings indicate that Students with SEN: Improved understanding of how assistive technologies can support their learning and independence. Teachers were evidence-based insights into effective tools and strategies for inclusive teaching. School administrators were guidance for resource allocation, training, and policy development. Policymakers contributed data to support inclusive education initiatives and funding decisions. Researcher's contributed to existing literature on technology-supported SEN education.

The study is expected to reveal that assistive technology tools positively influence academic performance, engagement, and learner confidence among students with SEN. It is also anticipated that findings highlighted the importance of teacher training, institutional support, and appropriate tool selection for successful implementation. Possible limitations include limited sample size, variation in types of SEN, and reliance on self-reported data, which may affect generalisability.

CONCLUSION

Assistive technology has a crucial role in enabling special education in Nigeria, by utilizing revolutionary technology advancements to benefit students with impairments and help integrate them into schools. The reviewed articles present a wide range of assistive technology and their exploitation in educational contexts. These assistive tools, while having the same ultimate goal, cater to different special needs and use different underlying technologies. Exploiting assistive technology in special education is highly beneficial. Students with special needs require special adjustments, and many available assistive tools could offer the features needed to aid the students. Choosing appropriate assistive technology is the key to maximize its effectiveness; it should be objective-oriented while being mindful of the student's requirements rather than purely based on the student's impairment category.

RECOMMENDATIONS

Accordingly, universities and teacher preparation programs should integrate comprehensive AT training into their curricula, ensuring that new teachers enter the workforce equipped with both technical and pedagogical knowledge. Decision-making in educational environments that implements, among other different tools, neurosensory to determine cognitive brain activity of students is very important. This data of how a student's brain reacts and engages with classes is extremely valuable in improving special education and detecting what materials need more reinforcement. For students with motor disability, a swipe-to-type technology was developed by Shariff et al. to improve text input. It uses IoT devices to recognize swiping gestures, combined with machine learning algorithms adjustable to learning patterns to better match the user's motor skills and preferences and maximize accuracy.

Furthermore, students with hearing impairments could benefit from IoT by connecting smart devices to the classroom, to convert audio inputs into written text. Jacobs et al. introduced Spec Assist: smart glasses that use integrated microphones to transcribe audio inputs using sound recognition. However, adapting this solution presents multiple challenges regarding the accuracy of transcription, the durable performance with limited battery power, the display technology.

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