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The Role of Adaptive Assistive Learning Tools in Supporting Students with Sensory Impairments

Master's thesis
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Abstract

This study explored the role of assistive technologies in enhancing the academic development of learners with special educational needs (SEN) under the age of twelve in inclusive public primary schools in Ghana. Using a convergent parallel mixed methods design, the research gathered data from thirty teachers and fifteen parents across five purposively selected inclusive schools. Quantitative data were collected through structured questionnaires and analysed using descriptive statistics, while qualitative insights were drawn from semi-structured interviews and analysed thematically. Findings revealed that tablets, text-to-speech software, hearing aids, and Braille tools were the most frequently used assistive technologies. However, their perceived effectiveness varied. Specialised tools such as hearing aids and digital Braille devices, although used less frequently, were viewed as more impactful than general tools like tablets and screen readers. The study also identified key challenges limiting the effective use of assistive technologies. These included limited teacher training, outdated equipment, inadequate school-level support, and weak maintenance systems. Despite these constraints, both teachers and parents recognised the positive effects of assistive technologies on learner confidence, participation, and literacy development. Teachers applied these tools to support reading, writing, and comprehension tasks, often adapting them to individual learner needs. However, implementation was mostly informal due to the absence of structured planning and institutional frameworks. The study concludes that while assistive technologies hold great promise for promoting inclusive education, their success depends on more than access to tools. Effective use requires sustained training, supportive infrastructure, and committed leadership. The findings contribute to the understanding of inclusive practice in low-resource settings and offer practical recommendations for policy and school-level reform to improve outcomes for SEN learners.

Keywords: Special Educational Needs Students, Assistive Technologies, Academic Performance, Implementation Challenges, Perceptions of Teachers and Parents

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Chapter One
Introduction

1.1 Background

Special Educational Needs (SEN) refer to learning difficulties or disabilities that make it significantly more challenging for a child to learn compared to their peers in mainstream education settings. The Children and Families Act 2014 in the UK defines a child as having SEN if they have a learning difficulty or disability requiring special educational provision. This encompasses conditions such as autism spectrum disorders, dyslexia, hearing and visual impairments, and cognitive developmental delays. The SEND Code of Practice 2015 highlights that SEN covers a wide range of needs, from physical and sensory impairments to social, emotional, and communication difficulties. Hodkinson (2016) emphasises that inclusive practices must adapt learning environments to accommodate this diversity, promoting participation and achievement for all learners.

Globally, assistive technologies have become vital tools in supporting the academic participation of learners with S EN. The World Health Organisation (2011) estimates that over 93 million children live with moderate to severe disabilities, many of whom face restricted access to formal education. In response, countries such as the United Kingdom, United States, and Canada have integrated assistive tools, including text-to-speech software, screen readers, digital Braille, and communication boards, into mainstream education systems. These technologies have been shown to enhance access, engagement, and learning outcomes for SEN learners (Cook & Polgar, 2014; Lazzari, 2018). Furthermore, Alnahdi (2020) notes that when assistive technologies are tailored to learner needs and supported by trained educators, they reduce learning barriers, foster independence, and improve academic performance.

However, the situation in Africa is more complex. Although several African countries have committed to inclusive education through national policies and international agreements, such as the Salamanca Statement (UNESCO, 1994), implementation is often limited. Donohue and Bornman (2014) report that the majority of learners with disabilities in sub-Saharan Africa remain excluded from meaningful participation in mainstream schools. Financial constraints, inadequate assistive technology infrastructure, insufficient teacher training, and negative cultural perceptions contribute to this challenge. For example, Chitiyo and Wheeler (2009) observed that,

despite legal frameworks supporting inclusive education in countries like Zimbabwe and South Africa, learners with SEN often lack the necessary tools and trained professionals for effective inclusion. UNESCO (2018) further indicates that fewer than 10% of children with disabilities in sub-Saharan Africa have access to formal education, highlighting systemic exclusion.

In Ghana, inclusive education is guided by the Inclusive Education Policy 2015, the Disability Act 2006, and the Education Strategic Plan 2018–2030, all of which recognise the right of children with disabilities to participate fully in mainstream schools. Despite this, implementation remains inconsistent. The Ghana Education Service (GES) has appointed inclusive education coordinators nationwide, but many schools, particularly in rural and peri-urban areas, lack the capacity to support SEN learners. Agyei and Voogt (2014) found that Ghanaian teachers have limited access to ICT tools, let alone specialised assistive technologies. Additionally, a GES (2020) report reveals that fewer than 30% of basic schools have any form of assistive devices, and most teachers receive little or no training in their use. This lack of training is particularly problematic, as even when tools are available, underprepared teachers may not know how to use them effectively (Shogren et al., 2015). Moreover, limited parental involvement and the absence of school-level policies on assistive technology use exacerbate the issue, as effective implementation of such tools often requires coordinated efforts between schools and families, guided by clear institutional frameworks (Donohue & Bornman, 2014; Alnahdi, 2020).

A significant gap exists in the literature regarding how assistive technologies are used in Ghanaian basic schools to support the academic development of children with SEN. While some studies have explored teacher attitudes or policy readiness (Agyei & Voogt, 2014; Ametepee & Anastasiou, 2015), few have investigated the types of assistive tools in use, stakeholder perceptions of their effectiveness, or specific challenges at the school level. Even fewer studies focus on children under 12 years of age, a important developmental stage where learning interventions can yield long-term benefits. McCoy and Thein (2016) argue that understanding the lived experiences and practical barriers faced by educators and parents is essential for building effective and sustainable inclusive systems. Yet, in Ghana, empirical studies combining quantitative evidence and qualitative details from teachers and parents on assistive technology use remain scarce.

This study addresses the gaps highlighted above by investigating the types of assistive technologies used in inclusive basic schools in Ghana and their perceived effectiveness by teachers and parents. It also examines the implementation challenges faced by these stakeholders and evaluates the impact of assistive tools on the academic performance of SEN learners under the age of 12.

1.2 Problem Statement

Despite policy frameworks promoting inclusive education in Ghana, such as the Inclusive Education Policy (2015) and the Education Strategic Plan (2018–2030), learners with special educational needs (SEN) continue to face marginalisation within the basic education system. According to Ametepee and Anastasiou (2015), the existence of inclusive policies in Ghana has not translated into effective classroom practice, particularly for young learners under twelve whose academic development is shaped by the level of support they receive in early schooling. Assistive technologies are not only tools that reduce learning barriers; they also serve essential cognitive and instructional functions. These tools support differentiated learning, improve content accessibility, and promote learner engagement. According to Alnahdi (2020), assistive technologies align with the Universal Design for Learning framework by providing multiple means of engagement, representation, and expression, which are important for learners with SEN. In the same light, Cook and Polgar (2014) argue that when assistive tools are integrated effectively, they empower learners to complete academic tasks independently and enhance participation in classroom activities.

However, implementation within Ghanaian inclusive classrooms remains limited and fragmented. Many teachers lack adequate training on how to use assistive technologies effectively, and there are no standardised mechanisms for identifying or integrating these tools into everyday instruction (GES, 2020). As a result, SEN learners are often unable to access curriculum content, complete assignments, or meaningfully participate in lessons. According to Edyburn (2013), the absence or misapplication of assistive tools contributes to persistent learning gaps, especially among young learners who require targeted support in foundational skills.

Moreover, there is limited local evidence on which assistive tools are perceived as effective by teachers and parents in Ghana. While global studies highlight the benefits of tools like screen readers, text-to-speech software, and digital learning applications (Lahm &

Morrissette, 2001; Alnahdi, 2020), the contextual realities of their application in Ghanaian classrooms remain unclear. Similarly, most Ghanaian literature on inclusive education tends to focus on teacher attitudes and infrastructural constraints (Agyei & Voogt, 2014) rather than the intersection of assistive technology use and academic outcomes for SEN learners.

This study seeks to address this gap by exploring the types of assistive technologies used in inclusive basic schools in Ghana, the challenges educators face in implementing them, and how stakeholders particularly teachers and parents perceive their impact on the academic performance of learners with SEN under the age of twelve. The aim is to contribute practical, context-specific evidence that can inform inclusive education practices and policy decisions at the school and national levels.

1.3 Main Objective

The primary aim of this study is to explore the perceived effectiveness, implementation challenges, and influence of assistive technologies on the academic performance of learners with special educational needs (SEN) under the age of 12 in inclusive basic education settings in Ghana. This study focuses on the perceptions of teachers and parents because they play a central role in the use and support of assistive technologies at both school and home. Learners' perceptions were not included in this study due to ethical concerns about interviewing young children under twelve and the potential difficulty in obtaining reliable self-reported data from this age group:

1.3.1 Specific Objectives

1. To explore the types of assistive technologies commonly used to support the academic development of SEN learners under twelve in inclusive basic schools.
2. To examine the challenges encountered by teachers and schools in the implementation of assistive technologies.
3. To describe how assistive technologies are applied in classroom instruction to support the learning needs of SEN learners.
4. To examine how teachers and parents perceive the role of assistive technologies in supporting the academic development of SEN learners

1.4 Research Questions

Based on the objectives, the study seeks to answer the following research questions:

1. What types of assistive technologies are used to support the academic development of SEN learners under twelve in inclusive basic schools?
2. What challenges do teachers and schools encounter in implementing assistive technologies in inclusive classrooms?
3. How are assistive technologies applied in classroom instruction to support SEN learners?
4. How do teachers and parents perceive the role of assistive technologies in supporting the academic development of SEN learners?

1.5 Scope and Delimitation of the Study

This study examines the use and perceived role of assistive technologies in supporting the academic development of learners with special educational needs (SEN) in inclusive basic schools in Ghana. The focus is specifically on children under the age of twelve, as this group represents the foundational stage of formal education where early intervention is important for long-term academic progress. The research engages two key stakeholder groups i.e teachers, who implement inclusive teaching strategies in the classroom, and parents, who support their children's learning at home.

The study focuses on inclusive public basic schools in urban and peri-urban areas of Ghana, chosen for having SEN learners and using assistive technology. Remote rural schools were excluded due to logistical constraints. Thematically, it examines assistive technologies for reading, writing, and comprehension, without delving into those for mobility, speech therapy, or non-academic communication. The study is descriptive, using both quantitative and qualitative data to provide practical insights into technology use and its challenges in classrooms. Theoretically, it employs Universal Design for Learning and social development theory to emphasize inclusive, learner-centred education. Findings aim to enhance teacher training, school leadership, and policy-making in Ghana’s education system.

Chapter Two

Theoretical Overview

2.1 Theoretical Frameworks

The use of assistive technologies in inclusive education must be understood within a broader educational and psychological framework, not merely as a technical intervention. Theories provide a foundation for understanding how learners with special educational needs (SEN) interact with learning environments, acquire knowledge, and benefit from tools to support their academic progress. This study adopts two theoretical perspectives: Vygotsky's Social Development Theory and the Universal Design for Learning (UDL) framework. These theories explain how assistive technologies can support cognitive development, classroom engagement, and inclusive participation for learners with disabilities, particularly at the foundational level.

2.1.1 Vygotsky's Social Development Theory

This theory was propounded by Lev Vygotsky in the early 20th century. It emphasises the fundamental role of social interaction in the cognitive development of children. Unlike Piaget, who viewed development as a largely individual process, Vygotsky argued that learning begins on a social level (interpsychological) and is later internalised at the individual level (intrapsychological) (Vygotsky, 1978). His theory highlights how learners acquire new knowledge through interaction with more knowledgeable others, including peers, teachers, and caregivers. The central concept is the Zone of Proximal Development (ZPD), which refers to the range of tasks a learner can perform with guidance from a more knowledgeable other but cannot yet do independently. Vygotsky posited that effective learning occurs when learners are supported to progress from what they know to what they can potentially understand with assistance. He also introduced mediated learning, where tools whether linguistic, physical, or digital act as bridges to help learners grasp new concepts.

In this study, assistive technologies serve as mediating tools within the learner's ZPD. For instance, a screen reader enables a visually impaired learner to access written content they could not otherwise comprehend. Similarly, text-to-speech software or interactive educational apps act as scaffolding tools, helping SEN learners engage with content and complete academic tasks. These technologies support both independent learning and participation in collaborative classroom environments. This theory is highly relevant, as it explains how assistive tools can

bridge learning gaps for SEN learners, particularly in early schooling. It supports the notion that with appropriate technological support, learners with disabilities are more likely to access curriculum content, participate meaningfully, and improve academic performance. The theory also aligns with the study's focus on teacher and parent perceptions, as both often act as the "more knowledgeable other" scaffolding the learning process.

2.1.2 Universal Design for Learning (UDL) Framework

The Universal Design for Learning (UDL) framework was developed by David H. Rose and his colleagues at the Center for Applied Special Technology (CAST) in the 1990s. The framework was inspired by the concept of universal design in architecture, which seeks to create environments that are accessible to all individuals regardless of ability. In the context of education, UDL applies this principle by promoting the design of flexible curricula and instructional strategies that accommodate the diverse needs of all learners from the outset, rather than modifying content after the fact to suit students with disabilities (Meyer, Rose, & Gordon, 2014).

UDL recognises that learners vary in how they engage with content, process information, and express understanding. It promotes flexibility in educational practices by encouraging educators to use varied methods of motivation, content delivery, and learner expression. This includes providing multiple means of engagement to support motivation, multiple means of representation to diversify information presentation, and multiple means of action and expression to allow students different ways to demonstrate learning. These pillars aim to reduce learning barriers and create equitable classroom environments. UDL's relevance to inclusive education is significant, as it anticipates learner diversity and promotes responsive teaching practices. Assistive technologies align naturally with UDL principles. For example, learners with hearing impairments benefit from captioning tools, while those with dyslexia may rely on text-to-speech software. Such tools not only eliminate access barriers but also enhance participation and comprehension for all learners. Within a UDL framework, assistive technologies are part of a universally designed classroom strategy supporting all students' success.

In this study, UDL provides a conceptual foundation for analysing how inclusive schools in Ghana implement assistive technologies. It reinforces the idea that these tools should be integral to everyday instruction, not special interventions. UDL's emphasis on anticipating

diversity positions it as an ideal lens for evaluating the role of assistive technologies in inclusive education.

2.1.3 How the Theories Complement Each Other

Vygotsky's Social Development Theory and the UDL framework complement each other by addressing both the social interactional context of learning and the structural design of learning environments. While Vygotsky provides detail into how learners construct knowledge through guided support and mediated tools, UDL focuses on how the learning environment itself can be intentionally designed to accommodate different needs from the outset. In combination, they offer a powerful justification for assistive technology integration that is both responsive to individual learner needs and embedded in proactive, inclusive pedagogy.

In practical terms, Vygotsky helps to explain how assistive technologies such as tablets or screen readers function within the learner's Zone of Proximal Development, acting as cognitive scaffolds. UDL builds on this by ensuring that such tools are not afterthoughts, but rather planned parts of an inclusive teaching strategy that benefits all learners, not just those with disabilities. Together, the theories align with the study's goal of understanding assistive technology as a bridge toward equitable learning, especially within resource-constrained classrooms.

Recent studies have demonstrated how combining these frameworks enhances inclusive education. For example, Alnahdi (2020) argues that UDL principles combined with mediated learning can transform how special education is delivered in low-resource contexts. Similarly, Ngugi (2017) shows that assistive tools, when integrated within a socially supportive and universally designed curriculum, promote not only access but meaningful academic participation among visually impaired learners in Kenyan schools. These contemporary applications reinforce the relevance of both frameworks to inclusive education in Ghana.

2.2 Conceptual Review of Literature

2.2.1 Types of Assistive Technologies and Their Role in Inclusive Education

Assistive technologies (AT) encompass devices, software, or systems designed to aid individuals with disabilities in accessing education, communication, and daily activities. These tools are pivotal in inclusive education, enabling students with special educational needs (SEN) to

surmount learning obstacles and engage effectively with the curriculum. Globally, there is increasing acknowledgement of how AT fosters independence, enhances access to educational content, and supports academic progress across various disability categories (Cook & Polgar, 2014).

Common types of assistive technologies include screen readers, text-to-speech software, Braille displays, hearing amplification devices, and communication boards. These tools provide multiple modes of content delivery visual, auditory, and tactile making learning more accessible for children with sensory or cognitive impairments. Alnahdi (2020) contends that screen readers and text-to-speech applications are particularly effective in supporting learners with dyslexia and visual impairments, improving their reading fluency, comprehension, and confidence. In classrooms across developed nations, tablets equipped with adaptive learning applications are widely used to personalise instruction, allowing learners to complete academic tasks at their own pace. Research by Lahm and Morrissette (2001) supports the assertion that flexible and customisable AT devices are important in addressing the diverse needs of learners in inclusive classrooms.

In the African context, however, the availability and utilisation of assistive technologies remain limited. While countries such as South Africa, Kenya, and Uganda have adopted policies to integrate technology into inclusive education, practical implementation is hampered by funding constraints, infrastructure deficiencies, and insufficient teacher training (Donohue & Bornman, 2014). Specialised tools, such as digital Braille devices and FM systems, are seldom available in public schools due to their high cost and limited distribution networks. Despite these challenges, there is growing evidence of success where basic technologies, such as tablets and mobile applications, have been deployed with appropriate training and support. For example, studies by Ngugi (2017) in Kenya found that students using speech-enabled tablets demonstrated significant improvements in literacy and classroom participation.

In Ghana, the situation reflects many of the challenges observed across sub-Saharan Africa. Although the Inclusive Education Policy (2015) recognises the importance of assistive tools, widespread adoption remains limited in public primary schools. A study by Fernández-Batanero et al. (2022) conducted a systematic review of 31 empirical studies published between 2009 and 2020, focusing on the impact of assistive technologies on the inclusion of students with

disabilities. The review found that digital tools like tablets, screen readers, and text-to-speech software significantly enhance academic engagement and inclusion for students with disabilities. These technologies were particularly effective in improving motivation, attention, and academic performance among students with visual and hearing impairments. However, the study also highlighted barriers such as limited teacher training and access to these technologies, especially in low-resource settings.

2.2.2 Challenges in Implementing Assistive Technologies

Although assistive technologies offer significant potential for transforming inclusive education, their implementation is often constrained by a combination of structural, institutional, and technical barriers. These challenges are particularly pronounced in developing countries, where resource limitations, inadequate policy frameworks, and restricted access to professional development opportunities hinder the full integration of assistive tools into classroom practice.

Globally, one of the most persistent challenges is the high cost of assistive technologies and the absence of sustainable funding mechanisms to support their procurement and maintenance. Lindqvist et al. (2019) assert that many schools in low- and middle-income contexts struggle to provide even the most basic digital tools for learners with disabilities. In the same light, insufficient teacher training remains a widespread concern. Teachers often lack the technical competence and pedagogical strategies necessary to use assistive tools effectively. According to Okolo and Diedrich (2014), the lack of structured professional development programmes not only lowers teachers' confidence but also contributes to the underutilisation of available devices. Within the African context, the successful integration of assistive technologies is further challenged by infrastructural deficits, limited internet access, and heavy dependence on donor-funded interventions. Donohue and Bornman (2014) observe that while several African countries have inclusive education policies in place, these are rarely backed by adequate budgetary allocations or clear operational guidelines. Maintenance and technical support services are often absent, resulting in frequent device breakdowns and extended periods of disuse. Moreover, schools face bureaucratic delays in acquiring or replacing devices due to weak procurement systems and limited collaboration with suppliers.

In the Ghanaian setting, similar systemic barriers have been documented. For instance, a study by Ampratwum, Offei, and Ntoaduro (2016) on the use of computer-based assistive

technologies at the Akropong School for the Blind revealed that the major obstacles included inadequate funding, limited teacher training, and poor access to modern devices. In the same context, Agyei and Voogt (2014) argue that the lack of capacity-building initiatives leads to the superficial integration of technology, with educators often using devices in ways that do not maximise their instructional potential. Beyond technical and logistical challenges, cultural attitudes and resistance to change also pose significant barriers. Wang and Winstead (2002) argue that even when resources are available, teachers who are sceptical about the value of technology may be slow to adopt it, thereby undermining its potential impact. This concern is particularly relevant in some Ghanaian schools, where assistive technologies are still seen by many educators and administrators as supplementary rather than essential teaching tools.

2.2.3 Stakeholder Perceptions of Assistive Technologies

The perceptions of key stakeholders, such as teachers and parents, play a important role in determining the success of assistive technology (AT) implementation in inclusive education. Positive stakeholder attitudes not only encourage the consistent use of AT in classrooms but also influence resource allocation, policy priorities, and learner motivation. As Blackhurst (2005) argues, stakeholder engagement is a important determinant of AT sustainability, particularly in settings where institutional support may be inconsistent.

Globally, educators value assistive technologies (AT) for aiding learners with disabilities, though their views depend on their training and institutional support. Shogren et al. (2015) found that teacher confidence in using AT ties closely to the quality and frequency of professional development. Well-trained teachers integrate assistive tools more effectively. Parents focus on their children's confidence, motivation, and engagement, with Alkahtani (2013) noting parental support often comes from personal experience, observing emotional and social improvements before academic gains.

In Africa, perceptions are influenced by cultural beliefs and infrastructure. Donohue and Bornman (2014) note that stigma around disabilities can deter parental and teacher advocacy. However, improved awareness and support from NGOs or donor agencies have led to positive AT experiences where available.

Chapter Three

Methods

3.1 Research Design

This study employs a convergent parallel mixed methods design, which allows for the concurrent collection of both quantitative and qualitative data. This design was selected over other mixed methods options such as explanatory or exploratory sequential designs, because it best suits the need to collect detailed numerical data alongside rich narrative details at the same time. As Creswell and Plano Clark (2018) note, the convergent design is ideal when the aim is to merge and compare results from both strands to gain a more comprehensive understanding of the research problem. The study investigates the role of assistive technologies in supporting the academic development of learners with special educational needs (SEN) under 12 years of age in inclusive basic schools in Ghana. The convergent parallel design aligns well with this objective, as it helps the researcher to simultaneously gather quantitative data from teacher questionnaires regarding the types of assistive technologies used, their frequency, and implementation challenges, while also collecting qualitative data through interviews with teachers and parents to understand their perceptions and experiences.

3.2 Sample

The study targets primary school teachers and parents of learners with special educational needs (SEN) in selected inclusive public schools in Ghana. These individuals were chosen because of their direct roles in using, supporting, or observing assistive technologies within inclusive classroom settings. The sample was structured to align with the study's convergent parallel mixed methods design. In the quantitative sample, all thirty (30) teachers completed structured questionnaires focusing on the types of assistive technologies used, the frequency of use, and the challenges encountered. For the qualitative sample, fifteen (15) participants, made up of ten (10) teachers and five (5) parents, were selected for in-depth interviews using a stratified purposive approach.

3.3 Data Collection Methods and Instruments

In this study, data were collected through structured questionnaires and semi-structured interviews. Structured questionnaires were administered to 30 teachers from the selected inclusive public primary schools. The questionnaires included closed-ended and Likert-scale

questions designed to collect data on the types of assistive technologies used, frequency of use, extent of teacher training, challenges encountered, and perceived impact on students' learning. Structured questionnaires facilitated consistent responses across participants, enabling statistical comparison and descriptive analysis. To complement the survey data, semi-structured interviews were conducted with 10 teachers and 5 parents, guided by open-ended questions exploring participants' experiences, attitudes, and observations regarding assistive technologies in inclusive classrooms.

3.4 Data Analysis

For the quantitative component, data from the structured questionnaires were analysed using descriptive statistical techniques. Frequencies and percentages were calculated to summarise trends in the types of assistive technologies used. These statistics were presented in tables and charts for clarity and ease of interpretation. For the qualitative data, thematic analysis was used to analyse interview transcripts from teachers and parents. This involved reading transcripts, coding meaningful segments, and grouping them into key themes aligned with the study's objectives. Thematic analysis identified recurring views and details regarding the practical use, perceived benefits, and emotional and institutional factors influencing assistive technology application. The data for the questionnaire can be found here (https://drive.google.com/drive/folders/1HH1y0RIEBOhIFar-YAf-Kk9IPOw0msxw?usp=share_link).

3.5 Ethical Considerations

The study followed ethical protocols, receiving approval from an institutional review board. Permission was obtained from the Ghana Education Service and schools. Informed consent was secured from all participants, informing them of their rights. Confidentiality was maintained by anonymizing data and securely storing audio recordings, ensuring information was used only for academic purposes.

Chapter Four

Results

4.1 Demographic Characteristics of Respondents

This section outlines the background characteristics study participants specifically teachers who responded to the questionnaires.

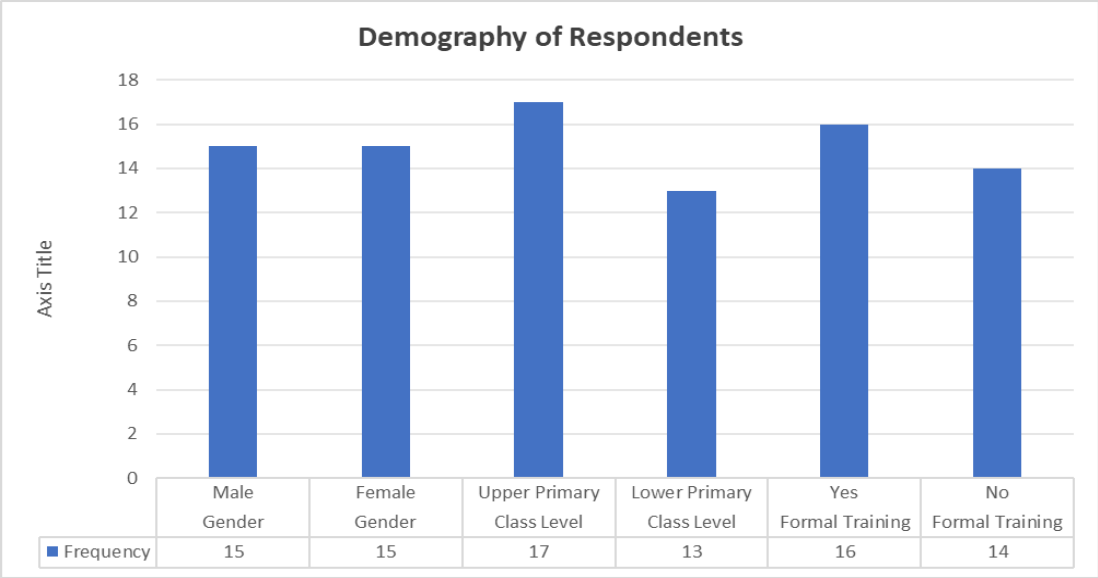

Figure 1: Demographic Characteristics of Respondents

Source: Field study (2025)

The Figure1 shows that the gender distribution among respondents is evenly split between males and females. More teachers teach at the upper primary level than the lower primary level. Additionally, slightly more respondents have received formal training in assistive technology than those without such training. This indicates a balanced gender mix, a higher representation of upper primary teachers, and moderate exposure to assistive technology training among the participants

4.2 Findings

4.2.1 Objective 1: To explore the types of assistive technologies commonly used to support the academic development of SEN learners under twelve in inclusive basic schools

This section presents findings related to the types of assistive technologies that teachers and parents perceived as most effective in supporting the academic performance of learners with special educational needs (SEN).

A Quantitative Analysis

To respond to this question, teachers were asked to indicate the types of assistive technologies they use in their classrooms to support learners with special educational needs (SEN). The focus was on five key tools i.e tablets, screen readers, text-to-speech software, braille tools, and hearing aids. The Figure 2 below summarizes the frequency of reported usage.

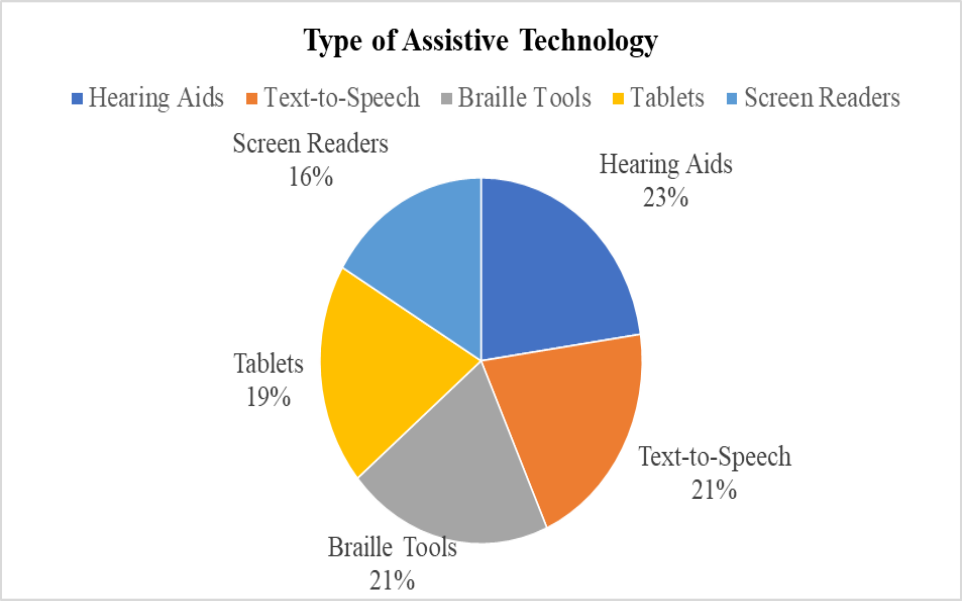

Figure 2: Types of Assistive Technologies Used by Teachers

Source: Field study (2025)

The findings show that hearing aids were the most widely used assistive technology, cited by 73.3% of teachers. This was closely followed by text-to-speech software and braille tools, each used by 66.7% of respondents. Tablets were also commonly used, with a 63.3% usage rate, while screen readers were used by just over half of the teachers (53.3%).

B Qualitative Analysis

The qualitative interviews provided deeper detail into the types of assistive technologies used in inclusive basic schools to support the academic development of learners with special educational needs (SEN). Three major categories of tools emerged consistently across parent and teacher narratives: Tablets and Learning Apps, Text-to-Speech and Speech-to-Text Tools, and Hearing Aids and FM Systems. These technologies were reported to address diverse learning barriers such as reading difficulties, speech limitations, and hearing impairments.

1. Tablets and Learning Apps

Tablets featured prominently as a widely accessible tool that helped learners engage with content both in and outside the classroom. These devices were often preloaded with educational apps that supported reading, spelling, and independent learning. In view of this One parent shared:

> *"The school introduced him to a tablet with specific learning apps… and some tools that help him with reading. He also used some interactive learning things that allow him to work at home alone."* (P1)

In the same light, another parent added:

> *"They have some apps where they go in to have the education, do their research and all that. So it has been easy for them. Whenever they have an assignment, they just go directly to it. Sometimes when they come to the house, they go straight to their notes using the apps."* (P2)

In a different light, a teacher also explained:

> *"Those that are not able to voice out properly can simply type whatever they want to communicate, and you, the teacher, get it easily. It makes learning easier, especially for the shy ones or those with speech problems."* (T1)

2. Text-to-Speech and Speech-to-Text Tools

Text-to-speech and speech-to-text tools were widely appreciated for their role in supporting learners with reading and writing difficulties. These tools enabled learners to access written content, improve communication, and engage more actively in class. One parent described:

> *"He used a reading pen, a text-to-speech app, and a simple spelling app. These tools made a big difference, especially with his reading. He used to avoid reading aloud, but now with the reading pen, he follows along better and even tries to read independently. His vocabulary is better, and he is becoming more comfortable in answering questions."* (P1)

In the same context, one teacher shared:

> *"I find the text-to-speech and speech-to-text tools very helpful. They help students who struggle with reading and writing to understand content. One of my pupils with low vision listens to everything now. The screen reader reads exactly what is on the board or app, and it has made a big difference in how he engages with lessons."* (T4)

Similarly, another teacher added:

> *"One student I had really struggled with writing, and once we introduced speech-to-text, their participation skyrocketed. Before, they would shut down, but suddenly they were even volunteering answers."* (T7)

3. Hearing Aids and FM Systems

Among students with hearing impairments, hearing aids and FM systems were consistently mentioned as essential. These tools were noted to improve listening, reduce frustration, and enhance participation. For instance, one parent noted:

> *"The school gave him a hearing aid tool, and it has been good for him. Before, he did not hear the teachers well, especially when there was a lot of noise. With this tool, he can concentrate much better. He uses a personal FM system that connects directly to his hearing aid. The teacher's voice is louder and clearer… His grades have improved, especially in maths and language classes where listening is important."* (P4)

In the same light, a teacher explained:

> *"The hearing aid is very good for them. It makes them identify things. It makes them hear you when you talk, and it makes them very comfortable and smart in class. At first, without it, you had to shout. Now, you just talk calmly, and they follow."* (T3)

Another teacher shared a broader classroom solution:

> *"Because of the difficulty they had in hearing, I spoke with the authorities, and they installed microphones and big speakers. Now when you speak, everyone hears clearly. Before that, these students would shut down. But now, they raise their hands and join the discussions. They want to be involved."* (T6).

4.2.2 Objective 2: To examine the challenges encountered by teachers and schools in the implementation of assistive technologies

This section presents findings related to the barriers faced by teachers and schools in the use of assistive technologies for supporting learners with special educational needs (SEN).

4.2.2A Quantitative Analysis

Teachers were asked to indicate the major challenges they encountered in implementing assistive technologies. The results are summarized in the Figure 3 below.

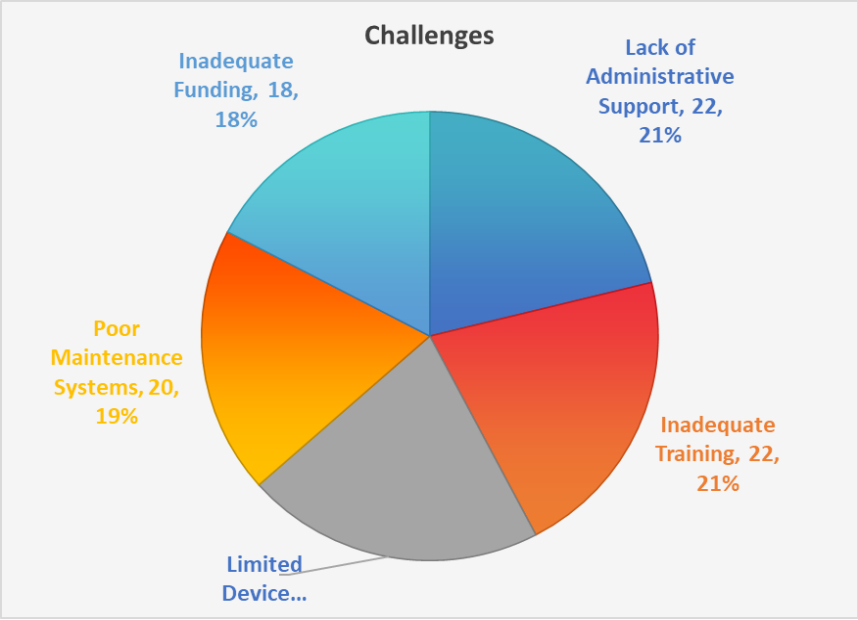

Figure 3: Challenges Teachers and Schools Face in Implementing Assistive Technologies

Source: Field study (2025)

The data shows that the three most common challenges which is lack of administrative support, inadequate training, and limited access to assistive devices were each reported by 73.3% (66) of teachers. Additionally, 66.7% of respondents cited poor maintenance systems as a barrier, suggesting that even when devices are available, keeping them functional is a challenge. Finally, 60% of respondents mentioned inadequate funding, indicating financial constraints as a persistent hurdle.

4.2.2B Qualitative Analysis

The qualitative data reveal several systemic and contextual challenges that hinder the smooth implementation of assistive technologies in inclusive classrooms. Three major themes emerged

and these are lack of teacher training and technical skills, inadequate and outdated equipment, and limited school-level support and infrastructure.

1. Lack of Teacher Training and Technical Skills

A recurring challenge across interviews was the limited training teachers receive on the use of assistive technologies. Many educators reported relying on personal effort, trial and error, or informal peer learning to support learners with special needs. For instance, one teacher explained:

> *"I've not had any training on that. Everything I'm doing now is based on my own experience, what I have tried and what I have achieved. And that's what I've actually learned from my colleagues."* (T4)

Similarly, Teacher 7 noted:

> *"Mostly workshops here and there, but a lot of it has been trial and error. Sometimes we get the tools but don't know which student they fit best."* (T7)

2. Inadequate and Outdated Equipment

Teachers also reported that the tools available were either insufficient in number or technologically outdated. In many cases, students were expected to bring their own devices from home, many of which could not support the necessary applications. In justifying this, teacher 4 shared that:

> *"We don't have enough devices for the students… and the ones they bring from home are also old versions. They can't download apps or use features we need."* (T4)

Teacher 2 pointed out:

> *"Some students have hearing or vision difficulties, but they lack the equipment they need. it becomes hard to adapt the lesson when the tools aren't available."* (T2)

3. Limited School-Level Support and Infrastructure

Even where teachers were motivated to use assistive technologies, they were often constrained by weak institutional support. Poor internet connectivity, unreliable electricity, and absence of technical assistance were common barriers. A teacher commented by saying:

> *"In this country Ghana, for instance, we have a lot of internet issues. it makes it difficult for us to speed up our learning."* (T1)

Similarly, another teacher further explained by revealing that:

> *"The school provided some devices like tablets and smartboards, but the problem was the technical know-how… we didn't get training, so most tools were not integrated properly into lessons."* (T5)

On the other hand, one teacher noted that initial resistance from school leaders also delayed the adoption of assistive technologies. He recounted:

> *"When I started suggesting these tools, even the authorities were not familiar. But after seeing improvement in student performance, they began supporting it more."* (T6)

4.2.3 Objective 3: To describe how assistive technologies are applied in classroom instruction to support the learning needs of SEN learners

This section presents findings on how assistive technologies are applied by teachers during classroom instruction to support learners with special educational needs (SEN).

A Quantitative Analysis

Teachers were asked to indicate how they use specific assistive technologies in their instructional practice and to rate how well each tool supported key academic activities such as reading, writing, listening, and comprehension. Table 1 summarises how these technologies were applied in classroom instruction.

Table 1: Application of Assistive Technologies in Instructional Activities

Assistive Technology	Common Instructional Uses	% of Teachers Applying the Tool in Lessons
Tablets with Learning Apps	Reading practice, spelling games, phonics apps	63.3%
Screen Readers	Reading aloud digital texts, accessing e-books	53.3%
Text-to-Speech Software	Supporting comprehension, decoding written instructions	66.7%
Digital Braille Tools	Reading Braille textbooks, writing assignments	66.7%
Hearing Aids/FM Systems	Enhancing teacher voice clarity, listening during lessons	73.3%

Source: Field Study (2025)

The data indicate that hearing aids and FM systems were most frequently integrated into classroom lessons, with 73.3% of teachers reporting their use to support listening and oral instruction. Text-to-speech software and Braille tools also featured prominently, especially during reading and writing tasks. Tablets were used largely to deliver interactive content such as phonics games or storytelling apps, although their use was more varied across classrooms.

B Qualitative Analysis

Interviews with teachers revealed a deeper understanding of how assistive technologies were being applied in real classroom contexts. Three key themes emerged i.e support for core academic skills, teacher-guided personalisation, and limitations in instructional planning.

1. Support for Core Academic Skills

Several teachers described how assistive technologies were actively used to support core academic skills such as reading, writing, and comprehension. The tools were not treated as supplemental but were integrated into lesson delivery to help SEN learners fully participate. One teacher explained:

> *"I use the Braille device when teaching English. As I read out, she follows along on the device and then writes her answers with it too."* (T2)

Similarly, another participant added:

> *"During reading time, I let my visually impaired learners use the screen reader to follow the passage. It reads while they listen and then answer questions after."* (T5)

In the same light, a third teacher provided further detail:

> *"We use the text-to-speech app in reading time. The child listens to it and responds. It helps them follow the same pace as the class."* (T4).

2. Teacher-Guided Personalisation

Teachers also described how they adjusted assistive technologies to suit the unique needs and preferences of individual learners. This form of personalisation included switching between audio, visual, or tactile formats, depending on what best supported learner understanding. One teacher noted:

> *"Some children need just audio; others prefer pictures. So, I adjust the tablet content or use the text-to-speech function depending on what helps them understand better."* (T4).

Another teacher remarked:

> *"The tablet is very helpful. For one child, I make them listen to phonics audio files. For another, I use more visual content because that's how they learn best."* (T3)

A third teacher also explained:

> *"We don't use the same tool for every child. Some are better with pictures, some with sound. It depends on how they respond."* (T7).

3. Limitations in Instructional Planning

While teachers made efforts to use assistive technologies, many acknowledged that their use was not always based on structured lesson planning. Instead, tools were often introduced informally or experimentally without long-term planning. One teacher admitted:

> *"We use the tools, yes, but not always with a clear method. Sometimes it's just trying what works in the moment."* (T6)

Another explained:

> *"There is no proper plan. We just try to fit the tool into whatever topic we're teaching that day."* (T5)

A third teacher added:

> *"Most of us weren't trained on how to use these tools in the lesson plan. So, we figure it out as we go."* (T1).

4.2.4 Objective 4: To examine how teachers and parents perceive the role of assistive technologies in supporting the academic development of SEN learners

This section presents the perceptions of key stakeholders—teachers and parents—regarding the use of assistive technologies in inclusive classrooms. Data were collected through structured questionnaires and in-depth interviews, consistent with the convergent parallel mixed methods design employed in the study. While the quantitative data highlight general trends, the qualitative

details provide richer understanding of how these technologies are emotionally, pedagogically, and institutionally experienced.

A Quantitative Analysis

The responses of teachers and parents regarding the impact and support for assistive technologies are summarised in Table 2.

Table 2: Stakeholder Perceptions of Assistive Technologies

Statement	Agree (%)	Neutral (%)	Disagree (%)
AT improves child's confidence (parents)	86.7	6.7	6.6
Teachers confident in using AT	60.0	26.7	13.3
School supports AT usage	53.3	33.3	13.4

Source: Field study (2025)

The table shows that a large majority of parents (86.7%) agreed that assistive technologies helped improve their children's confidence. This indicates that parents recognise the emotional and psychological value of these tools, particularly in reducing feelings of isolation and enhancing learner self-esteem. With respect to teachers, 60.0% reported confidence in using assistive technologies, whilst 26.7% expressed neutrality, and 13.3% disagreed.

B Qualitative Analysis

To deepen understanding of the quantitative patterns, interviews with selected teachers and parents were analysed. Three themes emerged from their reflections: perceived emotional and motivational benefits for learners, growing but uneven teacher confidence, and mixed views on institutional support.

1. Perceived Emotional and Motivational Benefits

Parents often described assistive technologies as transformative tools that boosted their children's self-esteem and encouraged active participation in learning. These technologies helped children feel less excluded and more capable. One parent shared:

> *"She used to feel different and left out, but now she sees herself as part of the class. That's what the tablet has done for her."* (P5)

Similarly, another parent added:

> *"He now feels proud when he gets answers right. Before, he used to be silent, but not anymore. He wants to go to school and do his homework without being reminded."* (P8)

Also, third parent reinforced this emotional shift by asserting that:

> *"Even at home, when he learns something new on the tablet, he rushes to show it to me. It's like he finally believes he can do it too."* (P2)

2. Growing but Uneven Teacher Confidence

Teachers expressed varying levels of confidence in using assistive technologies. Some felt increasingly comfortable and noticed improvements in learner engagement, while others acknowledged gaps in training and tool-specific knowledge.

One teacher shared:

> *"I'm getting used to it, and I see the difference it makes. But I still don't know all the features, so I'm learning along the way."* (T2)

Another teacher noted:

> *"We're not always confident. Some teachers are better with the tech than others. It depends on who got training and who didn't."* (T4)

A third teacher observed:

> *"When you see how the tools help the children improve, you want to keep using them. But we don't always have the full knowledge to use them well."* (T7)

3. Mixed Views on Institutional Support

Stakeholder perceptions about school-level support for assistive technologies varied. Some teachers acknowledged the presence of tools or initial efforts by school leadership. However, others reported a lack of planning, delayed maintenance, and absence of structured support systems. One teacher explained:

> *"The school tries its best, but assistive tech isn't yet a priority. If we don't push for it ourselves, nothing happens."* (T1)

In the same light, another teacher added:

> *"We have some tools, yes, but no clear support structure. If something breaks, we just wait or stop using it."* (T6)

Similarly, a third teacher commented:

> *"There is no timetable for maintenance, no one assigned to it. It's like we're on our own with these devices."* (T5)

Chapter Five

Discussion

5.1 Types of Assistive Technologies Perceived as Effective by Stakeholders

The findings revealed that tablets, hearing aids, Braille tools, and text-to-speech software were the most commonly used assistive technologies across inclusive classrooms. This aligns with earlier findings by Alnahdi (2014), who concluded that the most frequently adopted technologies are those that support reading, writing, and listening core competencies in academic settings. Similarly, Dell, Newton, and Petroff (2017) found that devices targeting auditory and visual impairments are often the first introduced in resource-constrained schools.

However, the relatively low use of screen readers despite their relevance for visually impaired learners raises questions about training and exposure. This contrasts with studies in more developed contexts, such as Kennedy and Deshler (2010), where screen readers are standard tools for learners with print disabilities. The variation may reflect contextual limitations in digital infrastructure or limited teacher competence in Ghanaian schools, suggesting that the availability of tools does not automatically translate into effective use. The findings also affirm the utility of the Universal Design for Learning (UDL) framework, which emphasises the need for multiple means of engagement and representation. Yet, unlike in settings where UDL is systematically embedded, the Ghanaian context reflects a more organic, teacher-led adoption rather than a policy-driven design. This highlights a gap between theory and practice, especially where formal instructional models are lacking.

5.2 Challenges in Implementing Assistive Technologies

The study identified several major implementation challenges: lack of teacher training, insufficient and outdated equipment, poor maintenance systems, and weak administrative support. These findings echo the work of Alkahtani (2013), who documented similar barriers in low-resource contexts, particularly in relation to outdated infrastructure and insufficient investment in assistive tools. Teachers in this study reported relying on peer learning and trial-and-error strategies to apply tools in the absence of structured training. This mirrors the observations made by Donohue and Bornman (2014), who argue that many inclusive education policies in Africa fail at the implementation stage due to weak capacity-building strategies.

The findings here support that claim and further suggest that informal workarounds, though well-intentioned, are not sustainable in the long term. Interestingly, the results challenge optimistic assumptions in some literature that once technologies are introduced, inclusion naturally follows. For instance, whereas Judge, Floyd, and Jeffs (2008) posited that the presence of assistive technologies significantly enhances learning outcomes, the current study suggests that without adequate training and system support, the tools may underperform or even be abandoned. This contradiction highlights the importance of viewing assistive technology not as a standalone intervention but as part of a coordinated educational ecosystem.

5.3 Classroom Application of Assistive Technologies

The findings revealed that assistive technologies were being applied in classroom instruction to support reading, writing, comprehension, and communication. These applications were mostly improvised rather than guided by formal lesson planning. Teachers often adapted tools based on their knowledge of learner needs, which shows initiative but also exposes the absence of systemic integration. This aligns with Okolo and Diedrich's (2014) observation that assistive technologies are often implemented in fragmented ways, especially where inclusive pedagogies are not embedded into teacher education.

The reliance on personalised content delivery where teachers switch between audio, visual, and tactile content supports the learner-centred orientation of inclusive education. This is consistent with the principles of Universal Design for Learning, which Meyer, Rose, and Gordon (2014) argue are essential for reaching diverse learners. However, unlike in contexts where differentiation is built into curriculum planning, the adaptations in this study occurred on an ad hoc basis, confirming the concerns raised by Florian and Spratt (2013) about over-reliance on individual teacher initiative in inclusive practice. Also, the integration of these tools within the framework of the classroom echoes Vygotsky's theory that learning is mediated through tools and social interaction. Yet, the absence of structured scaffolding in lesson planning suggests that while tools are present, their potential as cognitive mediators may not be fully realised. This partial alignment with theory signals a important implementation gap.

5.4 Stakeholder Perceptions of Assistive Technology

The results revealed that parents viewed assistive technologies as transformative for their children's confidence, participation, and academic motivation. This supports the findings of

Bouck (2015), who argued that assistive tools contribute to learner independence and emotional development, especially when aligned with the learner's strengths. Similarly, Cullen et al. (2017) observed that technologies enhance not only academic access but also student identity and sense of belonging an observation echoed strongly by parents in this study.

Teacher perceptions, however, were more dynamic. While many acknowledged the benefits of assistive tools, others noted a lack of confidence and uneven training. This aligns with Bouck and Flanagan's (2010) research which found that teacher buy-in is strongest when schools invest in continuous professional development. The study's finding that only 60 percent of teachers felt confident in using assistive tools reveals that training gaps persist, thereby limiting the full benefits of technology use. On the other hand, there is partial contradiction with studies such as Edyburn (2004), which assume that teachers become effective users of assistive technologies with minimal guidance. In contrast, this study highlights that without structured institutional support, training, and follow-up, even well-designed tools may not be used effectively. The results affirm that policy intentions must be supported with operational clarity at the school level, especially around technical maintenance and resource allocation.

Chapter Six
Conclusions and Recommendations

6.1 Conclusions

Based on the findings, it can be concluded that assistive technologies play a significant role in improving the academic and emotional development of learners with special educational needs. Tools such as tablets, screen readers, and text-to-speech software have proven effective in promoting literacy, autonomy, and classroom participation. Several systemic challenges. Without adequate funding, structured training, and institutional support, the full benefits of assistive tools may not be realised. Teachers' willingness to use these tools is evident, but their efforts are often hampered by a lack of technical support and leadership direction. Moreover, stakeholder perceptions strongly influence the success of assistive technology implementation. When teachers and parents recognise the value of these tools, they are more likely to support and reinforce their use. Creating inclusive classrooms therefore requires not just technological investment, but also a shift in school culture, leadership priorities, and capacity development.

6.2 Recommendations

In light of the findings, the study recommends that policy makers take deliberate steps to integrate assistive technologies into national education strategies. This should include the establishment of dedicated funding mechanisms for the procurement and maintenance of such tools and the development of regulatory standards to ensure the quality and relevance of devices supplied to public schools. Education authorities, particularly the Ghana Education Service, are encouraged to design and implement structured in-service training programmes that equip teachers with the technical and pedagogical skills required for effective use of assistive technologies. Furthermore, schools should appoint inclusion coordinators or resource persons to provide on-site support to teachers, ensure proper device use, and track learner outcomes.

School leadership should prioritize assistive technology in improvement plans by maintaining devices and fostering a supportive environment for teacher integration. Teachers should aim for continuous development, collaborate with peers, and provide feedback on technology use. Further research is essential to understand the long-term effects on SEN learners in Ghana. Comparative studies in rural vs. urban areas can identify disparities, while teacher-led research can develop classroom-specific strategies.

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Appendices

Appendix 1: Teacher Questionnaire

Section 1: Demographic Information

1. What is your gender?
    a. Male [ ]
    b. Female [ ]
2. What class level(s) do you currently teach?
    a. Lower Primary [ ]
    b. Upper Primary [ ]
3. Have you received formal training in using assistive technologies?
    a. Yes [ ]
    b. No [ ]

Section 2: Use and Perception of Assistive Technologies

4. Which of the following assistive technologies do you currently use in your classroom? (Tick all that apply)
    a. Tabletswith learning apps [ ]
    b. Screen Readers [ ]
    c. Text-to-Speech software [ ]
    d. Digital Braille tools [ ]
    e. Hearing aids/FM systems [ ]
5. In your experience, which of the above tools are most effective in supporting SEN learners academically? (Select top 3)
    a. Tabletswith learning apps [ ]
    b. Screen Readers [ ]
    c. Text-to-Speech software [ ]
    d. Digital Braille tools [ ]
    e. Hearing aids/FM systems [ ]

6. Rate your level of confidence in using assistive technologies
    a. Very confident [ ]
    b. Confident [ ]
    c. Neutral [ ]
    d. Not confident [ ]
7. Does your school provide sufficient support for the use of assistive technologies?
    a. Yes [ ]
    b. No [ ]
    c. Partially [ ]
8. In your opinion, how much impact have assistive technologies had on the academic performance of SEN learners?
    a. High [ ]
    b. Moderate [ ]
    c. Minimal [ ]
    d. None [ ]

Section 3: Challenges in Using Assistive Technologies

9. Which of the following challenges do you face when using assistive technologies? (Select all that apply)
    a. Inadequate funding [ ]
    b. Lack of training [ ]
    c. Maintenance issues [ ]
    d. Limited access to modern devices [ ]
    e. Lack of administrative support [ ]
10. Would you recommend increased use of assistive technologies in inclusive education?
    a. Yes [ ]
    b. No [ ]
    c. Not sure [ ]

Appendix 2: Teacher Interview Guide

Introductory Questions

1. Can you describe your experience working with learners with special educational needs (SEN)?
2. How familiar are you with assistive technologies?

Core Questions

3. In your own words, which assistive technologies do you find most helpful in supporting the academic performance of your SEN learners? Why?
4. Have you observed any changes in students' academic behaviour or performance after using assistive technologies?
5. What has been your level of training or preparation in using these technologies?
6. Can you describe any difficulties you face in applying assistive technologies in your classroom?
7. How would you describe the support you receive from your school regarding assistive technology?
8. Do you feel assistive tools improve the independence and confidence of SEN learners? Can you give examples?
9. If you could change or improve anything about assistive technology use in your school, what would it be?

Appendix 3: Parent Interview Guide

Introductory Questions

1. Tell me about your child's educational experience in an inclusive classroom.
2. Has your child been exposed to any assistive technologies at school?

Core Questions

3. What assistive tools has your child used, and how do you feel they have helped your child academically?
4. Have you observed any changes in your child's attitude or confidence since using assistive technologies?
5. Are there any challenges you've faced as a parent regarding access or use of assistive technologies?
6. Do you feel included or informed by the school about your child's learning support tools?
7. What additional support do you think schools or teachers need to improve their use of assistive technologies?
8. Have you taken any steps at home to support your child's use of these tools?

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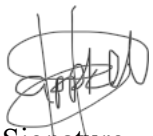
Author's Declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.

Benjamin Kelly Appiah  29/05/2025

(Student) Signature Date

Natalia Edisherashvili ……...…..……. ……..…..……..

(Supervisor) Signature Date

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List of Abbreviations

AT	Assistive Technologies
CAST	Center for Applied Special Technology
DfE	Department for Education
EHCPs	Education, Health, and Care Plans
GES	Ghana Education Service
IDEA	Individuals with Disabilities Education Act
NGOs	Non-governmental Organizations
SEN	Special Educational Needs
SEND	Special Educational Needs and Disabilities
UDL	Universal Design for Learning
UNESCO	United Nations Educational, Scientific, and Cultural Organization
ZPD	Zone of Proximal Development

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