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Original Paper

Challenges of Students with Hearing Impairments in Learning Mathematics: Evidence of St. John's Integrated Senior High Technical School

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Abstract

This study examined the challenges that some hearing impairment students in the senior high school face when learning mathematics in school. Employing qualitative case study techniques, data was gathered through interviews and observations checklists involving 11 participants. These included sign language interpreters, mathematics teachers, and students with hearing impairments. Results revealed that delay in sign language development, unfavourable curriculum, unavailability of assistive technology resources, and insufficient proficiency of mathematics teachers in sign language and prominence dyslexia were prevalent challenges that were identified. Based on the findings it was recommended that educational institutions, such as the colleges of education should open more training centres for teachers to learn the sign language during their studies. These institutions could train mathematics teachers. Also, it is recommended that individuals and organizations could establish sign language clubs in schools and the communities in order to boost the proficient of all interested persons. Stakeholders should be encouraged to recognise the education of students with hearing impairments as a societal investment aimed at cultivating a comprehensive social framework that nurtures self-reliant individuals. Lastly, it is recommended that government and nongovernmental organizations should support the institutions with learning aids that will help them teach mathematics, proficiently.

Keywords

assistive technology, hearing impaired student, hearing impairment, inclusive education, sign language, student with hearing impairment

1. Introduction

St. John's Integrated Senior High Technical School (Special) is a state funded secondary situated in Navrongo within the Kassena Nankana Municipality of the Upper East Region of Ghana. The school was founded in 2006. Unlike Senior High Schools in Ghana, the school is the sole secondary school in the nation where both hearing impaired and non-hearing impaired students were enrolled, studying together in classes and sitting for identical examinations and offering a range of courses including General Arts, Agricultural Science, Technical, Business, and Visual Arts. This establishment was initiated as a component of the government's strategy to advance inclusive education by integrating students with special education needs (specifically, hearing impairment) alongside those without hearing impairment into the community. The school had a pre-classroom for hearing impaired students, with a total population of twenty (20) students and a waiting period of one year before they moved on to the next class. The pre-classroom was established to teach a unified language and basic concepts, as students with hearing impairments came from different parts of the country with their distinct ways of communicating using sign language. The school's population numbered 811, with 68 students with the corresponding percentage of 8.4% having hearing impairments.

However, Kaindu (2021) and Migeha (2014) observed that, several research studies have explored the mathematical achievement of impaired students in various parts of Ghana. Until then, there is no comprehensive research focusing on challenges of students with hearing impairments in learning mathematics at the secondary school level. Moreover, studies have indicated that pupils who are deaf or hard of hearing frequently perform less well in mathematics than their hearing counterparts. According to one study, senior high school deaf and hard-of-hearing students computed arithmetic at a sixth-grade level and solved problems at roughly a fifth-grade level. The reasons for this underperformance include communication obstacles, a shortage of teachers with the necessary training to work with kids who have hearing impairments, and trouble understanding word problems (Addi, 2021).

Governments worldwide strived toward inclusive education, including Ghana. Specific programmes and welfare services were established to assist children with hearing impairments (CHI) in integrating into society. These services, encompassing healthcare and education, were grounded in international agreements and national legislation, such as the UN Convention on the Rights of Persons with Disabilities and Ghanaian Acts like the Persons with Disabilities Act 2006 (Act 715), the Children's Act 2006 (Act 715), and the Children's Act 1998 (Act 560) (Agyire-Tettey et al., 2017; Asante & Sasu, 2015; "Public Health Act and Vaccine Manufacturing in Ghana", 2024). These legislative frameworks laid the foundation for providing necessary support and services to safeguard the rights and well-being of children with hearing impairments in Ghana and belong.

Notwithstanding the adoption of conventions, policies, and programmes, as well as the recognition of rights for people with disabilities in Ghana, a significant challenge persisted. The academic performance of students with hearing impairments in secondary schools, especially in mathematics, remained a major issue. Their performance in the West African Examination Council (WAEC) exemplified this, with a significant percentage of students failing to attain qualifying grades for university and training colleges. Between 2019 and 2022, only a small fraction of the total number of students with hearing impairments who sat for the West Africa Examination (80 in total, including 46 males and 34 girls) achieved qualifying scores. The successful students' ratio was 2 males to 1 female (2:1), indicating a high failure rate, with 77 of the 80 students failing their West Africa Examinations. Again, during this period, none of the hearing-impaired students achieved a C4 or better grade in mathematics. These findings depicted a pattern of weak mathematics performance among students with hearing impairments in school.

Compared to their hearing colleagues, students with hearing impairments encounter particular difficulties when learning mathematics. The language barrier is a significant hurdle since mathematics depends so much on precise terminology and specialized vocabulary. A lot of mathematics phrases and concepts are abstract, making lip-reading or sign language inadequate for communicating them (Nunes & Moreno, 2002; Santos & Cordes, 2022). Furthermore, auditory explanations and debates are a common part of classroom instruction, which can be difficult for students with hearing impairments to follow (Pagliaro, 2015; Yuknis, 2015). This linguistic barrier can cause miscommunication and impede the growth of mathematical ideas and problem-solving abilities.

Not having access to auditory signals and feedback during maths instruction presents a serious problem for students with hearing problems. Listening students can get clarification on their knowledge and reinforcement of topics from teachers and peers through verbal explanations, conversations, and questions (Kritzer, 2009; Schindler et al., 2022). It may be more challenging for students with hearing impairments to understand complex mathematical concepts and keep up with the flow of the class if they are unable to hear these important auditory inputs (Nunes & Moreno, 2002). Moreover, although beneficial, the use of visual aids and manipulatives might not be adequate to completely make up for the absence of auditory input (Pagliaro, 2015).

Additionally, social and emotional difficulties have been linked to a reduction in hearing-impaired students' mathematical learning. Due to communication issues and their inability to keep up with their hearing peers, these students may feel alone, low in self-worth, and frustrated (Kritzer, 2009). According to Nunes and Moreno (2002), these affective aspects may be detrimental to students' motivation, engagement, and general academic success in mathematics. Moreover, the difficulties faced by pupils with hearing impairments may be exacerbated by teachers who lack the necessary training or expertise (Aftab et al., 2022; Pagliaro, 2015).

Recently, Basas (2024) has stressed on a critical aspect of language learning for deaf children, highlighting their potential disadvantage compared with their hearing peers. However, despite Ramaa's (2014) investigation into the significance of language skills in the mathematics learning process, the study did not specifically address the challenges faced by deaf and hard-of-hearing students. Agyire-Tettey and colleagues (2017) studied the academic performance of hearing-impaired students in Ghana, although their research did not focus on mathematics. Additionally, Oppong and colleague (2018) evaluated the academic experiences of deaf students at Ghana's University of Education, Winneba. The researchers identified a need for additional resources to meet the demands of deaf students, despite these challenges, evidence suggests that students with hearing impairments can excel in mathematics when provided with appropriate support. Furthermore, Alasim (2020) emphasised the pivotal role of instructors in supporting the learning of hearing-impaired students.

While several research projects have explored the mathematical achievement of impaired students in various parts of Ghana, a notable gap exists. There is a lack of comprehensive research focusing on challenges of students with hearing impairments in learning mathematics at St. John's Integrated Senior High Technical School (special) in the Navrongo municipality of the Upper East Region of Ghana. Consequently, this study aimed to explore the challenges of hearing-impaired students in learning mathematics at St. John's Integrated Senior High Technical School (special) and to provide suggestions based on empirical data. The purpose of this research was to shed light on the barriers that hindered hearing-impaired students from participating and succeeding in regular classes by assessing their academic achievements in learning mathematics.

When a kid falls short of projected milestones for speech and language skills at a typical age range, it's called a delay in language development (Dione et al., 2020; Law et al., 1998). This may entail issues with either expressive language (word use and sentence formation) or receptive language (language understanding), or both. Not babbling by the age of twelve, not uttering single words by the age of sixteen, not stringing two words together by the age of twenty-four, and having difficulty adhering to straightforward instructions are a few indicators of a possible language delay. Many conditions, including hearing loss, intellectual difficulties, autism spectrum disorder, and a lack of stimulation and social engagement, can result in language delays (Shriberg et al., 2011). Since language skills are fundamental to the development of cognitive, social, and academic abilities, early detection and intervention are essential.

It is imperative to obtain professional evaluation and help for a kid exhibiting indicators of language delay (Scarborough & Dobrich, 1990). Speech-language pathologists are qualified to carry out thorough evaluations in order to pinpoint the root reasons and provide customized treatment programmes. Speech therapy may be used as part of an intervention to enhance vocabulary, grammar, articulation, and pragmatic language abilities. It is also critical to treat any underlying issues, such developmental abnormalities or hearing difficulties. By having regular talks, reading aloud, singing, and creating an atmosphere that is rich in language, parents and other careers can greatly assist language development in

their children (Silva et al., 1987; Sunderajan & Kanhere, 2019). Many children with language delays can catch up to their classmates and acquire age-appropriate communication skills with the help of early intervention and ongoing assistance.

2. Objectives

This study aimed at exploring the challenges of hearing-impaired students in learning mathematics in St John's Integrated Senior High Technical School and the specific objective was to explore challenges affecting mathematics learning of students with hearing impairments.

3. Theoretical Framework

This study adopted the Ecological Systems Theory as its theoretical framework. This theory elucidated that the development of a child, including those with hearing impairments, within an ecological context is significantly influenced by the child's experiences in both immediate and distant ecological settings that interact with them. Various ecological elements, such as individuals, residences, families, neighbourhoods, communities, play areas, and schools, collectively possess the potential to facilitate children's learning. The Ecological Model of Child Development seeks to explain the intricate relationships between active children, including those with hearing impairments, and the connections and interactions among individuals, objects, and symbols within the child's ecological surroundings. These dynamics play a crucial role in shaping the growth and development of such children.

This model served as a framework for understanding how the connections and interactions among homes, families, communities, and schools can positively influence a child's academic performance. Building upon the insights of Bronfenbrenner (1979), and Bronfenbrenner and Morris (1998), this work explored how the model can enhance the connections and interactions within the immediate and distant ecological environment of children with hearing impairments. The goal is to enrich the overall experience of these children and foster success in school, steering away from academic failures.

4. Methodology

The study implemented a case study design. A case study, as outlined by Ebneyamini and Moghadam (2018), involves a thorough empirical examination of a current phenomenon within its real-life context. The selection of this design was motivated by its suitability for convenient data collection at the School. The instruments in data collection were structured interview guide and observation check list. Data was collected from 11 participants; three (3) mathematics teachers, three (3) sign language interpreters and five (5) students with hearing impairments. All the participants were sampled using the purposive sampling procedure.

For this inquiry, a qualitative research approach was employed. This methodology enabled the researcher to systematically collect data from participants about their emotions, sentiments, experiences, and thoughts concerning the efficacy of the study involving students with hearing challenges. Rooted in

the interpretivist research paradigm, the qualitative approach is grounded in the belief that reality is shaped by individuals' subjective perceptions of the external world, as highlighted by Nickerson (2022). This method was particularly well-suited for the current study, as it facilitated the extraction of insights from participants regarding their emotions, experiences, and viewpoints pertaining to the achievement of the study's objectives involving hearing-impaired students.

5. Findings

5.1 Delay in Sign Language Development

Addressing the question about factors affecting mathematics learning among students with hearing impairment. First sign language interpreter, (SLI1) elaborated that the underperformance of these students in mathematics could be attributed to the delay in their language development. With regards to sign language development, one of the sign language interpreter, SLI was quoted to have said:

> *These students commonly encounter a delay in the development of their language skills, sir. This delay stems from the fact that in many of their homes, their parents and siblings are unfamiliar with sign language, leading to a lack of its usage. As a result, these children are only introduced to sign language once they commence their schooling.*

In response to the inquiry regarding the challenges impacting mathematics performance of students with hearing impairments, SLI1 addressed the matter by indicating that the primary issue lay in the delayed acquisition of language skills. According to the sign language interpreter one, SLI1, the process of language development tends to be more time-consuming for students with hearing impairment, (SwHI). The exact wording of SLI1's response was as follows:

> *The hearing impairments delay in learning sign language. The majority of these students' encounter sign language for the first time when they commence their education. This reinforces my belief that an early initiation of schooling would be advantageous, as it would allow them to become familiar with sign language from an early stage of life.*

5.2 Unavailability of Assistive Technology Resources

Another noteworthy aspect that surfaced revolved around the inquiry regarding the unavailability of assistive technologies for students with hearing impairments at the school. In addressing this question, a student with hearing impairment, SwHI, clarified that they were devoid of any technological devices. She emphasized that:

> *We avoid using those objects, and the school doesn't possess them either. They make me uncomfortable, and I prefer things the way they currently are. Additionally, those items generate noise.*

Fourth student with hearing impairment, SwHI4, held the same perspective as the first student, SwH1. He clarified that his awareness was limited to hearing aids and he lacked knowledge about other types of assistive technologies. As matter of fact, they were not accessible in school. The following response was recorded:

I only know about hearing aids, that's all. We don't have any other things like that. Some time ago, there were people who had hearing aids, but I didn't get one myself.

5.3 Unfavorable Curriculum

In another transpiring theme, a second sign language interpreter, SLI2, answered that one of the causes of underperformance mathematics among students with hearing impairment was an unfavorable curriculum. SLI2 asserted that:

The curriculum is very unpleasant. What I'm saying is that the curriculum doesn't think about what students with hearing problems need. Also, the learning materials for these students are not in sign language.

SLI1 reaffirmed the perspective put forth by SLI2, asserting that the curriculum employed for students with hearing impairments lacks customization to cater for their specific needs. The response was recorded:

The issue at hand, sir, lies in the curriculum not being adapted to align with the learning requirements of hearing impaired students. The existing curriculum is better suited for students who do not have hearing impairments. For these hearing impaired students, it proves to be excessively rigid and unsuitable. Not this… it is too inflexible.

5.4 Insufficient Proficiency of Mathematics Teachers in Sign Language

In addressing the question, the third mathematics teacher, MT3, attributed the below-average mathematics performance to the insufficient proficiency of mathematics teachers in sign language. When asked about his own competence in sign language, the MT3 acknowledged that his fluency was not particularly high. The MT3 maintained:

When I joined, I lacked proficiency in sign language. However, I have been progressively enhancing my skills by learning directly from the students. Through interactions with them, I've found that the students themselves serve as teachers, and this is how I've been able to improve.

The first mathematics teacher, MT1, provided a response to the inquiry about the factors influencing the underperformance of students with hearing impairments that closely resembled the answer given by MT3. He stated that a notable challenge was the lack of competence among certain teachers in sign language. The following response corroborated the concern on lack of competence among sign language teachers:

A significant challenge we face is that some teachers who instruct hearing-impaired students are not sufficiently proficient in sign language. This issue detrimentally affects the learning process. In some cases, teachers resort to using English before fully grasping sign language, which presents a substantial problem. For students who are entirely hearing impaired, this becomes particularly challenging as they are unable to hear anything during lesson.

In responds to the question of the difficulties affecting his achievements in mathematics, the fifth mathematics teacher, SwHI5 opined:

I have challenges in mathematics because mathematics is difficult, secondly the words problems form of mathematics is really a big challenge to me.

I have problem understanding certain things, especially in Mathematics. The issue is that I struggle to comprehend what the teacher is explaining in sign language.

5.5 Prominence of Dyslexia

In a transpiring theme, the second mathematics teacher, MT2, the first sign language interpreter, SLI1, and the third sign language interpreter, SLI3, connected the low mathematics achievements of students with hearing problems to their limited reading and writing skills. She pointed out that many students with hearing impairments at the school struggle with reading and writing. The following was submitted:

The student's mathematics achievement isn't satisfactory. Reading and writing pose significant challenges for many of them. Their ability to read and write is quite poor. It's important to note that these difficulties with reading and writing have a major impact on their overall mathematics achievements.

6. Discussion

6.1 Challenges Affecting Mathematics Learning of Students with Hearing Impairment

These findings revealed several problems that make it hard for students with hearing impairments to do well in mathematics in the school. The sign language translators, mathematics teachers, and the students themselves talked about these issues. Some of the main problems are: gap in language development, unfavourable curriculum, knowledge in teachers sign language, no technological devices, challenged writing and reading and lack of materials in sign language.

6.2 Delay in Language Development

The findings under this theme illustrated the factors that influenced mathematics performance among students with hearing impairments in the school. Both first and second sign language interpreters, SLI1 and SLI2 attributed the below-average mathematics achievement of these students to the delayed development of their language skills, particularly in sign language. This delay was often linked to a lack of exposure to sign language within their homes, where family members were unfamiliar with this form of communication. As a result, these students only encountered sign language once they entered formal schooling. The ideas that were shared by both SLI1 and SLI2 aligned with Bronfenbrenner's Ecological Systems theory. This connection could have made sense because the family, which was a component of the Mesosystem, had a powerful and enduring influence on a child. The influence of the family extended to various aspects of a child's development, including their language growth.

The consistent theme of language deficit in relation to mathematics achievement among students with hearing impairments resonated with the conclusions drawn by (Musonda & Phiri, 2017). The research by Musonda and Phiri (2017) identified language deficit as a significant challenge affecting the academic performance of learners with hearing impairments. The connection between language

development and academic success was evident in both studies, emphasizing the need to address this issue to support students in their educational journey.

In contrast, the findings of Akellot and Bangirana (2019) challenged the notion that parental involvement directly influenced the academic achievement of deaf children. Again, they found no association between parental involvement and the academic performance of deaf children. This disparity suggested that while parental involvement may not have been directly linked to academic achievement, the role of parents in supporting language development and exposure to early language could have been vital (Marschark et al., 2015).

Marschark et al. (2015) emphasized the important role parents played in exposing their children to early language, which served as a foundational aspect of academic achievement. Their research aligned with SLI1's and SLI2's observations that a lack of early exposure to sign language in the home environment contributed to delayed language development among students with hearing impairments, ultimately affecting their mathematics achievement.

In conclusion, the research findings indicated that the delay in development of language skills, particularly sign language, posed a significant challenge for students with hearing impairments in terms of their mathematics achievement. This aligned with Musonda and Phiri (2017) conclusion regarding the impact of language deficit on academic performance. While Akellot et al. (2019) found no direct association between parental involvement and academic achievement, Marschark et al. (2015) highlighted the crucial role parents played in fostering early language development, which could influence overall academic success.

6.3 Unavailability of Assistive Technology Resources

The findings under the theme illustrated the aspect related to the availability and utilization of assistive technologies for students with hearing impairments. The participants, particularly, the first and fourth students with hearing impairment, SwHI and SwHI4, shared their perspectives on the absence of such technologies at the school. The SwHI emphasized her discomfort with using technological devices. She also mentioned noise as a potential concern. The SwHI4 had echoed the same thought and further indicated his limited awareness, noting that only hearing aids were familiar to him, and he was unfamiliar with other types of assistive technologies.

Both participants had disclosed that these technologies were not accessible within in the school premises. These findings aligned with the observations made by other scholars. Ferguson et al. (2017) identified the transformative potential of technological and assistive developments for individuals with hearing impairments, suggesting that such advancements could alter their experiences of the world. The experiences shared by SwHI and SwHI4 had reflected a discrepancy between this potential and the current reality at the school.

Similarly, Frush (2019) proposed that hearing aids and cochlear implants could enhance auditory processing and communication abilities, potentially leading to improved mathematics achievements. However, the lack of awareness and availability of such technologies as revealed by the participants

and had indicated that the potential benefits highlighted by Frush (2019) might not have been fully realized in the school context.

6.4 Unfavourable Curriculum

The research findings centered on the factors that contributed to the below-average mathematics achievement of students with hearing impairments. One notable issue highlighted by second sign language interpreter, the first mathematics teacher, and the first sign language interpreter denoted as SLI2, MT1, and SLI1, respectively was the inadequacy of the curriculum for these students. They indicated that the curriculum in place was not tailored to meet the unique needs of students with hearing impairments, thereby contributing to their difficulties in mathematics.

This worry about an inappropriate curriculum aligns with what Migeha (2014) found. They highlighted that the absence of specific learning materials and the lack of a shared communication method were important reasons behind the poor academic performance of students with hearing impairments. The findings echoed this sentiment by revealing that the curriculum itself did not accommodate the specific requirements of students with hearing impairments. The second sign language interpreter, the first mathematics teacher, and the first sign language interpreter denoted as SLI2, MT1, and SLI1 respectively all shared their perspectives that the curriculum lacked flexibility and failed to include crucial elements such as sign language, which was essential for effective communication and comprehension among students with hearing impairments. Their verbatim responses emphasized the idea that the rigid structure and absence of personalize in the curriculum hindered the academic advancement of these students in mathematics.

Additionally, these students were expected to respond in English, a language that had not been used for instruction during their learning period. This could be interpreted as a deliberate choice, considering that the assessors were well aware of the communication challenges faced by students with hearing impairments. As a result, there should be consideration for modifying assessments to prevent placing students with hearing impairments at a disadvantage.

6.5 Insufficiency Sign Language Proficiency among Certain Teachers

Under this theme the findings revealed the challenges that led to the below-average mathematics achievement among students with hearing impairments. Multiple perspectives were presented, shedding light on the factors that hindered these students' success in mathematics and how these challenges could be attributed to the proficiency of mathematics teachers in sign language.

The third mathematics teacher, MT3, highlighted that the insufficient proficiency of mathematics teachers in sign language played a crucial role in the students' underachievement in mathematics, this finding resonated with Sibanda (2018) conclusions on analysis of sign language proficiency among teachers of the hearing impaired in primary schools in Bulawayo Zimbabwe and the implications for learning and inclusion education. The MT3 acknowledged his own limitations in sign language fluency but had noted that he had been progressively improving through interactions with students. This adaptive learning process explained the significance of student-teacher interactions in bridging the

communication gap.

The first mathematics teacher, MT1 echoed similar feelings, emphasizing that the lack of competence in sign language among teachers posed a major challenge. This challenge hindered the learning process, leading to instances where teachers had resorted to using English even before fully grasping sign language. This not only had hindered effective communication but had also created difficulties for students who had relied solely on sign language due to their complete hearing impairment. The fifth student with hearing impairment, SwHI5's perspective had provided an additional layer of insight. The student expressed the challenges faced in mathematics, particularly in word problems, which had proven to be a major hurdle. He again said, difficulties in understanding certain concepts had been compounded by the teacher's use of sign language that the student could not fully comprehend.

The findings revealed that the underperformance in mathematics amidst students with hearing impairments could be attributed to multiple factors, including the proficiency of mathematics teachers in sign language. The first and third mathematics teachers, MT3 and MT1, respectively highlighted the challenge of inadequate sign language proficiency among teachers, leading to communication barriers and ineffective instruction, this aligned with the study by Chibuye et al. (2023) Student SwHI5's input had emphasized the difficulty in understanding certain mathematical concepts, especially word problems, further underpinning the challenges faced by students with hearing impairments. In essence, the findings had emphasized the crucial role of effective communication, particularly through sign language, in enhancing the learning experience of students with hearing impairments. Addressing the proficiency gap among teachers in using sign language and finding innovative ways to convey complex concepts to these students could potentially have contributed to improved mathematics achievement among this group.

6.6 Prominence of Dyslexia

The findings highlighted on another theme that revolved around the relationship between reading and writing skills and the low mathematics achievements of students with hearing impairments. The second mathematics teacher, the first sign language interpreter, and the third sign language interpreter denoted respectively as MT2, SLI1, SLI3, had all contributed to this discussion by emphasizing the challenges faced by these students in reading and writing, and how these challenges subsequently impacted their mathematical achievement.

The observations made by MT2, SLI1, and SLI3 had pointed to a crucial factor that contributed to the underachievement of students with hearing impairments in mathematics. Reading and writing were fundamental language-based skills that played a pivotal role in understanding and solving mathematical problems. The struggles experienced by these students in reading and writing had hindered their ability to comprehend mathematical concepts, follow instructions, and communicate their responses effectively. In general, students engage in reading for the purpose of learning. However, when reading and writing pose challenges, this can lead to a highly frustrating learning experience (Kaindu, 2021).

7. Conclusion

From the major finding the following conclusions were made: delay in sign language development, unavailability of assistive technologies, unfavourable curriculum, insufficient sign language proficiency, and dyslexia among students with hearing impairments contribute significantly to their underperformance in mathematics.

8. Recommendations

a) A purposeful policy and centres should be established, in cooperation with the Ministry of Education, to ensure early assessment and identification of students with hearing impairments, enabling their timely entry into the education system and minimizing delays.

b) The Ministry of Education should take responsibility for providing essential assistive technologies devices such as hearing aids and cochlear implant to amplify their hearing sensory, so as to improve mathematics learning of SwHI.

c) The Directorate of Teacher Education and pertinent stakeholders in special education training should collaborate with the Ministry of Education (MoE) to embark on a thorough review of the teacher education curriculum for hearing impaired students.

d) The central government should provide additional training for teachers specializing in instructing students with hearing impairments and consider reassigning previously trained teachers to schools dedicated to hearing-impaired students.

e) The Ministry of Education should collaborate with relevant stakeholders to enhance the teacher education curriculum for hearing-impaired students, specifically focusing on improving sign language skills for prospective special needs educators and employ sign language interpreters with mathematics backgrounds.

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Author's contributions

Basigi: Conceptualization, data curation, methodology, formal analysis, writing-original draft and preparation, project administration, final draft.

Bornaa: Conceptualization, data curation, supervision.

Atepor: Formal analysis, conceptualization

Uchenna: Data curation, project administration

Kwakye: Final draft, final write-up

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained

Ethics approval

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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