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Technological Inclusivity and Equity for Students with Visual Impairments in Ghanaian Teacher Education: Examining the Role of Assistive Technologies

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ABSTRACT

This study examines the impact of access to assistive technologies (AAT) on inclusive practices for equitable educational experiences (IPEEE) for students with visual impairments (SVIs) in colleges of education (CoEs). A mixed-methods approach utilising a convergent parallel research design was implemented. Data were gathered from 20 SVIs within three special needs-designated CoEs. Data were collected using a self-administered structured questionnaire that utilised a four-point Likert-type scale. The analysis employed Pearson's correlation, utilising IBM SPSS version 27. The Pearson correlation analysis indicated a weak positive relationship between AAT and IPEEE ($r = 0.236$, $p = 0.317$). This suggests that while access to assistive technologies may enhance inclusive practices, it is insufficient to ensure equitable educational experiences for SVIs. The findings underscore the need for a holistic approach that integrates institutional support, pedagogical inclusion, and systemic enhancements in technology utilisation. The research underscores the necessity of addressing systemic and attitudinal barriers to achieve comprehensive and inclusive education.

INTRODUCTION

Inclusive education is a crucial global necessity in the 21st century as nations strive to fulfil the objectives of the United Nations' Sustainable Development Goals (SDGs). SDG 4 aims to provide inclusive and equitable quality education for all, with Target 4.4 emphasising the importance of infrastructure that accommodates individuals with disabilities and access to assistive technology (UNESCO, 2017). Students with visual impairments require equipment such as screen readers, braille displays, and magnifying devices to participate fully in and access education. The literature shows that access to assistive technology remains unequal. For example, nearly 1 billion people worldwide who need assistive technologies lack access to them, and this issue is particularly severe for students in low- and middle-income countries (UNICEF, 2017; WHO, 2019).

In Ghana, visual impairment represents the most common form of disability, affecting approximately 4% of the population (Ghana Statistical Service, 2021). While the Ghanaian government has enacted the Persons with Disability Act (Act 715), ratified the UN Convention on the Rights of Persons with Disabilities, and introduced a national inclusive education policy in 2015, implementation challenges persist due to limited resources, inadequately trained educators, and the absence of comprehensive support systems in many educational institutions (Kuyini et al., 2016). These challenges are particularly pronounced in Colleges of Education (CoEs), which are responsible for preparing the next generation of teachers. Despite their strategic importance in shaping inclusive classroom practices nationwide, many CoEs struggle to provide

equitable learning environments for SVIs, who continue to face barriers related to access, pedagogy, and participation.

This study investigates the relationship between access to assistive technologies and inclusive practices among students with visual impairments (SVIs) in Ghana's CoEs. This research is significant for three reasons: it provides quantitative baseline data to inform policy and institutional strategies for inclusive education, offers insight into the educational realities of SVIs in teacher education, and serves as a foundation for investments in assistive technology and capacity-building programs in low- and middle-income countries (LMICs).

The study is guided by three research questions: (1) What is the level of access to assistive technologies among SVIs in Ghana's CoEs? (2) How do SVIs perceive the inclusiveness and equity of their educational experiences? (3) What is the nature and strength of the relationship between access to assistive technologies and inclusive educational experiences among SVIs?

This study employs a mixed-methods design prioritising qualitative insights with quantitative elements. It uses a purposive sample from CoEs in Ghana for special needs. The approach was selected to capture both the measurable extent of AT access (RQ1) and the nuanced perceptions of inclusion (RQ2), while allowing for correlation analysis (RQ3) within this specialised population. The purposive sampling strategy targets the specific CoEs designated for special needs education, where SVIs are concentrated.

By combining narrative insights with measurable data, the study provides a comprehensive understanding of the relationship between AT and inclusion. Although the purposive sample limits broad statistical generalisability, the findings offer contextually grounded insights. The inclusion of quantifiable indicators enhances evidence-based decision-making, while the qualitative depth ensures that policy recommendations reflect the realities of resource-constrained educational settings in Ghana.

LITERATURE REVIEW

Global Perspectives on Assistive Technology Access for Students with Visual Impairments

Globally, inclusive education has become a vital framework for advancing equity and access in learning environments. The United Nations Sustainable Development Goal 4 emphasises inclusive and equitable quality education, with Target 4.4.a specifically calling for disability-sensitive educational facilities and access to assistive technologies (UNESCO, 2020). Assistive technologies (ATs), including screen readers, magnification tools, braille displays, and audio learning devices, are central to educational inclusion for SVIs. Despite their accepted significance, access to AT remains very uneven, particularly in low- and middle-income countries (LMICs).

According to a joint report by the World WHO and UNICEF (2022), approximately one billion people worldwide do not have access to the assistive items they require, with LMICs facing the most severe shortfalls owing to underfunded health and education systems. In low-income countries, AT provision is often limited to low-tech aids such as white canes and braille slates, while access to high-tech solutions is scarce and mostly confined to externally funded initiatives or urban centres. A global report on assistive Technology by WHO (2022) notes that in many developing contexts, assistive technology interventions are not integrated into systemic educational planning, making their reach both inconsistent and unsustainable.

Although screen-reading tools like the Dolphin Pen have shown potential in Kenya and Tanzania, they are still out of reach for the majority due to their high cost and lack of institutional commitment (Ogeto, 2025). This restricted access creates an educational gap for SVIs, who, although having the cognitive potential to achieve, are frequently unable to engage effectively in learning contexts. Studies in low-income regions outside of Africa have reported similar challenges. In India, assistive technology experience facilities have given visually impaired students access to digital magnifiers and braille equipment. However, the

COVID-19 epidemic substantially hampered access, underscoring the fragility of technology-based inclusion measures (Mishra, 2023).

In Southeast Asia, experimental projects in Cambodia and Laos adopted mobile reading software with text-to-speech capabilities; nevertheless, these initiatives faced issues with language localisation, user literacy, and smartphone adoption (UNESCO, 2025). These instances demonstrate that the success of AT integration is heavily reliant on context-specific infrastructure, cultural preparedness, and regulatory support.

Assistive Technology Access in Sub-Saharan African Educational Contexts

The promise of inclusive education across Africa remains constrained by infrastructural, financial, and systemic limitations. Isolated initiatives aimed at improving the availability of assistive technologies are often donor-driven and tend to be unsustainable. The literature indicates that fewer learning resources in sub-Saharan Africa are available in easily accessible formats, which makes it difficult for students with visual impairments to study (Le Fanu et al., 2022). Additionally, inadequate teacher preparation, negative attitudes, and limited institutional support can render inclusive policies less effective. It is reported that assistive technology is still not widely used in places like Kenya, Nigeria, and Ethiopia since there isn't enough money, localised material, or technical knowledge (WHO, 2022).

Research in Uganda identified several challenges that hinder the learning and performance of SVIs in educational settings. These challenges include inadequate professional skills among specialised teachers in utilising assistive technologies, as well as insufficient financial support from the government, among others (Peter & Tumwesigye, 2025). The findings demonstrate that simply providing AT is inadequate unless it is supported by institutional capacity building and user assistance.

In Nigeria, Dabi and Golga (2024) found that 36% of visually challenged young people were aware of assistive technologies, but only 17% used them. High prices, a lack of technical expertise, poor infrastructure, and an erratic electricity supply were among the obstacles. Significant obstacles face older people, who frequently exhibit uneasiness with digital devices and doubt their educational benefits. The observed pattern of insufficient uptake, despite substantial knowledge, reveals a notable gap between policy objectives and their implementation. This is especially apparent in underfunded public institutions, where the acquisition and maintenance of assistive technologies are often overlooked.

Despite these challenges, promising efforts are emerging. The World Intellectual Property Organisation (WIPO) Accessible Books Consortium (ABC), a global initiative under the Marrakesh Treaty framework, has significantly increased the availability of educational materials in accessible formats through partnerships with publishers and libraries in low- and middle-income countries (LMICs) (WIPO, 2019). In Eswatini, the integration of inclusive education principles into teacher education programmes has enabled some visually impaired students at the University of Eswatini to access braille printers and screen-reading software (UNICEF, 2021). These achievements underscore the significance of institutional commitment, capacity development, and sustainable investment in expanding educational access for students with visual impairments.

The Ghanaian Context: Policy Frameworks and Implementation Realities

In Ghana, visual impairment represents the most common form of disability, affecting approximately 4% of the population (Ghana Statistical Service, 2021). While the Ghanaian government has enacted the Persons with Disability Act (Act 715) and ratified the UN Convention on the Rights of Persons with Disabilities (CRPD), implementation challenges persist. The national inclusive education policy, introduced in 2015, has faced setbacks due to limited resources, poorly trained educators, and the absence of comprehensive support systems in many educational institutions (Kuyini et al., 2016). These issues are

particularly salient in CoEs, which are responsible for preparing the next generation of teachers. Despite their strategic importance, many CoEs struggle to provide inclusive learning environments for students with disabilities, especially SVIs, who continue to face barriers related to access, pedagogy, and participation.

In the context of Ghana, existing literature highlights similar trends. Although Ghana's inclusive education policy and legal frameworks, such as Act 715 and the ratification of the CRPD, demonstrate a formal commitment to inclusion, the implementation remains fragmented and under-resourced (Kuyini & Desai, 2020). Research demonstrates that students with visual impairments (SVIs) in Colleges of Education face persistent challenges, including inaccessible instructional materials, a lack of trained faculty, and insufficient assistive devices (Akyeampong, 2023; Leonhardt & Teferra, 2024; Salifu, 2024).

Although some institutions have assistive devices available, their underutilisation is often linked to staff unfamiliarity and a lack of user training programmes. Consequently, students with visual impairments continue to face marginalisation within teacher education settings. This gap between policy and practice underscores the need for empirical research that examines not only the availability of assistive technologies but also their effective integration into inclusive pedagogical practices.

Theoretical Frameworks: The Social Model of Disability and Universal Design for Learning

This research is grounded in two interconnected theoretical frameworks. The Social Model of Disability (SMD) and the Universal Design for Learning (UDL) framework. These models provide a robust conceptual framework for comprehending the relationship between access to assistive technology and inclusive practices that promote equitable educational experiences for SVIs. These frameworks emphasise the significance of systemic and structural obstacles, redirecting attention from individual limitations to the learning environment's influence on promoting or obstructing inclusion.

The Social Model of Disability

The Social Model of Disability, initially proposed by Oliver Oliver (2013), contradicts the conventional medical model that perceives disability as a personal condition. It asserts that disability arises from the interplay between persons with disabilities and the attitudinal, institutional, and environmental obstacles that impede full societal involvement. This model illustrates how institutional policies, pedagogical methods, and infrastructure may either marginalise or empower students with disabilities within the educational context.

Several studies have used the Social Model to explore how inaccessible curricula, underprepared teachers, and a lack of support systems are primary causes of exclusion in educational settings, rather than disabilities alone (Donald & Frank, 2023; Kattari et al., 2017; Shakespeare & Watson, 2022). This model allows for an investigation into how the availability, or lack, of assistive technology impacts the inclusion or exclusion of visually impaired students in educational institutions. In the context of this study, the Social Model offers a framework for examining how systemic barriers in Ghana's Colleges of Education, such as inadequate infrastructure, limited provision of assistive technology, and insufficient teacher training, contribute to the educational exclusion of students with visual impairments.

Universal Design for Learning (UDL)

The Universal Design for Learning framework, created by the Centre for Applied Special Technology (CAST), complements this approach (CAST, 2018). This framework promotes the creation of curriculum, assessments, and learning environments that are inherently inclusive and adaptable (Gronseth & Dalton, 2019). It underscores the necessity of providing multiple means of interaction, representation, and expression to accommodate the unique educational needs of all students, including those with disabilities.

Studies conducted by Al-Azawei et al. (2017) and Rao et al. (2021) demonstrate that the UDL principles significantly enhance academic equity and reduce learning barriers. This study used UDL as a normative

framework to evaluate the integration of assistive technology into comprehensive inclusive teaching practices, rather than treating them as mere afterthoughts or isolated adjustments. The UDL framework allows the research to assess whether assistive technologies in Ghana's CoEs are being implemented as part of a holistic, proactive approach to inclusion or merely as reactive accommodations.

Research Gap and Study Contribution

This review highlights key insights into the study. While assistive technologies promote educational inclusion, their effectiveness is influenced by factors like institutional readiness, user training, and supportive infrastructure. Access alone is insufficient; knowledge, comfort, and system support are also crucial. The literature shows a lack of quantitative research on the correlation between access to assistive technology and educational inclusion, especially in teacher training institutions in low-income contexts.

Several studies have qualitatively explored the challenges faced by SVIs in Ghana, but there is a lack of empirical research that quantitatively examines the relationship between access to assistive technologies and the inclusiveness of educational experiences in tertiary teacher training institutions. This study investigates whether access to assistive technologies is associated with inclusive practices and equitable educational experiences (IPEEE) among SVIs in Ghana's special needs-designated Colleges of Education.

This study investigates the relationship between access to AT and inclusive educational practices for SVIs at Ghana's special needs-designated CoEs. It provides empirical evidence from a developing country, contributing to the global conversation on inclusive education and offering policy insights for stakeholders in teacher education. The study examines how technology, pedagogy, and institutional culture influence the educational experiences of students with visual impairments. By situating assistive technology within these frameworks, the research evaluates the accessibility of devices for SVIs and how this access facilitates meaningful inclusion and equitable participation.

METHODOLOGY

This study used a mixed-methods design to explore the relationship between access to assistive technologies and inclusive practices for students with visual impairments in Ghana's special needs Colleges of Education. To address the limitations of the accessible population and gain a deeper understanding, it combines quantitative survey data with qualitative elements to examine the experiences of this underserved group (Creswell & Creswell, 2018). The exploratory nature of the research acknowledges the limited sample size and the early stage of investigation into assistive technology access for SVIs in Ghanaian tertiary institutions.

This research was designed as a cross-sectional exploratory study combining quantitative and qualitative approaches. The quantitative component used a structured questionnaire to gather standardised data on assistive technology access and inclusive educational practices, while qualitative elements, including open-ended survey items and contextual observations, captured the nuanced experiences of participants. This mixed-methods approach was necessary to address the limitations of the small sample size and to provide depth that purely quantitative analysis cannot achieve.

Data were collected from a purposive sample of 20 SVIs enrolled in three CoEs designated for special needs students in Ghana (Lakens, 2022). These institutions were selected based on their official mandate to promote inclusive education and their historical commitment to admitting students with disabilities. The purposive sampling strategy was necessitated by the extremely limited population of SVIs within tertiary institutions in Ghana a reality that reflects broader systemic barriers to educational access for persons with visual impairments in the country.

The sample size of n = 20 is a significant limitation for quantitative analysis. A post-hoc power analysis using G*Power 3.1 revealed that with this sample size, the statistical power to detect a medium-to-large

correlation ($r = 0.50$) at $\alpha = 0.05$ (two-tailed) is approximately 0.56, well below the recommended threshold of 0.80 for adequate statistical power (Cohen, 1988). This indicates that the study is underpowered and may fail to detect meaningful relationships. Consequently, any non-significant findings (such as $p = 0.317$ for the correlation between assistive technology access and inclusive practices) should be interpreted with caution, as they may reflect insufficient statistical power rather than a true absence of relationship.

Several potential sources of bias must be acknowledged. First, purposive sampling introduces selection bias, as participants were not randomly selected from the broader population of SVIs in Ghana. The sample is limited to students enrolled in designated special needs institutions, which may differ from SVIs in mainstream institutions or those unable to access tertiary education. Second, the small sample size increases the risk of sampling error and limits the generalisability of findings. Third, self-selection bias may be present, as students who chose to participate may have stronger opinions or different experiences than those who declined. Given these limitations, findings from this study should be considered preliminary and exploratory rather than definitive or generalisable to the wider population of SVIs in Ghanaian higher education.

The data collection instrument was a structured questionnaire with four sections (A through D). Section A collected demographic information, including gender, age, academic level, programme of study, and type of visual impairment. Section B was divided into two parts: B1 focused on the availability of inclusive devices, and B2 addressed institutional policies for providing assistive technology to students with visual impairments. Section C investigated students' educational experiences and perceptions of academic and social inclusion. Section D examined access to assistive technology (AAT) and inclusive practices for equitable educational experiences (IPEE).

The instrument included 40 closed-ended items to assess participants' perceptions of the availability, accessibility, and effectiveness of assistive technology, as well as the inclusiveness of their learning environments. Items were scored on a four-point Likert scale from 1 (strongly disagree) to 4 (strongly agree), enabling quantification of attitudes and experiences. This scale was chosen to eliminate neutral options and encourage clear responses. However, the lack of a neutral midpoint may polarise responses on issues perceived as ambiguous. Additionally, the questionnaire featured three open-ended questions in Section C for participants to elaborate on their experiences, adding qualitative depth to the quantitative data.

To enhance the instrument's rigor, validity procedures went beyond internal consistency reliability. Content validity was established through a review of literature on inclusive education and assistive technology, ensuring alignment between questionnaire items and theoretical constructs. Experts in special education reviewed the instrument for clarity and relevance, and revisions were made based on their feedback. Face validity was supported through a pilot review with a small group of SVIs to ensure accessibility and clarity. Construct validity was grounded in frameworks of technological inclusion and educational equity; however, due to the limited sample size, factor analytic procedures were not conducted. Thus, construct validation remains preliminary and requires further examination in future studies with larger samples.

Internal consistency reliability was assessed using Cronbach's alpha coefficients in IBM SPSS Statistics version 27. The alpha coefficients for the five constructs ranged from 0.60 to 0.81. The IPEEE construct had an alpha of 0.60, which is minimally acceptable in exploratory research, especially with subscales containing few items. The overall instrument demonstrated good reliability ($\alpha = 0.81$), indicating satisfactory internal consistency across items measuring technological inclusivity and equitable educational experiences.

Ethical approval for the study was obtained from the institutional review authority before data collection. Participation was voluntary, and informed consent was secured from all participants after they received information about the study's purpose, procedures, and confidentiality. Accessibility

accommodations were implemented for students with visual impairments, including accessible formats and assistance upon request. Participants were informed of their right to withdraw at any time without penalty, and measures were taken to ensure the anonymity and confidentiality of their responses. No incentives were offered to avoid coercion. Data were securely stored in password-protected digital files and locked physical cabinets that were accessible only to the research team. No personally identifiable information was included in the study findings.

Data collection took place over three weeks. Institutional permission was obtained from the administrations of the three participating colleges. The researcher administered the questionnaire on-site, providing accessibility accommodations and allowing participants to seek clarification. All participants had visual impairments; therefore, attention was given to accessibility. The questionnaire was available in multiple formats: a large print version (18-point font) for those with partial sight and oral administration for totally blind participants. Adequate time was given to complete the questionnaire, and the researcher was available for questions. Completed questionnaires were collected immediately.

Data were analysed using IBM SPSS Statistics Version 27 (Field, 2018). Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarised demographic characteristics and item-level responses. Due to significant limitations in statistical power, inferential analyses were conducted with caution. Pearson's product-moment correlation coefficient explored the relationship between access to assistive technology and inclusive educational practices, but the correlation findings were interpreted as a preliminary exploration rather than a definitive test.

Given these limitations, the findings of this study should be seen as exploratory and hypothesis-generating rather than confirmatory. The study offers preliminary insights into the experiences of SVIs in Ghanaian colleges of education and highlights areas for future investigation. However, conclusions must be tentative, and replication with larger, more diverse samples is essential before any firm generalisations can be drawn.

RESULTS AND DISCUSSION

Results

Demographic Data

The demographic data requested from the SVIs includes gender, age, academic level, degree programme, and characteristics of visual impairments. Analysing the characteristics of the twenty student respondents is essential for contextualizing the findings. The distribution of variables such as gender, age, academic level, and type of visual impairment could significantly affect students' experiences and access to inclusive technology in educational environments. The gender representation was balanced, with ten male and ten female participants, each constituting 50% of the total. This parity ensures equal representation of perspectives from both male and female students with visual impairments. The age distribution indicated that the majority of respondents (70%) were between 23 and 27, while smaller groups were aged 18-22 (15%), 28-32 (5%), and 33 and up (10%). This suggests that most participants were likely familiar with digital technologies.

In terms of academic level, 55% of participants were Level 300 students, while 45% were Level 200. This distribution indicates that the respondents had adequate exposure to institutional structures and technological resources. Regarding academic programmes, 80% of the students were enrolled in the B.Ed. Junior High School program, reflecting both institutional enrolment trends and the technical demands of junior high education. In terms of visual impairment, 60% of the students were partially sighted, and 40% were blind, facilitating a comparison of experiences across various degrees of visual ability. Overall, the

demographic profile revealed a young and relatively experienced group of students, whose characteristics provided a solid foundation for investigating technological inclusion and equity.

Educational Experiences of SVIs in CoEs

This section summarises the findings of SVIs' educational experiences in CoEs, as acquired through Section C of the student questionnaire. The study focused on students' attitudes towards digital literacy, academic involvement, the availability and accessibility of assistive technology, social support, and academic inclusion.

Table 1: Results on Students' Educational Experiences

Items	SD	D	A	SA	Mean (Std Deviation)	Position
I have the digital literacy skills to engage with assistive technologies in my college.	2(10.0)	4(20.0)	5(25.0)	9(45.0)	3.1(1.1)	3rd
I receive adequate academic support from lecturers in using assistive technologies.	3(15.0)	6(30.0)	8(40.0)	3(15.0)	2.6(1.0)	7th
The available technologies make it easier for me to participate fully in class.	2(10.0)	4(20.0)	7(35.0)	7(35.0)	3.1(1.0)	4th
I feel included in the academic environment of my college.	3(15.0)	3(15.0)	9(45.0)	5(25.0)	2.8(1.0)	5th
There is social support and understanding from peers and lecturers.	1(5.0)	3(15.0)	9(45.0)	7(35.0)	3.1(0.9)	2nd
The academic materials provided by lecturers are accessible to me.	1(5.0)	7(35.0)	7(35.0)	5(25.0)	2.8(0.9)	5th
My academic performance has improved due to the use of assistive technologies.		1(5.0)	14(70.0)	5(25.0)	3.2(0.5)	1st
I do not face any challenges when it comes to accessing course materials because of assistive technologies.	1(5.0)	7(35.0)	8(40.0)	4(20.0)	2.8(0.9)	6th
I can fully participate in group discussions and other class activities using available technologies.	1(5.0)	2(10.0)	11(55.0)	6(30.0)	3.1(0.8)	2nd

Mean of Means = 2.9→Agree; Mean of Standard Deviation = 0.9 ***Source****: Field Data – Students' Questionnaire (April, 2025)* ***Key****: N = 20, Strongly Disagree (SD) = (1.00 – 1.74); Disagree (D) = (1.75 – 2.49); Agree (A) = (2.50 – 3.24); Strongly Agree (SA) = (3.25 – 4.00)*

Table 1 demonstrates that the statement "My academic performance has improved due to the use of assistive technologies" received the highest level of agreement from students, reflected by a mean score of 3.2 (SD = 0.5). This suggests that the majority of respondents in this small sample acknowledge a favourable relationship between academic results and the use of assistive technologies. A mean score of 3.1 was also found for elements related to perceived social support and group discussion involvement, both of which showed high levels of agreement. These descriptive findings from this sample indicate that assistive technologies may enhance peer interaction and engagement in classroom activities, though confirmation with larger samples is necessary.

The question that addressed academic assistance from lecturers in the use of assistive technology had the lowest mean score (M = 2.6, SD = 1.0). This score suggests relatively low levels of perceived instructional assistance among respondents in this sample, implying that these students may not be receiving appropriate supervision while using assistive technologies for academic reasons. Another item with a lower mean score (M = 2.8) addressed issues in accessing course materials, demonstrating that educational resources are not always available or usable, even when assistive aids are present.

The mean of the nine questionnaire items was 2.9, placing the entire result in the "Agree" category based on the grading system used. This finding suggests that students in this sample, on average, report generally positive perceptions of their educational experiences, particularly in terms of academic success and inclusiveness. However, the diversity in results across questions reveals potential deficiencies in institutional assistance, notably from teaching professionals, as well as accessibility to learning materials. These descriptive findings from this small exploratory sample suggest that, while technology tools may help SVIs achieve academic inclusion, additional focused interventions may be needed to improve the instructional and institutional support required to enable complete inclusiveness and equality in the learning environment. These patterns warrant further investigation with larger, more representative samples.

Access to Assistive Technologies by SVIs in CoEs

The first research question sought to find out how access to assistive technologies by SVIs in the Coes. This section explicitly examined how SVIs' access to key assistive equipment, such as screen readers, Braille embossers, and other digital tools, promotes inclusive learning. The questions further enquired about the ease of access, institutional support systems, and comfort of employing these technologies in academic contexts.

The results were analysed into frequencies of mean and SD and presented in Table 2.

Table 2: Results on Access to Assistive Technologies

Items	SD	D	A	SA	Mean (Std Deviation)	Position
I have access to screen-reading software (e.g., JAWS, NVDA) when needed.	5(25.0)	4(20.0)	4(20.0)	7(35.0)	2.7(1.2)	1st
I have access to Braille embossers when necessary for my studies.	14(70.0)	6(30.0)	0(0)	0(0)	1.3(0.5)	8th
The college provides personal devices (e.g., laptops, tablets) with assistive software for students with visual impairments.	17(85.0)	3(15.0)	0(0)	0(0)	1.2(0.4)	10th
I have access to audio textbooks or recorded lectures.	9(45.0)	4(20.0)	5(25.0)	2(10.0)	2.0(1.1)	5th
I experience technical difficulties with the assistive technologies provided by the college.	10(50.0)	6(30.0)	1(5.0)	3(15.0)	1.9(1.1)	6th
The assistive technologies I use are user-friendly and meet my educational needs.	4(20.0)	6(30.0)	5(25.0)	5(25.0)	2.6(1.1)	2nd
I receive adequate technical support when assistive technologies malfunction or need updates.	6(30.0)	7(35.0)	4(20.0)	3(15.0)	2.2(1.1)	3rd
The process of accessing and using assistive technologies at the college is convenient.	6(30.0)	8(40.0)	3(15.0)	3(15.0)	2.2(1.0)	4th
The college provides funding or subsidies for the purchase of personal assistive devices.	16(80.0)	4(20.0)	0(0)	0(0)	1.2(.4)	9th
The college administration supports technology-mediated teaching and learning for students with disabilities.	11(55.0)	6(30.0)	2(10.0)	1(5.0)	1.7(0.9)	7th

Mean of Means =1.9→Disagree; Mean of Standard Deviation = 0.

Source: Field Data – Students' Questionnaire (April, 2025)

Key: N = 20, Strongly Disagree (SD) = (1.00 – 1.74); Disagree (D) = (1.75 – 2.49); Agree (A) = (2.50 – 3.24); Strongly Agree (SA) = (3.25 – 4.00).

The results in Table 2 showed diverse levels of access to various assistive aids among this sample of participants. Access to screen-reading software obtained a mean score of 2.7, indicating moderate availability among respondents. In contrast, access to Braille embossers (M = 1.3), college-provided

personal assistive devices (M = 1.2), and institutional financing for personal devices (M = 1.2) had the lowest mean ratings, indicating a scarcity of these critical technologies among the surveyed students. In terms of usability and institutional support, the results indicated that the availability of technical assistance for assistive technologies was assessed at a mean of 2.2, while the ease of using these tools inside the college environment received a mean of 2.2. These scores suggest modest challenges in terms of user support and ease of engagement with accessible resources in this sample.

The total mean score for all questions in this section was 1.9, which falls within the "Disagree" range on the four-point Likert scale (1.75–2.49). This indicates that the majority of respondents in this small sample perceived access to assistive technology to be generally inadequate across the studied institutions. These descriptive findings characterise the existing settings under which these particular SVIs engage with assistive technology and provide preliminary indications for additional research with larger, more diverse samples to determine whether these patterns are representative of the broader population.

Perception of SVIs on Institutional Policies in the Provision of Inclusive and Equitable Education

This section of the study focused on students' perceptions of institutional policies concerning the provision of assistive technologies and their implications for technological inclusivity and equity for students with visual impairments (SVIs) in Ghana's Colleges of Education (CoEs). Institutional policies are fundamental to efforts in inclusive education, as they influence the availability of essential assistive technologies such as screen readers, Braille embossers, and other adaptive tools that enable full participation in teaching and learning processes by SVIs. Table 3 shows results on institutional policies on providing assistive technologies for SVIs.

Table 3. Results on Institutional Policies on Providing Assistive Technologies for SVIs.

Items	SD	D	A	SA	Mean (Std Devtn)	Position
My college has clear policies to support students with visual impairments.	6(30.0)	7(35.0)	5(25.0)	2(10.0)	2.2(1.0)	2nd
The college administration ensures equal educational opportunities for students with visual impairments.	3(15.0)	3(15.0)	10(50.0)	4(20.0)	2.8(1.0)	1st
There is a policy on providing assistive technologies to students with disabilities.	8(40.0)	10(50.0)	2(10.0)	0(0)	1.7(0.7)	5th
I am aware of the policies supporting visually impaired students.	7(35.0)	9(45.0)	3(15.0)	1(5.0)	1.9(0.9)	4th
The college regularly reviews and updates policies for students with visual impairments.	7(35.0)	8(40.0)	3(15.0)	2(10.0)	2.0(1.0)	3rd
I believe that the institutional policies on disability are effectively implemented and enforced.	7(35.0)	9(45.0)	1(5.0)	3(15.0)	2.0(1.0)	3rd

Mean of Means = 2.1 →Disagree; Mean of Standard Deviation = 0.9

Source: Field Data – Students' Questionnaire (April, 2025)

Key: N = 20, Strongly Disagree (SD) = (1.00 – 1.74); Disagree (D) = (1.75 – 2.49); Agree (A) = (2.50 – 3.24); Strongly Agree (SA) = (3.25 – 4.00)

The findings presented in Table 3 reveal considerable dissatisfaction among students in this sample regarding the institutional efforts to support SVIs. The statement "There is a policy on providing assistive technologies to students with disabilities" received the lowest mean score (M = 1.7, SD = 0.7), indicating that many respondents in this sample perceive a lack or ineffectiveness of such policies. Similarly, the item "I am aware of the policies supporting visually impaired students" scored low (M = 1.9, SD = 0.9),

emphasising a general lack of awareness among these students about existing institutional commitments to disability support.

Interestingly, while the statement "The college administration ensures equal educational opportunities for students with visual impairments" received the highest average score (M = 2.8, SD = 1.0) among this sample, it still fell short of the agreement benchmark (≥ 3.0), indicating that perceptions of institutional equity remain weak. Other items assessing the clarity and enforcement of policies, as well as their periodic review, also received low ratings, with mean scores between 2.0 and 2.2. Collectively, these descriptive results from this small sample highlight potential systemic gaps in the visibility, communication, and implementation of disability-related policies within the Colleges of Education, though confirmation with larger samples is necessary to establish generalisability.

Overall, the mean score across all items in this subscale was 2.1, which falls within the "Disagree" range (1.75–2.49) on the four-point Likert scale. This finding highlights a common perception among SVIs in this sample that inclusive policies are either absent or poorly implemented in their colleges. While these preliminary findings suggest significant concerns, the implications remain tentative given the small sample size. If confirmed in larger studies, they would indicate an urgent need for Colleges of Education in Ghana to develop and institutionalise comprehensive disability policies that prioritise the provision of assistive technology, raise stakeholder awareness, and establish mechanisms for ongoing monitoring and enforcement.

The Relationship between Access to Assistive Technologies (AAT) and Inclusive Practices for Equitable Educational Experiences (IPEEE)

The section aimed to examine the impact of Access to Assistive Technology (AAT) on Inclusive Practices for Equitable Educational Experiences (IPEEE) of SVIs in colleges of education. Pearson's Product-Moment Correlation was employed to assess the relationship and strength between AAT and IPEEE. Table 4 presents the analysis results.

Table 4. Pearson's Product-moment correlation for Students' AAT and IPEEE

Variables		AAT	IPEEE
AAT	Pearson Correlation	1	.236
	Sig. (2-tailed)		.317
	N	20	20
IPEEE	IPEEE Pearson Correlation	.236	1
	Sig. (2-tailed)	.317	
	N	20	20

Pearson Product-moment Correlation Interpretation: r = .10 to .29 (small); r = .30 to .49 (medium); r = .50 to 1.0 (large); 0.00 (No relationship); 1.0 (perfect positive correlation) (Cohen, 1998).

Note. *AAT = Access to Assistive Technologies; IPEEE = Inclusive Practices and Equitable Educational Experiences*

The analysis presented in Table 4 yields a correlation coefficient (r) of 0.236 and a p-value of 0.317, based on a sample size of 20 respondents. According to Cohen's (2013) standards, this represents a small positive relationship between the two variables; however, it is statistically non-significant at the 0.05 level ($p > 0.05$). Critically, the 95% confidence interval for this correlation is approximately -0.22 to 0.60, an extremely wide range that encompasses both negative correlations and moderately strong positive correlations. This substantial uncertainty reflects the small sample size and indicates that the true population correlation could plausibly be anywhere within this broad range.

Statistical Power and Interpretation Constraints

It is crucial to explicitly address the limitations of inadequate statistical power when interpreting these correlation results. As detailed in the Methodology section, this study, with n = 20, has a statistical power of only approximately 0.56 to detect a medium-to-large correlation ($r = 0.50$) at $\alpha = 0.05$ (two-tailed). This

is significantly below the conventional threshold of 0.80, which is recommended for adequate statistical power (Cohen, 1988). Consequently, the study is severely underpowered, resulting in a high likelihood of failing to detect meaningful relationships, even if they genuinely exist in the population.

The non-significant finding ($p = 0.317$) observed in this study should not be interpreted as evidence that no relationship exists between access to assistive technology and inclusive educational practices. Instead, it indicates that this small exploratory sample lacks the statistical power to reliably detect such a relationship. The extremely wide confidence interval (-0.22 to 0.60) highlights this uncertainty, with the data being consistent with scenarios ranging from a slight negative relationship to a moderately strong positive relationship. Given this ambiguity, the observed correlation of $r = 0.236$ should be viewed as a preliminary, tentative estimate rather than a definitive characterisation of the true relationship.

If this study had been adequately powered (e.g., with a sample of 100–200 participants), the observed correlation might have achieved statistical significance, or conversely, a larger sample might have revealed a correlation closer to zero. Without replication in a sufficiently powered study, it is impossible to determine which scenario is accurate. Therefore, any substantive conclusions about the relationship between AAT and IPEEE must be deferred until confirmatory research with adequate sample sizes is conducted.

This limitation affects the interpretation of all inferential findings. The descriptive statistics in Tables 1–3 are valid for this specific sample's responses. However, generalising these patterns to the broader population of SVIs in Ghanaian Colleges of Education or drawing causal inferences should be approached with caution. The findings should be seen as hypothesis-generating rather than hypothesis-testing, providing preliminary indications that require further investigation.

Discussion

This exploratory study examined the relationship between access to assistive technology (AAT) and inclusive practices for equitable educational experiences (IPEEE) among students with visual impairments (SVIs) in CoEs. The weak positive correlation ($r = 0.236$, $p = 0.317$; 95% CI: -0.22 to 0.60) observed in this small sample provides tentative preliminary evidence. If confirmed in larger studies, these findings would suggest that while AAT may enhance access and engagement, its availability alone may not ensure robust inclusive practices or equitable outcomes. However, due to severe statistical power limitations and the wide confidence interval, this finding should be interpreted with considerable caution. The observed correlation is consistent with a range of possibilities, from a slight negative relationship to a moderately strong positive relationship.

If future research confirms a weak or null relationship between AAT and IPEEE, it would align with prior studies indicating that technology alone cannot dismantle systemic barriers to participation (Al-Azawei et al., 2017; Florian & Black-Hawkins, 2011). A key explanation for this pattern is that AAT in CoEs is often introduced without comprehensive institutional policies, faculty training, or curriculum modifications. When technologies are perceived as supplementary rather than integrated into pedagogy, their impact may remain limited. The Social Model of Disability and Universal Design for Learning emphasize the importance of incorporating accessibility into learning environments through structural modifications, adaptable teaching methods, and proactive institutional initiatives (CAST, 2024; Oliver, 2018).

The preliminary exploration indicates gaps in faculty responsiveness, inadequate access to essential devices like Braille embossers, and weak perceptions of institutional policy implementation. These issues align with critiques of technology-centric inclusion models, which tend to overemphasize access to devices while underestimating institutional readiness and the need for pedagogical change (Le Fanu et al., 2022; Simui et al., 2018). Evidence from Ghana and similar contexts suggests that, although devices like screen readers may be available, their effectiveness is often hindered by inadequate support systems and low

lecturer preparedness (Akoto, 2021; Holloway & Barbareschi, 2022). These patterns observed in the small sample require confirmation through larger, more representative studies before any conclusions can be drawn.

If confirmed, the patterns observed in this study would underscore the gap between global commitments and local execution. Despite SDG 4, Target 4.5, which aims to eliminate disparities in education access for learners with disabilities, systemic weaknesses in Ghanaian CoEs may hinder meaningful inclusion. Inconsistent institutional funding, inadequate training for lecturers, and insufficient administrative support could undermine compliance with international standards (UNESCO, 2025). Similar disparities exist globally, with well-resourced institutions in the Global North utilizing advanced assistive technology infrastructures, while underfunded institutions in low- and middle-income countries struggle with resource and training gaps (Putri et al., 2025; Wilson, 2017).

The descriptive data suggest that SVIs perceive some benefits from AAT regarding independence and participation, but gaps in faculty responsiveness and device availability may limit these benefits. Previous studies emphasise the need for AT availability to be paired with faculty engagement, inclusive pedagogy, and peer support to ensure meaningful learning (Mutanga, 2017; Papadopoulos et al., 2024). Without this broader ecosystem, technologies risk underutilisation or misalignment with learners' needs. These interpretations remain speculative without adequately powered confirmatory research.

Given the exploratory nature of this study and the significant limitations in statistical power and sample size, the policy implications are framed as tentative suggestions that require confirmation in future research rather than as firm conclusions. The following recommendations are preliminary and dependent on validation through adequately powered studies.

Future research should replicate this study with larger samples (ideally 100–200 participants or more) to achieve sufficient statistical power and obtain precise estimates of the relationship between AAT and IPEEE. National education frameworks should establish clear criteria for evaluating the impact of assistive technology on students' inclusive experiences, rather than focusing solely on infrastructure or equipment procurement. These evaluation frameworks must be based on robust empirical evidence from adequately powered studies. Longitudinal studies tracking changes in AAT access and inclusive practices over time would enable stronger causal inferences and provide insight into the evolution of technology and institutional practices.

Limitations of the Study

This study has several limitations. The main limitation is the small sample size (n = 20), which restricts statistical power and the ability to detect meaningful relationships. Power analysis indicates that this study is underpowered to reliably detect even moderate-to-large effects. The implications of this study's findings are significant. The non-significant correlation between access to assistive technology and inclusive practices for equitable educational experiences ($r = 0.231$, $p = 0.317$) cannot be taken as evidence of no relationship. It is statistically more likely that a meaningful relationship exists but was not detected due to insufficient statistical power.

Related to statistical power is the imprecision of parameter estimates in small samples. The 95% confidence interval for the observed correlation of $r = 0.231$ is wide, ranging from approximately $r = -0.23$ to $r = 0.60$ (calculated using Fisher's z transformation). This wide interval suggests that the true population correlation could range from a weak negative to a strong positive relationship. The point estimate of 0.231 offers little information about the true strength of the relationship in the broader population of students with visual impairments in Ghanaian tertiary institutions.

Findings are not generalisable beyond the specific sample of SVIs in the three participating institutions, as their experiences may differ from those of SVIs in other contexts, especially in mainstream institutions or

those unable to access tertiary education. Also, purposive sampling introduces selection bias, and the sample is not representative of the broader population of SVIs in Ghana.

Data were collected through self-report questionnaires, which are susceptible to social desirability and recall bias, meaning participants' perceptions may not reflect objective realities. The cross-sectional design captures data at a single point in time and cannot establish causal relationships or temporal dynamics. This study focused exclusively on SVIs in designated special needs colleges and did not examine the experiences of students with other disabilities, SVIs in mainstream institutions, or broader systemic and policy factors influencing assistive technology provision.

These limitations necessitate caution in interpreting findings from this study. It is an exploratory investigation offering preliminary insights into the experiences of a small group of students with visual impairments in specific Ghanaian Colleges of Education. It does not provide generalizable knowledge about assistive technology access or inclusive education for students with visual impairments in Ghana or elsewhere. The non-significant correlation between assistive technology access and inclusive practices should not be viewed as evidence of unimportance; it reflects the study's limitations in detecting relationships due to power constraints.

CONCLUSION

This study examined the relationship between access to assistive technology (AAT) and inclusive practices for equitable educational experiences (IPEEE) among SVIs in CoEs in Ghana. The findings should be interpreted cautiously due to methodological limitations, particularly the small sample size ($n = 20$) and lack of statistical power. The correlation analysis revealed a weak positive relationship between AAT and IPEEE ($r = 0.236$, $p = 0.317$), but this was not statistically significant. The study's insufficient statistical power (approximately 0.56 for detecting a medium-to-large effect) suggests that the non-significant finding may indicate an inability to detect an effect rather than its absence. Therefore, no firm conclusions can be drawn regarding the relationship between assistive technology access and inclusive educational practices based on these results.

Despite significant limitations in inferential capacity, the study offers valuable descriptive insights into the experiences of SVIs in Ghanaian Colleges of Education. The findings reveal that students perceive gaps in institutional support, device availability, and faculty engagement. Access to critical assistive technologies, such as Braille embossers and personal devices, was reported as severely limited, while policies supporting SVIs were seen as absent or poorly implemented. If confirmed in larger studies, these patterns suggest that providing assistive technologies alone may be insufficient without systemic reforms, including supportive policies, flexible teaching methods, and enhanced teacher preparedness to address barriers to inclusivity.

This study potentially contributes to extending the Social Model of Disability and Universal Design for Learning frameworks into teacher education in low- to middle-income settings, particularly in sub-Saharan Africa. Although these frameworks are typically associated with high-income contexts, preliminary evidence from this study suggests their relevance in Ghanaian institutions. However, these contributions remain tentative and require empirical confirmation through adequately powered research. If future studies substantiate that institutional inclusivity may mediate the relationship between technological provision and equitable student outcomes, this would challenge the assumption that access to technology alone ensures educational equity and provide support for integrating AAT within inclusive pedagogical practices. Currently, such claims must be treated as hypotheses for future investigation rather than established findings.

The limitations of this study, particularly the small sample size of 20 participants, result in inadequate statistical power. This lack of power means that non-significant correlations should not be

interpreted as evidence of no relationship; rather, they reflect the study's inability to identify relationships that may exist. Replication with larger samples is essential before any patterns observed can be considered reliable or generalizable. The primary value of this study is as an exploratory, hypothesis-generating foundation for future research, rather than as definitive empirical evidence.

This study provides insights into the relationship between access to assistive technology and inclusive educational practices for SVIs in Ghanaian Colleges of Education. The findings highlight concerns regarding device availability, policy implementation, and faculty support that require further investigation. The non-significant correlation indicates the need for adequately powered replication studies rather than suggesting an absence of a relationship.

This study serves as an exploratory step in building an evidence base rather than a conclusive contribution to knowledge. Further research with larger, more diverse samples and rigorous methodologies is needed to advance evidence-based policy and practice for educational equity and inclusion for students with visual impairments in Ghana. The current study, with its limitations acknowledged, aims to serve as a catalyst for future inquiry.

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