British Journal of Teacher Education and Pedagogy
ISSN: 2755-1482
DOI: 10.32996/bjtep
Journal Homepage: www.al-kindipublisher.com/index.php/bjtep

BJTEP
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Improving Learning Outcomes of Students through Technology Integration in Special Needs Education Programs

Zaisa Lustica[1], Sherelyn S. Sapio[2], Ritchelle S. Paredes[3], Mariel Jean M. Bejagan[4], Mary Fe L. Gardose[5] Niña Rozanne T. Delos Reyes[6], Raymond C. Espina[7]

[1234567]*Cebu Technological University-Main Campus, Philippines*
Corresponding Author: Zaisa Lustica, **E-mail**: zaisasoberano@gmail.com

| ABSTRACT

This study aimed to improve the learning outcomes of students with special needs by examining the integration of technology in Special Education (SPED) programs at Lamac Elementary School. It focused on identifying the types of digital tools used by SPED and receiving teachers, evaluating the perceived effectiveness of these tools, and assessing the challenges encountered in their implementation. A descriptive-correlational research design was employed, and data were collected through a researcher-made questionnaire administered to 30 purposively selected teachers. Statistical tools such as frequency counts, weighted mean, standard deviation, and Pearson Product-Moment Correlation were used to analyze the data. Findings revealed that while teachers frequently use basic digital tools such as mobile devices and classroom management apps, there is a notable lack of availability and usage of specialized assistive technologies, particularly for students with speech, mobility, auditory, and cognitive impairments. Additionally, a significant challenge identified was the limited training of SNED teachers in the use of assistive technology. Despite the presence of digitally literate teachers, the effective integration of technology is hindered by inadequate resources, a lack of administrative support, and resistance to change among some educators. The study underscores the importance of sustained investment in digital infrastructure, ongoing professional development, and collaborative efforts among stakeholders to create inclusive, technology-supported learning environments for students with special needs. Based on the findings, an action plan was developed to address the five lowest-rated areas, including improving access to assistive tools and providing targeted teacher training.

| KEYWORDS

Special Education, Inclusive Education, Assistive Tools, descriptive-Correlational, Philippines

| ARTICLE INFORMATION

ACCEPTED: 28 November 2025 **PUBLISHED:** 17 December 2025 **DOI:** 10.32996/bjtep.2025.4.9.1

Introduction

The integration of technology into classroom instruction has become increasingly essential in meeting the evolving needs of modern learners and enhancing the quality of education. While traditional teaching methods have long served as the foundation, they are no longer enough in today's digital age, where students seek flexible, interactive, and accessible learning environments and where information continues to grow at an unprecedented rate(Adera, 2025; Scully et al., 2021; Ulanday et al., 2021). Digital tools and platforms improve engagement and learning efficiency by providing teachers and students access to advanced resources such as online learning environments, digital libraries, and interactive applications(Adeshina, 2024; Josué et al., 2023; Rafiq et al., 2024). These innovations enable personalized and self-paced learning experiences that cater to diverse backgrounds, abilities, and learning styles (Karagianni & Drigas, 2023). Likewise, technology promotes communication and collaboration through cloud-based

systems, online forums, and virtual conferencing, supporting dynamic learning environments beyond the traditional classroom walls (Anitha, 2025; Matthew et al., 2021; Qasim, 2024). Nowadays, technology has demonstrated significant potential for improving the educational experiences of learners with special needs (Iskakova, 2023). According to Oyedokun (2025), assistive and adaptive technologies help reduce learning gaps, respect individual differences, and offer support aligned with various learning styles. However, the full benefits of technology integration in special education remain hindered by a range of challenges. As the researchers have observed, many schools face funding limitations that restrict the acquisition of specialized devices and software, resulting in unequal access and disparities in learning opportunities. Teachers also often lack sufficient training or professional development, which affects their ability to implement assistive technologies effectively and to stay up to date with rapidly evolving digital tools (Christiana Obadimeji & Olasumbo Oredein, 2022).

Despite these challenges, evidence indicates that technology can significantly improve learning outcomes for students with disabilities. Assistive communication devices, speech-to-text applications, and other specialized digital tools enable learners with impairments to participate more actively and independently in educational activities (Fernández-Batanero et al., 2022). Adaptive learning platforms further promote inclusive education by personalizing content based on individual needs and supporting differentiated instruction that accommodates diverse skills and learning styles (Contrino et al., 2024). However, effective technology integration depends on sufficient administrative support, ongoing professional development, and equal access to technological resources—conditions that are not always consistently available in schools (Brennan et al., 2024; Basham et al., 2024; U.S. Department of Education, 2024).

In the Philippines, inclusive education is supported by national policies and initiatives aimed at providing equitable learning opportunities for all students, including those in Special Education (SPED) and Special Needs Education (SNED) programs. The Inclusive Education for All program exemplifies the country's efforts to equip educators, parents, and school administrators with the necessary knowledge and skills to address learner diversity. Despite these efforts, ongoing issues continue to challenge SNED implementation. Espeño et al. (2024) noted that funding shortages, insufficient teacher training, inflexible curricula, societal stigma, and poor infrastructure hinder the delivery of quality education for learners with special needs. Many schools lack essential facilities, instructional materials, and assistive technologies, limiting teachers' ability to offer individualized support. Additionally, the limited availability of specialized training opportunities has left many educators without the skills needed to effectively meet the unique needs of SNED learners, leading to teacher burnout and shortages in the field (Woulfin & Jones, 2021). Although Filipino teachers generally exhibit foundational digital literacy, studies show that deeper engagement with advanced digital tools remains necessary to maximize instructional effectiveness and foster more interactive and inclusive learning environments (Rathnasekara et al., 2025). Structural barriers, insufficient preparation programs, and limited access to assistive resources continue to obstruct technology adoption in SPED settings, ultimately affecting students' opportunities for academic growth and participation.

Given these ongoing challenges, it is crucial to analyze how technology is currently used in SNED classrooms and its impact on learning outcomes.

2. Purpose of the Study

This study assessed teachers' use of assistive tools when delivering instruction to learners with special educational needs (LSENs) at an Elementary School in Cebu during the school year 2024–2025. Specifically, this sought to determine the assistive tools that were available for LSENs as perceived by teachers; examine the respondents perceived frequency of using assistive tools for learners with visual, hearing, cognitive, learning, mobility, and speech or communication impairments; and evaluate the perceived effectiveness of these tools across the same categories of disabilities. Additionally, the study aimed to identify the challenges teachers faced when using assistive tools in SNED instruction, particularly related to a lack of training and digital literacy, limited access to technology, resistance to change, and institutional or administrative barriers. Lastly, it sought to determine whether a significant correlation existed between the availability of assistive tools and teachers perceived frequency and effectiveness of their use in teaching learners with special needs.

3. Methodology

This study employed a descriptive-correlational research design to examine the use of assistive tools in special education, assess their perceived effectiveness, and identify the challenges teachers face when integrating these technologies. A descriptive approach was used to systematically present data on the types of assistive tools used, their effectiveness, and the challenges teachers encountered. Meanwhile, a comparative approach was used to determine whether significant differences existed across demographic profiles in digital tool usage, effectiveness, and challenges. Purposive sampling was used in selecting 30 Special Needs Education teachers and receiving teachers, which was considered appropriate to ensure meaningful insights while maintaining the feasibility and inclusivity of this study.

This study used a research-developed questionnaire that underwent a pilot test to ensure reliability and validity, with Cronbach's alpha of 0.808 indicating excellent internal consistency. The questionnaire was designed to gather data on the use of assistive tools in special education (SNED) instruction. It aimed to assess the types of digital tools used by SNED teachers, evaluate

their effectiveness in enhancing learning, and identify the challenges educators faced in integrating these technologies into their teaching practices.

The study was conducted in three phases. First, a formal request was made to the school principal for permission to conduct the research with the identified teacher respondents. After the approval, the data collection phase began using the survey questionnaire to gather information about the assistive tools used in SNED instruction, their perceived effectiveness in supporting student learning, and the challenges teachers faced when integrating these tools. After collecting the data, the responses were organized, tabulated, and analyzed. The data gathered were analyzed using frequency, weighted mean, standard deviation, and Pearson Product-Moment Correlation.

4. Results and Discussions

This section presents, analyzes, and interprets the data gathered.

4.1 Availability of Assistive Tools Used in School as Perceived by the Teachers

The tools are categorized by the types of impairments they are designed to support—visual, hearing, cognitive/learning, mobility, and speech/communication.

Table 1
Availability of Assistive Tools in School as Perceived by the Teachers

Type of Impairments	Type of Tools	F	%
For Learners with Visual Impairments	Google Talkback (Android phones)	5	27.78
	Screen Readers	0	0.00
	Braille Slates and Styluses	0	0.00
	Braille Tools	1	5.56
	Voice Dream Reader	1	5.56
	Braille Embossers Text-to-Speech Apps	9	50.00
	Refreshable Braille Displays	2	11.11
For Learners with Hearing Impairments	Hearing Aids	0	0.00
	Speech-to-Text and Captioning Tools	13	14.61
	Google Live Transcribe	11	12.36
	Otter.ai	6	6.74
	Sign Language Support	11	12.36
	Filipino Sign Language (FSL) apps	8	8.99
	Interpreter services via NGOs	2	2.25
	Visual Schedules and Timers	19	21.35
	Commonly used in SNED centers (e.g., visual cards, Time Timer apps)	19	21.35
For Learners with Cognitive or Learning Disabilities	Text-to-Speech and Speech-to-Text Tools	16	26.23
	Google Dictation	8	13.11
	Microsoft Immersive Reader	4	6.56
	Learning Apps	14	22.95
	Ghotit or Grammarly	12	19.67
	Khan Academy, Quizlet, and Duolingo	7	11.48
For Learners with Mobility Impairments	Wheelchair-Compatible Workstations	0	0.00
	Alternative Input Devices	2	5.56
	Adaptive Keyboards and Mice	6	16.67
	Touchscreen or voice-command tablets	7	19.44
	Smartphones/Tablets with Accessibility Features	21	58.33
For Learners with Speech or Communication Difficulties	AAC (Augmentative and Alternative Communication) Tools	5	11.90
	Picture Exchange Communication System (PECS)	19	45.24
	Locally made communication boards	18	42.86

Table 1 shows the availability of assistive tools in schools, categorized by type of impairment, as perceived by receiving teachers. For learners with visual impairments, the most commonly available tool reported was Braille Embossers Text-to-Speech Apps (9 or 50%) of the respondents, followed by Google Talkback follows/Android Phones (5 or 27. 78%), refreshable Braille

displays (2 or 11.11%), Braille tools (1 or 5.56%), and Voice Dream Reader (1 or 5.56%). No commonly available were Screen readers, Braille Slates, and Styluses. The data suggest that while basic screen-access tools are relatively available, more advanced and specialized tactile tools, such as Braille Slates and styluses, remain limited.

For learners with hearing impairments, Visual Schedules and timers were commonly used in SNED centers, such as visual cards and time-timer apps, which were the most frequently reported, each noted by 19 or 21.35% of respondents. Speech-to-Text and Captioning Tools (13 or 14.61%), Google Live Transcribe and Sign Language Support, each noted (11 or 12. 36%), also show a moderate presence. However, Filipino Sign Language (FSL) apps were less available (8 or 8.99%), such as Otter. AI transcription tools (6 or 6.74%) and Interpreter services via NGOs were scarce (2 or 2.25%). Notably, Hearing Aids received a zero-availability response, indicating a critical gap in access to communication for students who rely on hearing aids.

For learners with cognitive or learning disabilities, the most commonly used tools were Text-to-Speech and Speech-to-Text Tools (16 or 26.23% of respondents). Tools such as Learning Apps (14 or 22.95%) and Grammarly or Ghotit (12 or 19.67%) were also available. Meanwhile, Google Dictation (8 or 13.11%), content-based apps like Khan Academy, Quizlet, and Duolingo (7 or 11.48%), and Microsoft Immersive Reader (4 or 6.56%) were noted less frequently. This distribution reflects a balanced availability of both digital and low-tech learning supports; however, more widespread access to adaptive literacy tools may still be necessary.

For learners with mobility impairments, the most available tools were smartphones or tablets with accessibility features, mentioned by 58.33% of respondents. Touchscreen or voice-command tablets (7 or 19.44%), Adaptive Keyboards and Mice (6 or 16.67%), and Alternative Input Devices (2 or 5.56%) were less frequently noted. Notably, Wheelchair-Compatible Workstations received no availability response. These results suggest that mainstream mobile technology with built-in accessibility is more prevalent than specialized hardware or furniture modifications.

For learners with speech or communication difficulties, the Picture Exchange Communication System (PECS) was the most frequently reported tool, used by 19 respondents (45.24%), followed closely by Locally Made Communication Boards, used by 18 respondents (42.86%). Only (5 or11.90%) noted the presence of AAC (Augmentative and Alternative Communication) tools, indicating limited access to more sophisticated speech-generation devices.

The findings reveal that the availability of assistive tools across impairments varies significantly, with more common and cost-effective tools (e.g., mobile apps, communication boards, screen readers) being more accessible than specialized or high-tech equipment (e.g., refreshable Braille displays, AAC devices, captioning tools).

The data suggest that while schools are making efforts to integrate assistive technologies, a gap remains in access to advanced, specialized, or professionally supported tools, especially for learners with visual, hearing, and speech impairments. This highlights the need for increased investment, training, and policy support to ensure that all learners, regardless of disability type, have equitable access to tools that meet their learning and communication needs.

The present study's findings align with the systematic review of a few which identified that high costs, limited awareness, inadequate assessment, and weak policy frameworks often constrain access to assistive technology for individuals with intellectual disabilities (Boot, Ghosh, et al., 2021; Boot, Kahonde, et al., 2021; Rasouli et al., 2023). These barriers indicate that the presence of assistive tools alone is insufficient to ensure equitable access, reinforcing the need for comprehensive strategies that address financial, informational, and institutional gaps.

This pattern reflects a systemic issue in many Philippine SNED schools, where assistive technologies exist but remain insufficiently available or underutilized due to resource constraints, a lack of training, or maintenance problems. Campado et al. (2023a) documented similar findings, noting that while SPED teachers value interactive multimedia and high-tech assistive devices, many of these tools are scarce or damaged, which adversely affects instruction quality. They also highlighted challenges like inadequate resources and insufficient staff training as barriers to effective technology integration. Complementing this, studies identified issues with availability and accessibility, as well as the need for specialized training in the use of assistive technology within Philippine SNED centers (Kilag et al., 2023; Reyes, 2023a).

4.2 Frequency of Using Assistive Tools

This section presents the frequency of using assistive tools in SNED instruction, categorized into five areas based on the type of learners: (1) for learners with visual impairments; (2) for learners with hearing impairments; (3) for learners with cognitive or learning disabilities; (4) for learners with mobility impairments; and (5) for learners with speech or communication difficulties.

4.2.1 Use of Assistive Tools for Learners with Visual Impairments

The effective use of assistive technologies is crucial to providing equitable learning opportunities for learners with visual impairments. These tools help reduce barriers to access, improve communication, and foster independence in learning.

Table 2

Frequency of Using Assistive Tools in SNED Instructions for Learners with Visual Impairments

S/N	For Learners with Visual Impairments	Mean	SD	Category
1	I use screen readers to support students with visual impairments.	2.80	1.24	Sometimes
2	I use braille tools to assist students with visual impairments.	2.87	1.28	Sometimes
3	I provide braille slates and styluses for students with visual impairments.	2.67	1.18	Sometimes
4	I use refreshable braille displays to teach students with visual impairments.	3.23	1.14	Sometimes
5	I utilize braille embossers and text-to-speech apps for students with visual impairments.	3.20	1.40	Sometimes
6	I use Google Talkback on Android phones to assist visually impaired students.	2.83	1.17	Sometimes
7	I use Voice Dream Reader to support students with visual impairments.	2.95	0.97	Sometimes
	Overall	**2.94**	**0.90**	**Sometimes**

Legend: 1.00-1.79 Never; 1.80-2.59 Rarely; 2.60-3.39 Sometimes; 3.40-4.19 Often; 4.20-5.00 Always

Table 2 shows the frequency of using assistive tools in SNED instruction for learners with visual impairments, as rated by the receiving teachers. The overall mean score was 2.94, which falls within the **"Sometimes"** category, indicating that these tools are not used regularly or consistently in teaching practices.

Among the listed tools, the most frequently used was refreshable braille displays, with a mean of 3.23, still only categorized as "Sometimes". This suggests that even the highest-rated tool was not used "Often" or "Always" by most teachers. Similarly, Braille embossers and text-to-speech apps (M = 3.20) and Voice Dream Reader (M = 2.95) were also used only occasionally.Other tools, such as screen readers (M = 2.80), Google Talkback (M = 2.83), and braille tools (M = 2.87), were all rated in the lower end of the "Sometimes" range, further emphasizing their infrequent use in SNED classrooms. The least frequently used tool was braille slates and styluses, with a mean of 2.67, still within the same category but close to the "Rarely" threshold.

The consistent "Sometimes" rating across all items reveals a pattern of minimal or occasional integration of assistive tools for visually impaired learners. No tool reached the level of "Often" (3.40–4.19) or "Always" (4.20–5.00), indicating that these assistive technologies, while known or available to some extent, are not actively or routinely used in daily instructional practices.

This table underscores the need to strengthen both the availability and daily use of these tools. The fact that even widely accessible tools like Google Talkback are only used occasionally suggests either a lack of training, limited tool integration in the curriculum, or minimal learner demand, all of which require further attention from administrators and policymakers.

Campado et al. (2023) observed that although assistive technologies are perceived as valuable and motivational for learners, their effective integration into instruction is often hindered by factors such as limited training, resource inadequacy, and technological challenges. Charcos et al. (2025) found that the consistent use of assistive tools is linked to better learning outcomes, but this depends heavily on teacher readiness, ongoing training, and the availability of resources in Philippine schools. Similarly, Fernández-Batanero et al. (2022) emphasized that for students with visual impairments, regular and adequate use of assistive technologies, such as screen readers and braille devices, significantly improves academic engagement; however, barriers remain due to insufficient teacher training and systemic support.

4.2.2 Use of Assistive Tools for Learners with Hearing Impairments

Providing accessible instruction to learners with hearing impairments requires specialized tools and strategies to facilitate communication and participation in classroom activities. Assistive technologies such as hearing aids, captioning systems, and sign language applications enable teachers to bridge communication gaps and promote inclusivity.

Table 3
Frequency of Using Assistive Tools in SNED Instructions for Learners with Hearing Impairments

S/N	For Learners with Hearing Impairments	Mean	SD	Category
1	I use hearing aids to support students with hearing impairments.	4.07	0.83	Often
2	I use speech-to-text and captioning tools in my teaching.	3.63	1.16	Often
3	I use Google Live Transcribe to assist students with hearing impairments.	3.83	1.05	Often
4	I use Otter.ai to provide transcription support for students.	3.50	1.20	Often
5	I incorporate sign language support during lessons.	3.10	1.32	Sometimes
6	I use Filipino Sign Language (FSL) apps to communicate with students.	3.85	0.77	Often
7	I coordinate with interpreter services provided by NGOs to support students with hearing impairments.	3.73	1.06	Often
	Overall	**3.67**	**0.87**	**Often**

Legend: 1.00-1.79 Never; 1.80-2.59 Rarely; 2.60-3.39 Sometimes; 3.40-4.19 Often; 4.20-5.00 Always

Table 3 presents the frequency of use of assistive tools among learners with hearing impairments, as reported by the receiving teachers. The overall mean score is 3.67, which falls within the **"Often"** category, indicating that assistive technologies for learners with hearing loss were frequently used in SNED instruction.

Among the tools listed, the Filipino Sign Language (FSL) apps received the highest frequency rating (M = 3.85), followed closely by Google Live Transcribe (M = 3.83) and coordinating with interpreter services provided by NGOs (M = 3.73). These results show that teachers are actively utilizing digital and community-supported solutions to bridge communication gaps in their classrooms. Hearing aids, a traditional support tool, were also frequently used (M = 4.07), the only item in this category to approach the "Always" threshold. This high frequency reflects the essential role of hearing aids in supporting auditory access for learners with hearing loss. It suggests that learners already come to school with personal devices that teachers are trained to work with.

Other tools, such as speech-to-text and captioning tools (M = 3.63) and Otter.ai (M = 3.50), were also frequently used, indicating that transcription technologies are gaining traction in inclusive classrooms. These tools help ensure that spoken content is made accessible in text format, a key requirement for learners who rely more on visual information. However, one item stood out with a slightly lower rating- the sign language support during lessons (M = 3.10), which fell into the "Sometimes" category. This suggests that while assistive technologies are actively used, direct use of sign language may not be consistently integrated in classroom teaching, possibly due to a lack of teacher fluency or formal training in sign language. The consistent use of both traditional tools (hearing aids) and modern digital solutions (captioning apps, live transcription, and FSL apps) reflects a strong effort to accommodate learners with hearing impairments.

Some literature supports these findings, emphasizing the benefits and challenges of using such assistive technologies in classrooms. Otter.ai, a widely used AI-powered transcription tool, has been shown to enhance note-taking and accessibility in both physical and virtual classrooms by providing real-time transcription, summaries, and collaboration features, which help learners with hearing impairments follow lessons effectively (Basu, 2025; Chudaeva & Yuen, 2025). Studies have emphasized that tools like Google Live Transcribe and Otter.ai facilitate inclusion by making spoken content visually accessible, thereby improving learner engagement and comprehension (Nacheva, 2024; Williams, 2024).

4.2.3 Use of Assistive Tools for Learners with Cognitive and Learning Disabilities

Learners with cognitive and learning disabilities benefit from a range of assistive tools that provide structure, simplify learning tasks, and promote independent skill development. These tools, both traditional and digital, play a vital role in enhancing students' comprehension, communication, and overall classroom engagement. Table 4 presents the frequency with which teachers use assistive technologies for learners with cognitive and learning disabilities.

Table 4
Frequency of Using Assistive Tools in SNED Instructions for Learners with Cognitive or Learning Disabilities

S/N	For Learners with Cognitive or Learning Disabilities	Mean	SD	Category
1	I use visual schedules and timers to support students with cognitive or learning disabilities.	3.63	0.85	Often
2	I use tools commonly found in SPED centers, such as visual cards and Time Timer apps.	3.83	1.18	Often
3	I use text-to-speech and speech-to-text tools to assist students.	4.57	0.63	Always
4	I use Google Dictation to help students with writing and communication tasks.	3.27	1.20	Sometimes
5	I use Microsoft Immersive Reader to support students in reading comprehension.	3.03	1.07	Sometimes
6	I use learning apps to reinforce lessons for students with cognitive or learning needs.	3.73	0.94	Often
7	I use writing and grammar tools like Ghotit or Grammarly to assist students.	3.92	0.68	Often
8	I incorporate platforms like Khan Academy, Quizlet, and Duolingo in my teaching for students with cognitive or learning disabilities.	3.15	0.96	Sometimes
	Overall	**3.64**	**0.60**	**Often**

Legend: 1.00-1.79 Never; 1.80-2.59 Rarely; 2.60-3.39 Sometimes; 3.40-4.19 Often; 4.20-5.00 Always

Table 4 shows that the most frequently used tools were text-to-speech and speech-to-text, with a mean score of 4.57, which falls within the "Always" category. This means that many teachers regularly use this tool to help learners read and write effectively. Other tools often used include Ghotit or Grammarly (mean = 3.92), visual tools such as cards and Time Timer apps (mean = 3.83), learning apps (mean = 3.73), and visual schedules and timers (mean = 3.63). These are commonly used to help learners organize their tasks, improve focus, and deepen their understanding of lessons.

Meanwhile, some tools were used occasionally, such as Google Dictation (mean = 3.27), Khan Academy, Quizlet, and Duolingo (mean = 3.15), as well as Microsoft Immersive Reader (mean = 3.03). The results show that while the tools were available, they were not yet fully used in daily instruction—possibly due to lack of training, time, or familiarity. The overall mean score of 3.64 indicates that teachers **Often** use assistive tools to support learners with cognitive or learning challenges.

This showed that teachers are making a strong effort to meet the needs of these learners. However, it also highlights the need for more training and support so that less-used tools can become integral to daily teaching. When teachers are more confident and better equipped, they can use a broader range of tools, which may lead to better learning outcomes for students with special needs.

AI-enhanced platforms, such as Khan Academy, Duolingo, and Quizlet, utilize adaptive algorithms that tailor instructional content to individual learner styles and needs, fostering personalized and inclusive education (Dey, 2024; Satti et al., 2025). These platforms engage learners through multimedia, gamification, and immediate feedback, which improve motivation and learning outcomes. However, successful implementation relies on teacher training and awareness to fully utilize these technologies in classrooms, underpinning the need for ongoing professional development to enhance the frequency and effectiveness of tool use (Mohebbi, 2025; Yılmaz, 2024).

4.2.4 Use of Assistive Tools for Learners with Mobility Impairments

Learners with mobility impairments require assistive tools that help them reduce barriers to learning and actively participate in classroom activities. Technologies such as adaptive devices, accessible workstations, and tablets with built-in features support inclusivity by fostering independence and ease of access. Table 5 presents the frequency with which teachers use various assistive tools designed for learners with mobility impairments.

Table 5
Frequency of Using Assistive Tools in SNED Instructions for Learners with Mobility Impairments

S/N	For Learners with Mobility Impairments	Mean	SD	Category
1	I provide wheelchair-compatible workstations for learners with mobility impairments.	4.37	0.81	Always
2	I use alternative input devices to support learners with limited motor control.	3.53	1.31	Often
3	I use adaptive keyboards and mice to assist learners with mobility challenges.	3.67	1.15	Often
4	I provide touchscreen or voice-command tablets for ease of use.	3.37	1.03	Sometimes
5	I use smartphones or tablets with built-in accessibility features to support students with mobility impairments.	3.07	1.14	Sometimes
	Overall	**3.60**	**0.75**	**Often**

Legend: 1.00-1.79 Never; 1.80-2.59 Rarely; 2.60-3.39 Sometimes; 3.40-4.19 Often; 4.20-5.00 Always

Table 5 illustrates the frequency with which assistive tools were used to support students with mobility impairments. The most used tool is wheelchair-compatible workstations, which received a mean score of 4.37, falling within the "Always" category. This suggests that schools ensure that learners using wheelchairs have proper seating and desk arrangements.

Other tools often used included adaptive keyboards and mice (mean = 3.67) and alternative input devices, such as switches or joysticks (mean = 3.53). These were essential for learners who struggle with using standard computer equipment. Meanwhile, some tools were used only occasionally. For example, touchscreen or voice-command tablets had a mean score of 3.37, and smartphones or tablets with built-in accessibility features had a mean of 3.07. This suggests that while these devices are beneficial, they are not yet being regularly utilized by all teachers. The overall mean score is 3.60, which falls within “Often,” indicating that most teachers do try to use these tools to support learners with mobility challenges.

This suggests that while many teachers are making efforts to provide proper support, there is still room for improvement in the use of mobile devices and built-in accessibility features. With increased awareness, training, and resources, these tools can be utilized more effectively in everyday teaching to enhance access and independence for learners with mobility impairments.

Oyedokun (2025) emphasized that assistive technologies, such as adaptive keyboards and alternative input devices, enhance students' ability to participate fully in educational activities; however, resource constraints and insufficient teacher training often limit accessibility. A study by Danemayer and Lim (2024) documented that while schools strive to provide physical accommodations, such as wheelchair-accessible workstations, the integration of mobile and voice-command technologies remains suboptimal due to limited awareness and insufficient support infrastructure.

4.2.5 Use of Assistive Tools for Learners with Speech or Communication Difficulties

Learners with speech or communication difficulties benefit greatly from tools that enhance their ability to express themselves and participate in classroom interactions. Assistive technologies such as AAC devices, communication boards, and picture-based systems provide alternative means of communication, helping learners overcome barriers and engage more effectively in learning. Table 6 presents the frequency with which teachers use assistive tools designed for learners with speech or communication difficulties.

Table 6
Frequency of Using Assistive Tools in SNED Instructions for Learners with Speech or Communication Difficulties

S/N	For Learners with Speech or Communication Difficulties	Mean	SD	Category
1	I use AAC (Augmentative and Alternative Communication) tools to support students with speech or communication difficulties.	2.60	1.25	Sometimes
2	I use the Picture Exchange Communication System (PECS) in my SPED classes.	3.07	1.31	Sometimes
3	I use locally made communication boards available in SPED schools to assist students with communication challenges.	2.90	1.03	Sometimes
	Overall	**2.86**	**1.07**	**Sometimes**

Legend: 1.00-1.79 Never; 1.80-2.59 Rarely; 2.60-3.39 Sometimes; 3.40-4.19 Often; 4.20-5.00 Always

As shown in Table 6, the overall mean was 2.86, which falls within the **"Sometimes"** category. This shows that these tools were not yet being used regularly in SNED instruction. Among the listed tools, the most used was the Picture Exchange Communication System (PECS), with a mean of 3.07. Although this was the highest among the three, it still only falls under the "Sometimes" category. This suggests that while PECS is known and used, it has not become a consistent part of classroom practice.

AAC tools, which include devices or apps that help learners communicate without speaking, had a mean of 2.60, just on the edge of the "Rarely" category. This suggests limited use, even though such tools are essential for learners with more severe communication needs. Locally made communication boards also received a "Sometimes" rating, with a mean of 2.90, suggesting that these low-cost alternatives are used occasionally but not as widely as they could be. The low usage of speech-related assistive tools suggests a gap in either access, training, or awareness. These tools are critical in helping non-verbal or minimally verbal learners express themselves and participate in learning. To better support these learners, schools may need to provide more communication tools, along with training for teachers to use them confidently and effectively.

Research by Norrie et al. (2021) highlighted that high-tech AAC devices, when supported by comprehensive training for educators, enhance language development and social participation for learners with complex communication needs. Rensfeld Flink et al. (2024) demonstrated that AAC devices significantly improve communication skills in children with developmental disabilities, especially when combined with appropriate teaching strategies and involvement of speech-language pathologists.

4.3 The Effectiveness of Using Assistive Tools in SPED Instruction

This section presents the analysis of the effectiveness of assistive tools used in Special Education (SNED) instruction, categorized into five areas according to learner needs: (1) visual impairments, (2) hearing impairments, (3) cognitive or learning disabilities, (4) mobility impairments, and (5) speech or communication difficulties.

4.3.1 Effectiveness of Using Assistive Tools for Learners with Visual Impairments

Assistive tools for learners with visual impairments play a vital role in fostering accessibility, independence, and active classroom participation. These resources, ranging from traditional braille materials to modern screen readers and text-to-speech applications, help address barriers in reading, writing, and overall learning engagement. Table 7 presents the perceived effectiveness of various assistive tools in supporting learners with visual impairments.

Table 7
The Effectiveness of Using Assistive Tools in SNED Instructions for Learners with Visual Impairments

S/N	For Learners with Visual Impairments	Mean	SD	Category
1	Screen readers are part of my instructional tools for students with visual impairments.	3.43	0.68	Highly Effective
2	Braille tools are integrated into my support for students with visual impairments.	3.07	0.98	Effective
3	I provide access to braille slates and styluses during lessons.	3.13	0.82	Effective
4	I incorporate refreshable braille displays into learning activities.	3.10	1.06	Effective
5	Braille embossers and text-to-speech apps are included in my teaching strategies.	2.90	1.09	Effective
6	Google TalkBack is used to assist students with visual needs.	3.25	0.68	Highly Effective
7	Voice Dream Reader is one of the tools I include for visually impaired learners.	3.12	0.84	Effective
	Overall	**3.14**	**0.72**	**Effective**

Legend: 1.00-1.74 Not Effective; 1.75-2.49 Slightly Effective; 2.50-3.24 Effective; and 3.25-4.00 Highly Effective

The data shows that the overall mean is 3.14, which falls under the **"Effective"** category. This means that while the tools are helpful, there is still space for better usage or more substantial support.Among all the tools listed, screen readers received the highest mean score of 3.43, making it the most effective tool based on teacher feedback. This was followed by Google TalkBack, with a mean of 3.25, also rated as "Highly Effective." These results suggest that digital tools with built-in accessibility features are well-recognized and likely more accessible to teachers. Other tools, such as braille slates and styluses (3.13), refreshable braille

displays (3.10), and Voice Dream Reader (3.12), were all rated as "Effective." These scores are close in range and indicate steady but not outstanding usage.Meanwhile, braille tools (3.07) and braille embossers with text-to-speech apps (2.90) were also considered effective, though the slightly lower rating for the latter may indicate that some tools are less frequently used or not readily available in some SNED settings.

The results suggest that while most assistive tools for visual impairments are viewed as helpful, only a few reach the "Highly Effective" level. This implies a need to improve teacher access, training, and confidence in using these tools. With better support, existing tools could become even more impactful, enabling learners with visual needs to engage more fully in class activities.

Aftab et al. (2024) and Babayemi et al. (2021) demonstrated that assistive technologies such as screen readers and text-to-speech software significantly improve engagement and academic outcomes for students with disabilities when teachers receive adequate training and resources. Gautam (2024) reported that tailored digital tools enhance communication and participation, especially for learners with visual impairments and autism spectrum disorder, provided that ongoing professional development accompanies their use of technology. Kandati et al. (2024) found that smart devices supporting individualized learning experiences boost motivation and independence among learners with learning disabilities, recommending broader integration and teacher support to optimize effectiveness.

4.3.2 Effectiveness of Using Assistive Tools for Learners with Hearing Impairments

Assistive tools for learners with hearing impairments are essential in creating inclusive classrooms where communication barriers are reduced and learning opportunities are enhanced. These tools, ranging from hearing aids to digital transcription applications and sign language support, provide students with multiple pathways to access information and actively participate in class.

Table 8
The Effectiveness of Using Assistive Tools in SNED Instructions for Learners with Hearing Impairments

S/N	For Learners with Hearing Impairments	Mean	SD	Category
1	Hearing aids are used as part of classroom support.	3.53	0.57	Highly Effective
2	My lessons include the use of speech-to-text and captioning tools.	3.50	0.51	Highly Effective
3	Google Live Transcribe is available for students during class.	3.47	0.63	Highly Effective
4	I include Otter.ai to support student understanding through transcription.	3.57	0.50	Highly Effective
5	Sign language is used to facilitate communication in class.	3.37	0.67	Highly Effective
6	Filipino Sign Language (FSL) apps are part of my communication approach.	3.52	0.50	Highly Effective
7	Interpreter services from NGOs are coordinated for students with hearing impairments.	3.52	0.44	Highly Effective
	Overall	**3.50**	**0.40**	**Highly Effective**

Legend: 1.00-1.74 Not Effective; 1.75-2.49 Slightly Effective; 2.50-3.24 Effective; and 3.25-4.00 Highly Effective

Table 8 shows the frequency and effectiveness of assistive tools used in SNED instruction for learners with hearing impairments. The overall mean is 3.50, which falls under the **"Highly Effective"** category. This suggests that most of the tools teachers use to support these learners are not only used but also effective in the classroom.

The tool with the highest rating is Otter.ai, with a mean of 3.57, showing that transcription tools are invaluable for learners with hearing difficulties. Hearing aids (3.53), Filipino Sign Language (FSL) apps (3.52), and interpreter services (3.52) all received strong scores, suggesting they are commonly used and considered reliable. Speech-to-text and captioning tools (3.50) and Google Live Transcribe (3.47) also ranked highly, showing that digital tools play a significant role in helping students follow class discussions. Sign language (3.37), while still considered highly effective, had the lowest mean among the listed tools, which may indicate that some teachers require more training or confidence in using it regularly.

The results indicate that most teachers are effectively utilizing a range of tools to support learners with hearing impairments. However, despite all tools being rated highly effective, continued training and awareness are important, especially for strengthening consistent use of sign language. When these tools are used together effectively, they help break down communication barriers and create more inclusive classrooms.

Mwongela Kavua (2023) found that the use of hearing aids, speech-to-text apps, and captioned content significantly improved academic outcomes and engagement in Kenyan secondary schools, especially when combined with trained teachers and supportive policies. McNicholl et al. (2021) noted that assistive hearing technology enhances educational participation, although further evidence-based research is needed to inform practice with advancing technology. Murithi (2022) reported that technology integration led to substantial improvements in academic achievement, collaboration, and learning experience for deaf students.

4.3.3 Effectiveness of Using Assistive Tools for Learners with Cognitive and Learning Disabilities

Learners with cognitive and learning disabilities benefit greatly from structured supports and technology-based tools that make learning more accessible and engaging. Assistive technologies are designed to improve comprehension, communication, and task completion.

Table 9
The Effectiveness of Using Assistive Tools in SNED Instructions
for Learners with Cognitive or Learning Disabilities

S/N	For Learners with Cognitive or Learning Disabilities	Mean	SD	Category
1	Visual schedules and timers are used to guide learner routines.	3.27	0.69	Highly Effective
2	Tools from SNED centers, like visual cards and Time Timer apps, are incorporated into my practice.	3.27	0.78	Highly Effective
3	Text-to-speech and speech-to-text tools are part of my instructional resources.	3.63	0.61	Highly Effective
4	Google Dictation is used for learner writing and communication tasks.	3.47	0.63	Highly Effective
5	Microsoft Immersive Reader supports learner reading comprehension.	3.10	0.71	Effective
6	Learning apps are utilized to reinforce lessons.	3.27	0.68	Highly Effective
7	I include grammar and writing tools like Ghotit or Grammarly in learning activities.	3.45	0.51	Highly Effective
8	Platforms like Khan Academy, Quizlet, and Duolingo are integrated into my instruction.	3.55	0.50	Highly Effective
	Overall	**3.38**	**0.48**	**Highly Effective**

Legend: 1.00-1.74 Not Effective; 1.75-2.49 Slightly Effective; 2.50-3.24 Effective; and 3.25-4.00 Highly Effective

Table 9 illustrates the frequency and effectiveness of assistive tools used in SNED classes for learners with cognitive or learning disabilities. The overall mean is 3.38, which falls under the **"Highly Effective"** category. This suggests that most of these tools are regularly used and effectively assist students in their learning.

The most effective tools, based on the data, are text-to-speech and speech-to-text tools, with a high mean of 3.63, indicating that these support both reading and writing tasks. Other tools, such as Khan Academy, Quizlet, and Duolingo (3.55), Google Dictation (3.47), and grammar and writing tools like Ghotit or Grammarly (3.45), were also widely used and helpful. Meanwhile, visual schedules and timers (3.27), SNED tools such as visual cards and Time Timer apps (3.27), and learning apps (3.27) were also considered highly effective, highlighting the importance of visual aids and routines. The only tool rated as "Effective" rather than "Highly Effective" was Microsoft Immersive Reader, with a mean of 3.10; however, it remains useful.

The findings suggested that teachers are using a broad mix of tools to help learners with cognitive or learning disabilities, with many digital tools proving highly effective. These tools not only support academic tasks but also improve students' independence and focus. Continued integration and training in using these tools can lead to even more personalized and practical instruction.

Systematic reviews and empirical studies emphasize that assistive technologies (AT), including speech-to-text, text-to-speech, and educational apps, significantly improve literacy, communication, and engagement for students with learning disabilities (Agrahari, 2023; Hamid et al., 2025; Hess, 2023; Putri et al., 2025; Svensson et al., 2021). Digital tools facilitate individualized learning, support independence, and reduce barriers in classroom participation (Pramesworo et al., 2023). Studies also highlight the transformative impact of tablets and adaptive software in creating engaging, sensory-rich learning environments that accommodate diverse cognitive (Yeganeh et al., 2025). The effectiveness of AT is maximized when combined with adequate teacher training, tailored instructional approaches, and a comprehensive understanding of student needs, highlighting the

importance of continuous professional development and resource allocation in SNED programs (Goyibova et al., 2025; Javed, 2023).

4.3.4 Effectiveness of Using Assistive Tools for Learners with Mobility Impairments

Learners with mobility impairments require accessible environments and specialized tools to participate in classroom activities fully. Assistive technologies such as adaptive keyboards, alternative input devices, and wheelchair-compatible workstations play a crucial role in ensuring equal access to learning opportunities. Table 10 presents the effectiveness of various assistive tools for learners with mobility impairments.

Table 10
The Effectiveness of Using Assistive Tools in SNED Instructions for Learners with Mobility Impairments

S/N	For Learners with Mobility Impairments	Mean	SD	Category
1	Wheelchair-compatible workstations are available in my classroom setup.	3.47	0.68	Highly Effective
2	I make use of alternative input devices to support learner needs.	3.10	0.76	Effective
3	Adaptive keyboards and mice are accessible for learners with mobility challenges.	3.20	0.71	Effective
4	Touchscreen or voice-command tablets are provided for ease of access.	3.07	0.64	Effective
5	Devices with built-in accessibility features are included in learning activities.	3.53	0.57	Highly Effective
	Overall	**3.27**	**0.54**	**Highly Effective**

Legend: 1.00-1.74 Not Effective; 1.75-2.49 Slightly Effective; 2.50-3.24 Effective; and 3.25-4.00 Highly Effective

As shown in Table 10, the overall mean is 3.27, which falls within **"Highly Effective**", indicating that these tools are considered applicable and are often included in teaching strategies. Among the items, the most effective tool is the use of devices with built-in accessibility features, which scored a mean of 3.53. This shows that technology with built-in support (such as voice control or screen navigation) plays a key role in learners' learning. Similarly, wheelchair-compatible workstations also scored high (3.47), showing that teachers are mindful of physical setup and accessibility. Meanwhile, some tools were rated slightly lower but still "Effective", such as adaptive keyboards and mice (3.20), alternative input devices (3.10), and touchscreen or voice-command tablets (3.07). These tools support learners who have difficulty using traditional devices, such as regular keyboards or mice.

Oyedokun (2025) and McNicholl et al. (2021) noted that assistive technology promotes independent learning by tailoring support to learners' individual needs, thereby reducing reliance on constant assistance and enhancing confidence and accessibility. A case study by Al-Dababneh and Al-Zboon (2022) found that assistive technology facilitates communication, socialization, and academic skills among learners with severe disabilities, but also highlighted the need for ongoing teacher training to optimize technology use. Vincent et al. (2024) emphasize that adaptive technologies, such as alternative input devices and accessible workstations, improve participation, but stress that limited resources and insufficient staff training can impede their full utilization. Collectively, these studies emphasize the importance of sustained professional development, effective resource allocation, and thoughtful classroom design in maximizing the effectiveness of assistive tools for mobility support in special education settings.

4.3.5 Effectiveness of Using Assistive Tools for Learners with Speech or Communication Difficulties

Learners with speech or communication difficulties often rely on specialized tools to express themselves and engage in learning effectively. Assistive devices such as AAC tools, communication boards, and picture-based systems provide alternative ways for students to communicate, helping reduce barriers in classroom interaction. Table 11 presents the effectiveness of various assistive tools for supporting learners with speech or communication difficulties.

Table 11
The Effectiveness of Using Assistive Tools in SNED Instructions for Learners with Mobility Impairments

S/N	For Learners with Speech or Communication Difficulties	Mean	SD	Category
1	AAC (Augmentative and Alternative Communication) tools support student communication.	3.067	0.691	Effective
2	PECS (Picture Exchange Communication System) is applied in SNED instruction.	3.167	0.747	Effective
3	Locally made communication boards are included in communication strategies.	3.000	0.643	Effective
	Overall	**3.078**	**0.523**	**Effective**

Legend: 1.00-1.74 Not Effective; 1.75-2.49 Slightly Effective; 2.50-3.24 Effective; and 3.25-4.00 Highly Effective

As shown in Table 11, the overall mean is 3.078, which falls under the "Effective" category. These tools are frequently used and perceived as beneficial for enhancing classroom communication. Among the tools, the Picture Exchange Communication System (PECS) received the highest mean score of 3.167, indicating that it is a widely accepted and effective method for facilitating nonverbal communication. AAC (Augmentative and Alternative Communication) tools followed closely with a mean of 3.067, indicating that these devices or apps are also a key component in helping students express themselves. Meanwhile, locally made communication boards scored a mean of 3.000, indicating they remain valuable and accessible options, especially in schools with limited resources.

The findings suggest that teachers consistently use a range of communication support tools in their SNED classrooms, and that these tools are proving effective. However, since the scores are only within the lower end of the "Effective" category, there is room for improvement. More training, exposure to advanced AAC technologies, and better integration of these tools in daily lessons may help enhance communication outcomes for students with speech or communication challenges. Schools may also benefit from investing in updated versions of these tools to create context-specific communication materials that better support learner needs.

The study Simeoli et al. (2024) indicate that AAC, including PECS and speech-generating devices, significantly improves communication abilities and social interaction for learners with diverse disabilities. However, optimal success depends on the skilled collaboration of a team involving teachers, speech-language pathologists, and families. Research by Andzik et al. (2021) stresses that AAC supports language development, participation, and reduces problem behaviors when integrated with appropriate instructional strategies and training. Furthermore, they provide empirical evidence that AAC interventions enhance communication outcomes in children with autism spectrum disorders, highlighting the importance of early and consistent AAC implementation in school settings.

4.4 The Perceived Challenges of Teachers in Using Assistive Tools in SPED Instruction

This section outlines the perceived challenges that teachers face in delivering instruction to learners with special needs through the use of assistive tools. The discussion is organized into four key areas: (1) Lack of Training and Digital Literacy, (2) Limited Access to Technology, (3) Resistance to Change, and (4) Institutional and Administrative Barriers.

4.4.1 Lack of Training and Digital Literacy

The effective use of assistive tools in SNED instruction requires teachers to have sufficient training and digital literacy skills. Without proper knowledge and confidence, teachers may face challenges integrating these tools into their lessons, which can limit their ability to support learners with special educational needs fully. Table 12 presents the perceived challenges teachers face when using assistive tools, including a lack of training and digital literacy.

Table 12
The Perceived Challenges of Teachers in Using Assistive Tools in SNED Instruction

S/N	Lack of Training and Digital Literacy	Mean	SD	Category
1	I lack confidence in using assistive tools for SNED instruction.	2.67	1.06	Agree
2	I have not received adequate training on how to use assistive tools in my teaching.	2.83	0.79	Agree
3	I often struggle to integrate assistive tools into my SNED lessons due to limited knowledge.	2.60	0.89	Agree

4	I have difficulty adapting to new digital tools and technologies for SED instruction.	2.67	0.99	Agree
5	I frequently encounter challenges in troubleshooting technical issues related to assistive tools.	2.83	0.91	Agree
	Overall	**2.72**	**0.79**	**Agree**

Legend: 1.00-1.74 Strongly Disagree; 1.75-2.49 Disagree; 2.50-3.24 Agree; and 3.25-4.00 Strongly Agree

The data in Table 12 shows that the overall mean score is 2.72, which falls under the category "**Agree**." This indicates that teachers generally agree that gaps in training and digital skills hinder their effective use of digital tools in SNED instruction. The highest individual mean scores were 2.83, recorded for two statements: "I have not received adequate training on how to use assistive tools in my teaching" and "I frequently encounter challenges in troubleshooting technical issues related to assistive tools." These results suggest that SNED teachers feel underserved in formal instruction and technical troubleshooting support. Other indicators, such as lack of confidence and difficulty adapting to new tools, both recorded mean scores of 2.67, reinforcing the notion that many teachers are hesitant to adopt technology-driven instructional methods. The lowest mean, 2.60, reflects the struggle to integrate assistive tools due to limited knowledge—still within the "Agree" range, indicating this is a shared concern among respondents.The standard deviations, ranging from 0.79 to 1.06, reflect the varied experiences among the teachers; however, the means consistently suggest a moderate level of agreement regarding these challenges.

The findings highlight a significant gap in professional development in SNED education. While assistive tools hold promises for enhancing learning, their effectiveness depends heavily on teachers' ability and confidence in using them. The data suggest that many SNED teachers operate without sufficient training or technical support, limiting the full potential of assistive tools in inclusive classrooms. This emphasizes the importance of institutional investment in capacity-building initiatives, including hands-on training, mentorship programs, and ongoing technical support.

Campado et al. (2023b) found that Filipino SNED teachers frequently experience technological problems and a lack of mastery of skills, which negatively impact the integration of assistive technology. Esther and Kerich (2025a) reported similar challenges among Kenyan pre-service special education teachers, where insufficient training and a lack of understanding of assistive technology limit its adoption, despite available resources. Furthermore, Oyedokun (2024) highlighted financial, attitudinal, and training deficits among educators in various developing countries, emphasizing that continuous professional development and institutional support are crucial to overcoming resistance and ensuring the sustainable use of technology in special education.

4.4.2 Limited Access to Technology

Access to reliable technology is crucial for the successful implementation of assistive tools in SNED instruction. However, many teachers face challenges related to limited resources, poor connectivity, and inadequate school funding, which hinder the consistent use of digital tools for learners with special educational needs. Table 13 presents teachers' perceived challenges related to limited access to technology.

Table 13
The Perceived Challenges of Teachers in Using Assistive Tools in SNED Instruction in terms of Limited Access to Technology

S/N	Limited Access to Technology	Mean	SD	Category
1	I cannot access the assistive tools for effective SNED instruction.	2.97	0.89	Agree
2	Poor internet connectivity significantly disrupts my use of assistive tools in teaching.	3.13	0.63	Agree
3	My school lacks sufficient funding to provide essential assistive tools for SNED instruction.	2.97	0.72	Agree
4	I often have to rely on my personal resources to access assistive tools for teaching.	3.17	0.65	Agree
5	The availability of assistive technology for SNED learners is inadequate in my school.	3.17	0.75	Agree
	Overall	**3.08**	**0.55**	**Agree**

Legend: 1.00-1.74 Strongly Disagree; 1.75-2.49 Disagree; 2.50-3.24 Agree; and 3.25-4.00 Strongly Agree

The data in Table 13 shows that the overall mean of 3.08, interpreted as **"Agree**", indicates that SNED teachers consistently experience barriers in accessing the technological tools necessary for effective instruction. The highest mean scores of 3.17 are recorded for two items: "I often have to rely on my personal resources to access assistive tools for teaching" and "The availability of assistive technology for SNED learners is inadequate in my school." These results highlight a systemic issue in which institutional

support is lacking, leaving teachers to bridge the gap with their own resources. This not only imposes financial strain but may also lead to inconsistent availability and use of assistive technologies. Poor internet connectivity also emerges as a significant issue, with a mean of 3.13, suggesting that even when tools are available, unstable internet access undermines their functionality and consistency during instruction. Meanwhile, statements about lack of school funding (mean = 2.97) and difficulty accessing tools (mean = 2.97) further underscore the challenges faced by SNED educators. The standard deviations, ranging from 0.55 to 0.89, reflect moderate variation in responses, indicating that while experiences may differ across schools, the concern over access remains widespread.

The findings suggest that limited access to technology is a persistent challenge that affects SNED instruction. Teachers are not only expected to adapt to assistive tools but are also burdened by infrastructure gaps, insufficient funding, and inadequate institutional support. These limitations prevent consistent and equitable implementation of assistive technologies for learners with special needs. For meaningful integration of assistive tools in SNED, education leaders and policymakers must prioritize funding, improve digital infrastructure (especially internet connectivity), and ensure that assistive technologies are readily accessible in all SNED classrooms. Without these measures, inclusive education goals may remain unfulfilled, and both teachers and learners will continue to face unnecessary obstacles.

Campado et al. (2023) highlighted that in Philippine SNED settings, the lack of sufficient and updated assistive devices, limited financial resources, and technical issues such as unstable power and internet connectivity critically impede teachers' ability to integrate assistive technologies effectively. Abu-Alghayth (2020) observed similar barriers in Saudi special education schools, noting that inadequate availability of AT devices and poor infrastructure constrained teachers' use of technology, while training deficiencies compounded the problem. Additionally, Mishra et al. (2024a) emphasized that globally, limited funding and infrastructure deficits remain primary obstacles to the accessibility of assistive technology in special education, recommending targeted investments, improved infrastructure, and policy support to overcome these barriers.

4.4.3 Resistance to Change

The successful integration of assistive tools in SNED instruction often depends on teachers' openness to adapt to new teaching methods and technologies. Resistance to change may arise when teachers feel uncomfortable, overwhelmed, or uncertain about the effectiveness of digital tools in enhancing instruction for learners with special needs. Table 14 presents the perceived challenges of teachers in terms of resistance to change.

Table 14
The Perceived Challenges of Teachers in Using Assistive Tools in SNED Instruction in terms of Resistance to Change

S/N	Resistance to Change	Mean	SD	Category
1	I feel uncomfortable adopting new assistive tools in my teaching.	2.40	1.00	Disagree
2	I struggle to transition from traditional teaching methods to assistive tools-based instruction.	2.50	0.94	Agree
3	I do not believe assistive tools significantly improve SNED instruction.	2.03	0.89	Disagree
4	Learning new assistive tools for SNED teaching feels overwhelming and time-consuming.	2.57	0.97	Agree
5	I hesitate to integrate assistive tools into my teaching due to uncertainty about their effectiveness.	2.53	0.90	Agree
	Overall	**2.41**	**0.83**	**Disagree**

Legend: 1.00-1.74 Strongly Disagree; 1.75-2.49 Disagree; 2.50-3.24 Agree; and 3.25-4.00 Strongly Agree

As shown in Table 14, the overall mean score is 2.41, which falls under the "Disagree" category. This suggests that most SNED teachers do not strongly resist the adoption of digital or assistive tools in their instruction. Looking at individual items, the highest mean is 2.57, for the statement "Learning new assistive tools for SNED teaching feels overwhelming and time-consuming," followed closely by "I hesitate to integrate assistive tools into my teaching due to uncertainty about their effectiveness" (mean = 2.53). These fall under the "Agree" category and indicate that, while teachers may not outright reject new tools, they do experience hesitation and challenges related to time, effort, and confidence in the benefits of the tools. Conversely, the statement "I do not believe assistive tools significantly improve SNED instruction" has the lowest mean of 2.03, indicating disagreement and suggesting that most teachers acknowledge the potential value of assistive tools in enhancing learning outcomes. Similarly, discomfort in adopting new tools and reluctance to shift from traditional methods (means = 2.40 and 2.50) show mixed perceptions, suggesting mild resistance but not a significant obstacle. The standard deviations ranging from 0.83 to

1.00 indicate moderate variability in responses, possibly due to differences in individual experience levels, school support systems, or exposure to technology.

The findings indicate that resistance to change is not a dominant barrier among SNED teachers when it comes to using assistive tools. While some hesitation exists mainly due to concerns about time, effort, and uncertainty, the majority recognize the importance and benefits of integrating assistive technology into SNED instruction. This implies that professional development initiatives can be more effective if they focus less on overcoming resistance and more on building confidence, providing hands-on training, and offering continuous support. Ensuring that teachers feel equipped and supported can help minimize hesitation and sustain momentum for digital integration in inclusive education settings.

Lee et al. (2021) highlight that teacher attitudes toward technology improve markedly when training addresses perceived complexity and usefulness, mitigating uncertainty and easing transitions from traditional methods. Moreover, Esther and Kerich (2025b) found that resistance to change diminishes substantially when professional development incorporates collaborative, practice-oriented approaches that equip educators with the skills and confidence to adopt technology, particularly in special education contexts. These studies collectively suggest that addressing the subtler barriers of uncertainty and perceived effort through well-designed training and support systems facilitates smoother technology integration among teachers.

4.4.4 Institutional and Administrative Barriers

The effective use of assistive tools in SNED instruction does not solely rely on teachers' skills and attitudes but also on the support and policies provided by their institutions. Inadequate administrative backing, unclear guidelines, and limited funding often serve as barriers to the successful integration of assistive technologies in special education classrooms. Table 15 presents the perceived challenges teachers face regarding institutional and administrative barriers.

Table 15
The Perceived Challenges of Teachers in Using Assistive Tools in SNED Instruction in terms of Institutional and Administrative Barriers

S/N	Institutional and Administrative Barriers	Mean	SD	Category
1	My school does not provide sufficient support for the use of assistive tools in SNED instruction.	2.93	0.78	Agree
2	There are no clear policies or guidelines on how to use assistive tools in SNED education.	2.80	0.85	Agree
3	A heavy administrative workload prevents me from exploring assistive tools for teaching.	3.03	0.72	Agree
4	Budget constraints limit the integration of assistive tools in SNED instruction.	3.17	0.70	Agree
5	Requesting assistive tools for SNED teaching is slow and complicated.	3.03	0.76	Agree
	Overall	**2.99**	**0.59**	**Agree**

Legend: 1.00-1.74 Strongly Disagree; 1.75-2.49 Disagree; 2.50-3.24 Agree; and 3.25-4.00 Strongly Agree

As shown in Table 15, the overall mean score is 2.99, which falls under the "Agree" category. This suggests that institutional support and administrative systems are perceived as significant barriers to the full integration of assistive tools in SNED teaching. Among the items, the highest mean score is 3.17 for the statement "Budget constraints limit the integration of assistive tools in SNED instruction," suggesting that funding limitations are a significant concern. Similarly, statements like "A heavy administrative workload prevents me from exploring assistive tools" (mean = 3.03) and "Requesting assistive tools is slow and complicated" (mean = 3.03) indicate system inefficiencies and time constraints that hinder teachers' ability to adopt or access new technology. Other items, such as "There are no clear policies or guidelines" (mean = 2.80) and "My school does not provide sufficient support" (mean = 2.93), emphasize that the lack of structured guidance and institutional backing hinders the consistent and effective use of assistive technology in SNED. The standard deviations, ranging from 0.59 to 0.85, show moderate agreement among the teachers, reflecting a shared concern across different school contexts.

These results imply that organizational-level improvements are crucial for the successful integration of digital tools in SNED education. Even if teachers are willing and somewhat skilled, their efforts may be limited by the absence of clear policies, administrative support, and available resources.

Ertmer et al. (2020) identified external barriers, such as insufficient equipment, unreliable connectivity, and inadequate administrative support, as primary obstacles to educational technology adoption, emphasizing the need for incremental institutional improvements. Campado et al. (2023) documented that, despite teachers' willingness, systemic barriers such as

ambiguous institutional policies, inconsistent funding, and complex procurement processes hinder the sustainable use of assistive tools, underscoring the need for clear guidelines, streamlined administration, and robust institutional support.

4.5 The Test of Significant Relationship

This section presents the statistical analysis of the significant relationship between the total number of assistive tools utilized in SNED instruction and the following variables: (1) the frequency of tool usage, and (2) the perceived effectiveness of the tools.

Table 16
Correlation Matrix Between the Available Assistive Tools and Frequency of Use in Teaching Students with Special Needs

S/N	Frequency of the use of the Assistive Tools for Learners with	Total Number of Assistive Tools			
		R Stat	P-value	Decision	Remarks
1	Visual Impairments	0.306	0.100	Failed to Reject Ho	Not Significant
2	Hearing Impairments	-0.031	0.869	Failed to Reject Ho	Not Significant
3	Cognitive or Learning Disabilities	0.079	0.678	Failed to Reject Ho	Not Significant
4	Mobility Impairments	-0.072	0.706	Failed to Reject Ho	Not Significant
5	Speech or Communication Difficulties	0.222	0.238	Failed to Reject Ho	Not Significant

Note. Values are Pearson correlation coefficients (r).
p < .05. ** p < .01.

As shown in Table 16, none of the correlations between the total number of assistive tools and the frequency of use for specific student needs were statistically significant. The highest correlation was observed for learners with visual impairments (r = 0.306, p = 0.100), but it was still not significant. All other correlations for hearing impairments (r = -0.031, p = 0.869), cognitive or learning disabilities (r = 0.079, p = 0.678), mobility impairments (r = -0.072, p = 0.706), and speech or communication difficulties (r = 0.222, p = 0.238)—were also statistically insignificant.

This result suggests that the number of available assistive tools does not directly influence how often they are used to meet different learner needs. Even when tools are present, they may remain underutilized, suggesting a gap between access and actual classroom integration. This highlights the need to investigate and address other factors, such as usability, training, and relevance to learners' needs, that may be limiting the frequency of tool usage.

Reyes (2023b) found that, despite improvements in the provision of assistive devices in Philippine SNED settings, many tools remain underutilized due to limited teacher expertise and insufficient alignment with learners' individualized needs. Likewise, Esther and Kerich (2025b) noted that in Kenya and comparable contexts, effective utilization depends not on the number of available technologies but on practical teacher proficiency, institutional support, and the perceived relevance of the tools to the classroom context.

Table 17
Correlation Matrix Between Total Number of Assistive Tools and the Effectiveness of Using Assistive Tools in Teaching Learners with Special Needs

S/N	Effectiveness of the Assistive Tools for Learners with	Total Number of Assistive Tools			
		R Stat	P-value	Decision	Remarks
1	Visual Impairments	0.048	0.801	Failed to Reject Ho	Not Significant
2	Hearing Impairments	-0.02	0.917	Failed to Reject Ho	Not Significant
3	Cognitive or Learning Disabilities	-0.143	0.452	Failed to Reject Ho	Not Significant
4	Mobility Impairments	-0.147	0.437	Failed to Reject Ho	Not Significant
5	Speech or Communication Difficulties	-0.152	0.422	Failed to Reject Ho	Not Significant

Note. Values are Pearson correlation coefficients (r).
p < .05. ** p < .01.

As shown in Table 17, there is no significant correlation between the total number of assistive tools and their perceived effectiveness for various learner needs. All computed p-values were greater than 0.05, indicating statistically insignificant relationships. The correlation values were also close to zero, such as for visual impairments (r = 0.048, p = 0.801) and hearing impairments (r = -0.020, p = 0.917), with similarly weak and negative correlations for cognitive or learning disabilities (r = -0.143), mobility impairments (r = -0.147), and speech or communication difficulties (r = -0.152).

This means that having more assistive tools does not necessarily lead to higher effectiveness in special education and disability instruction. The findings imply that effectiveness depends less on quantity and more on proper usage, training, and alignment with specific student needs. This highlights the importance of capacity-building for teachers and targeted investment in appropriate, well-supported tools, rather than simply increasing the number of tools.

A study in Saudi Arabia found that while the frequency of assistive technology use positively correlates with academic achievement, the key factors underlying effectiveness include teacher preparedness, accessibility, and instructional alignment, rather than merely the availability of devices (Aldehami, 2022; Almalky & Qaysi, 2025). Campado et al. (2023) emphasized in the Philippine context that the presence of assistive devices does not guarantee their effective use; critical enablers include adequate teacher training, ongoing technical support, and matching tools to individual learner needs. Additionally, Mishra et al. (2024b) highlighted that the lack of supportive policies, training, and resource optimization often limits the impact of assistive technologies, regardless of their quantity.

5. Conclusion and Recommendations

This study shows that while assistive tools are present and used in SNED classrooms, important gaps still remain—especially for learners with speech and communication difficulties. Teachers see the value of these tools, but their full potential is often held back by limited training, uneven access, and institutional challenges. The findings emphasize that technology can truly strengthen inclusive education only when teachers receive ongoing training, clear guidance, and strong support from school leaders. In the end, assistive tools can open doors for learners with special needs, but their success relies on SNED teachers who are fully equipped and supported to use them effectively. Hence, the proposed action plan is recommended to strengthen SNED instruction by enhancing teacher training, improving access to assistive tools, providing clear user guides, and ensuring strong administrative support to create a more inclusive, technology-enabled learning environment for LSENs.

6. Acknowledgment

The researchers acknowledge all their panel member, research respondents, and their family members for their support of this study.

7. Conflict of Interest

There is no conflict of interest among the members of this study.

References

[1] Abu-Alghayth, K. (2020). Assistive Technology in the Kingdom of Saudi Arabia. In D. Chambers (Ed.), *International Perspectives on Inclusive Education* (pp. 217–234). Emerald Publishing Limited. https://doi.org/10.1108/S1479-363620200000014016

[2] Adera, N. (2025). Innovative learning spaces and blended learning: Quest for 21st century competency teaching and learning approaches. *Creating Dynamic Space in Higher Education: Modern Shifts in Policy, Competencies, and Governance*, 139–174.

[3] Adeshina, A. E. (2024). The transformative role of digital resources in teaching and learning. *Open Journal of Educational Development (ISSN: 2734-2050)*, *5*(1), 1–9.

[4] Aftab, M. J., Irfan, N., & Amjad, F. (2024). Impact of Assistive Technology on Reading Comprehension Skills in Students with Learning Disabilities. *Annals of Human and Social Sciences*, *5*(3), 387–402.

[5] Agrahari, S. K. (2023). The Crucial Role of Accessibility Tools and Software in Meeting the Needs of Individuals with Learning Disabilities. *Cutting Edge in Special Education*, 121.

[6] Al-Dababneh, K. A., & Al-Zboon, E. K. (2022). Using assistive technologies in the curriculum of children with specific learning disabilities served in inclusion settings: Teachers' beliefs and professionalism. *Disability and Rehabilitation: Assistive Technology*, *17*(1), 23–33. https://doi.org/10.1080/17483107.2020.1752824

[7] Aldehami, S. (2022). Saudi Arabia Special Education Teachers' Attitudes toward Assistive Technology Use for Students with Intellectual Disability. *Contemporary Educational Technology*, *14*(2). https://eric.ed.gov/?id=EJ1341464

[8] Almalky, H. A., & Qaysi, K. A. (2025). Assistive technology for university students with disabilities: Availability, utilization, and impact on academic performance. *Research in Developmental Disabilities*, *164*, 105078.

[9] Andzik, N. R., Schaefer, J. M., & Christensen, V. L. (2021). The effects of teacher-delivered behavior skills training on paraeducators' use of a communication intervention for a student with autism who uses AAC. *Augmentative and Alternative Communication*, *37*(1), 1–13. https://doi.org/10.1080/07434618.2021.1881823

[10] Anitha, J. A. (2025). Revolutionizing Education: The Multifaceted Role of Cloud in Modern e-Learning Environment. In *Cloud Computing for Smart Education and Collaborative Learning* (pp. 286–298). Chapman and Hall/CRC. https://www.taylorfrancis.com/chapters/edit/10.1201/9781003472537-25/revolutionizing-education-josephine-anitha

[11] Babayemi, T. D., Raji, N. O., Egwuatu, O. V., & Olumide, O. M. (2021). Integrating Artificial Intelligence with Assistive Technology to Expand Educational Access through Speech to Text, Eye Tracking and Augmented Reality. *Communication In Physical Sciences*, *7*(4), 652–680.

[12] Basu, A. (2025). AI tools for everyone: Your guide to artificial intelligence. *Aditya Basu*. https://iawd-assets.sfo3.digitaloceanspaces.com/01JZ33P1STPHXRAMSFNVG9NT6B.pdf

[13] Boot, F. H., Ghosh, R., Dinsmore, J. G., & MacLachlan, M. (2021). Views and experiences of people with intellectual disabilities to improve access to assistive technology: Perspectives from India. *Disability, CBR & Inclusive Development*, *31*(4), 40.

[14] Boot, F. H., Kahonde, C., Dinsmore, J., & MacLachlan, M. (2021). Perspectives on access and usage of assistive technology by people with intellectual disabilities in the Western Cape province of South Africa: Where to from here? *African Journal of Disability (Online)*, *10*, 1–11.

[15] Campado, R. J., Toquero, C. M. D., & Ulanday, D. M. (2023a). Integration of assistive technology in teaching learners with special educational needs and disabilities in the Philippines. *International Journal of Professional Development, Learners and Learning*, *5*(1), ep2308.

[16] Campado, R. J., Toquero, C. M. D., & Ulanday, D. M. (2023b). Integration of assistive technology in teaching learners with special educational needs and disabilities in the Philippines. *International Journal of Professional Development, Learners and Learning*, *5*(1), ep2308.

[17] Charcos, A., Etcuban, J., Capuno, R., Espina, R., Pinili, L., Mangubat, R., Añora, H., & Calasang, V. (2025). Readiness and Challenges of Regular Teachers in Handling Elementary Learners with Intellectual Disabilities in an Inclusive Environment in the Philippines. *British Journal of Teacher Education and Pedagogy*, *4*(7), 32–54.

[18] Christiana Obadimeji, C., & Olasumbo Oredein, A. (2022). Digital Leadership and Communication Styles on Public Primary School Teachers Job Performance in Nigeria. *Science Journal of Education*, *10*(1), 1. https://doi.org/10.11648/j.sjedu.20221001.11

[19] Chudaeva, E., & Yuen, C. L. (2025). Taking notes with artificial intelligence (AI)-based technology and academic integrity: Perspectives from online learners. *Education and Information Technologies*. https://doi.org/10.1007/s10639-025-13718-y

[20] Contrino, M. F., Reyes-Millán, M., Vázquez-Villegas, P., & Membrillo-Hernández, J. (2024). Using an adaptive learning tool to improve student performance and satisfaction in online and face-to-face education for a more personalized approach. *Smart Learning Environments*, *11*(1), 6. https://doi.org/10.1186/s40561-024-00292-y

[21] Danemayer, J., & Lim, M.-J. (2024). Assistive technology in Korea: Findings from the 2017 National Disability Survey. *Disability and Rehabilitation: Assistive Technology*, *19*(4), 1637–1647. https://doi.org/10.1080/17483107.2023.2225565

[22] Dey, D. N. C. (2024). Enhancing educational tools through artificial intelligence in perspective of need of AI. *Available at SSRN 5031275*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5031275

[23] Espeño, S., Babiano, E. H., Bucoy, M. L. R., Busime, E. L., & De Borja, J. M. A. (2024). Issues and challenges of implementing special education (SPED) curriculum in the Philippines: A systematic literature review. *Jurnal Inovasi Pendidikan*, *2*(4), 196–205.

[24] Esther, G., & Kerich, M. (2025a). Preparedness of Pre-Service Teachers in Use of Assistive Technology in Adapted Physical Education in Selected Public Primary Teacher Training Colleges in Kenya. *European Journal of Education Studies*, *12*(1). https://oapub.org/edu/index.php/ejes/article/view/5772

[25] Esther, G., & Kerich, M. (2025b). Preparedness of Pre-Service Teachers in Use of Assistive Technology in Adapted Physical Education in Selected Public Primary Teacher Training Colleges in Kenya. *European Journal of Education Studies*, *12*(1). https://oapub.org/edu/index.php/ejes/article/view/5772

[26] Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2022). Assistive technology for the inclusion of students with disabilities: A systematic review. *Educational Technology Research and Development*, *70*(5), 1911–1930. https://doi.org/10.1007/s11423-022-10127-7

[27] Gautam, D. (2024). PROFESSIONAL DEVELOPMENT FOR SPECIAL EDUCATION TEACHERS IN ICT INTEGRATION. *ICT Development in Education & Special Education*, 83.

[28] Goyibova, N., Muslimov, N., Sabirova, G., Kadirova, N., & Samatova, B. (2025). Differentiation approach in education: Tailoring instruction for diverse learner needs. *MethodsX*, *14*, 103163. https://doi.org/10.1016/j.mex.2025.103163

[29] Hamid, M. S., Abo Hamza, E. G., Bedewy, D., Elsiddig, F. M. E., AlShammari, S. A., Bakhiet, S. F., & Mohamed, N. I. A. (2025). Impact of digital competencies and assistive technologies on learning outcomes for students with learning disabilities in Kingdom of Saudi Arabia: A systematic review. *Frontiers in Education*, *10*, 1640556. https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2025.1640556/abstract

[30] Hess, K. (2023). *Effective use of assistive technology to accommodate students with learning disabilities*. https://repository.stcloudstate.edu/cgi/viewcontent.cgi?article=1179&context=sped_etds

[31] Iskakova, M. (2023). Electronic technologies to ensure individual learning of education seekers with special needs. *Futurity of Social Sciences*, *1*(1), 4–20.

[32] Javed, M. (2023). The Effectiveness of Different Teaching Methods in Education: A Comprehensive Review. *Journal of Social Signs Review*, *1*(1), 17–24.

[33] Josué, A., Bedoya-Flores, M. C., Mosquera-Quiñonez, E. F., Mesías-Simisterra, Á. E., & Bautista-Sánchez, J. V. (2023). Educational Platforms: Digital Tools for the teaching-learning process in Education. *Ibero-American Journal of Education & Society Research*, *3*(1), 259–263.

[34] Kandati, D. R., Sirasanambeti, A., & Hussain, A. B. (2024). Technologies to Assist Students with Specific Learning Disabilities in Higher Education: Concepts, Challenges and Future Directions. In R. Kaluri, M. Mahmud, T. R. Gadekallu, D. S. Rajput, & K. Lakshmanna (Eds.), *Applied Assistive Technologies and Informatics for Students with Disabilities* (pp. 235–254). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-0914-4_14

[35] Karagianni, E., & Drigas, A. (2023). New Technologies for Inclusive Learning for Students with Special Educational Needs. *International Journal of Online & Biomedical Engineering*, *19*(5). https://www.researchgate.net/profile/Athanasios-Drigas/publication/370300895_New_Technologies_for_Inclusive_Learning_for_Students_with_Special_Educational_Needs/links/644a462e97449a0e1a5f36ea/New-Technologies-for-Inclusive-Learning-for-Students-with-Special-Educational-Needs.pdf

[36] Kilag, O. K., Quezon, J., Pansacala, J. A., Suba-an, J., Kilag, F., & Esdrelon, K. G. (2023). Advancing reading skills: State-of-the-art remediation strategies. *Excellencia: International Multi-Disciplinary Journal of Education (2994-9521)*, *1*(1), 15–29.

[37] Lee, W. C., Neo, W. L., Chen, D.-T., & Lin, T.-B. (2021). Fostering changes in teacher attitudes toward the use of computer simulations: Flexibility, pedagogy, usability and needs. *Education and Information Technologies*, *26*(4), 4905–4923. https://doi.org/10.1007/s10639-021-10506-2

[38] Matthew, U. O., Kazaure, J. S., & Okafor, N. U. (2021). Contemporary development in E-Learning education, cloud computing technology & internet of things. *EAI Endorsed Trans. Cloud Syst.*, *7*(20), e3.

[39] McNicholl, A., Casey, H., Desmond, D., & Gallagher, P. (2021). The impact of assistive technology use for students with disabilities in higher education: A systematic review. *Disability and Rehabilitation: Assistive Technology*, *16*(2), 130–143. https://doi.org/10.1080/17483107.2019.1642395

[40] Mishra, S., Laplante-Lévesque, A., Barbareschi, G., Witte, L. D., Abdi, S., Spann, A., Khasnabis, C., & Allen, M. (2024a). Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: A scoping review. *Disability and Rehabilitation: Assistive Technology*, *19*(2), 474–485. https://doi.org/10.1080/17483107.2022.2099021

[41] Mishra, S., Laplante-Lévesque, A., Barbareschi, G., Witte, L. D., Abdi, S., Spann, A., Khasnabis, C., & Allen, M. (2024b). Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: A scoping review. *Disability and Rehabilitation: Assistive Technology*, *19*(2), 474–485. https://doi.org/10.1080/17483107.2022.2099021

[42] Mohebbi, A. (2025). Enabling learner independence and self-regulation in language education using AI tools: A systematic review. *Cogent Education*, *12*(1), 2433814. https://doi.org/10.1080/2331186X.2024.2433814

[43] Murithi, S. B. (2022). *Utilization of Assistive Technology in Improving Academic Performance in Primary Schools for Learners with Hearing Challenges in Meru and Tharaka Nithi Counties, Kenya* [PhD Thesis, KeMU]. http://41.89.31.5:8080/handle/123456789/1362

[44] Mwongela Kavua, M. (2023). *Digital Literacy Among Teachers of Learners with Disabilities in Czech Republic and Kenya*. https://dspace.cuni.cz/handle/20.500.11956/186953

[45] Nacheva, R. (2024). Conversational AI for Students with Hearing Disabilities: Approach to the Text Quality Evaluation. *2024 International Conference Automatics and Informatics (ICAI)*, 130–135. https://ieeexplore.ieee.org/abstract/document/10851526/

[46] Norrie, C. S., Waller, A., & Hannah, E. F. S. (2021). Establishing Context: AAC Device Adoption and Support in a Special-Education Setting. *ACM Transactions on Computer-Human Interaction*, *28*(2), 1–30. https://doi.org/10.1145/3446205

[47] Oyedokun, T. T. (2025). Assistive technology and accessibility tools in enhancing adaptive education. In *Advancing adaptive education: Technological innovations for disability support* (pp. 125–162). IGI Global Scientific Publishing. https://www.igi-global.com/chapter/assistive-technology-and-accessibility-tools-in-enhancing-adaptive-education/367296

[48] Pramesworo, I. S., Fathurrochman, I., Sembing, D., Bangkara, B. A., & Sudrajat, D. (2023). Relevance between Blended Learning and Students' Independent Learning Curriculum: An Overview of Digital Age Education, Student and Teacher Engagement, Technological Resources. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran, Dan Pembelajaran*, *9*(3), 858–869.

[49] Putri, N. K. S., Yuhana, U. L., Siahaan, D. O., Rahayu, W., & Pardede, E. (2025). Assistive technology classification for students with disabilities in higher education: A systematic literature review. *IEEE Access*. https://ieeexplore.ieee.org/abstract/document/10870262/

[50] Qasim, S. H. (2024). *Beyond the classroom: Emerging technologies to enhance learning*. https://books.google.com/books?hl=en&lr=&id=eBEMEQAAQBAJ&oi=fnd&pg=PA1&dq=technology+promotes+communication+and+collaboration+through+cloud-based+systems,+online+forums,+and+virtual+conferencing,+supporting+dynamic+learning+environments+beyond+the+traditional+classroom+walls+&ots=kErIKkDcBG&sig=YcccbUqnQ-NR9saP8LJZwMnGwUs

[51] Rafiq, S., Iqbal, S., & Afzal, A. (2024). The impact of digital tools and online learning platforms on higher education learning outcomes. *Al-Mahdi Research Journal (MRJ)*, *5*(4), 359–369.

[52] Rasouli, O., Kvam, L., Husby, V. S., Røstad, M., & Witsø, A. E. (2023). Understanding the possibilities and limitations of assistive technology in health and welfare services for people with intellectual disabilities, staff perspectives. *Disability and Rehabilitation: Assistive Technology*, *18*(7), 989–997. https://doi.org/10.1080/17483107.2021.1963856

[53] Rathnasekara, K., Yatigammana, K., & Suraweera, N. (2025). Innovative pedagogical framework in K12 education: Enhancing productivity and engagement of digital natives within resource-constrained environments. *Quality Education for All*, *2*(1), 413–438.

[54] Rensfeld Flink, A., Thunberg, G., Nyman, A., Broberg, M., & Åsberg Johnels, J. (2024). Augmentative and alternative communication with children with severe/profound intellectual and multiple disabilities: Speech language pathologists' clinical practices and reasoning. *Disability and Rehabilitation: Assistive Technology*, *19*(3), 962–974. https://doi.org/10.1080/17483107.2022.2137252

[55] Reyes, C. L. A. (2023a). A systematic review on the state of special education in the Philippines: Identifying challenges, gaps, and future directions. *Journal of Educational Policy*, *27*(1), 58–72.

[56] Reyes, C. L. A. (2023b). A systematic review on the state of special education in the Philippines: Identifying challenges, gaps, and future directions. *Journal of Educational Policy*, *27*(1), 58–72.

[57] Satti, S. M. J., Asad, M., Saleem, A., Mahmood, A., & ul Muntaha, S. S. (2025). Reimagining English Language Learning Through Artificial Intelligence. *Dialogue Social Science Review (DSSR)*, *3*(4), 711–718.

[58] Scully, D., Lehane, P., & Scully, C. (2021). 'It is no longer scary': Digital learning before and during the Covid-19 pandemic in Irish secondary schools. *Technology, Pedagogy and Education*, *30*(1), 159–181. https://doi.org/10.1080/1475939X.2020.1854844

[59] Simeoli, R., Iovino, L., Guglielmino, G., Marocco, D., & Rega, A. (2024). A comparison of Picture Exchange Communication System (PECS) and Speech-Generating Device (SGD) as communication aids for children with Autism Spectrum Disorders. *LIFE SPAN AND DISABILITY*, *27*(1), 43–67.

[60] Svensson, I., Nordström, T., Lindeblad, E., Gustafson, S., Björn, M., Sand, C., Almgren/Bäck, G., & Nilsson, S. (2021). Effects of assistive technology for students with reading and writing disabilities. *Disability and Rehabilitation: Assistive Technology*, *16*(2), 196–208. https://doi.org/10.1080/17483107.2019.1646821

[61] Ulanday, M. L., Centeno, Z. J., Bayla, M. C., & Callanta, J. (2021). Flexible learning adaptabilities in the new normal: E-learning resources, digital meeting platforms, online learning systems and learning engagement. *Asian Journal of Distance Education*, *16*(2). http://asianjde.com/ojs/index.php/AsianJDE/article/view/580

[62] Vincent, D. A., Okeowo, R. O., & Ariyo, S. (2024). The Use of Assistive Technology for Students with Disabilities in Technical Colleges in Ondo State. *Journal of Educational Research and Practice*, *14*(1), 4.

[63] Williams, L. (2024). *Unlocking accessibility: Captions, transcripts, and audio descriptions*. https://openlibrary-repo.ecampusontario.ca/jspui/handle/123456789/2204

[64] Woulfin, S. L., & Jones, B. (2021). Special development: The nature, content, and structure of special education teachers' professional learning opportunities. *Teaching and Teacher Education*, *100*, 103277.

[65] Yeganeh, L. N., Fenty, N. S., Chen, Y., Simpson, A., & Hatami, M. (2025). The future of education: A multi-layered metaverse classroom model for immersive and inclusive learning. *Future Internet*, *17*(2), 63.

[66] Yılmaz, Ö. (2024). Personalised learning and artificial intelligence in science education: Current state and future perspectives. *Educational Technology Quarterly*, *2024*(3), 255–274.