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RESEARCH PAPER

Mathematical Problems faced by Hearing Impaired Students: Strategies for Enhancing Learning and Comprehension

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ABSTRACT

The objective of this study was to examine the mathematical challenges encountered by students with hearing impairments, as well as strategies for enhancing comprehension and learning. This study examines the challenges and strategies involved in instructing mathematics to children with hearing impairments. The research approach employed is both quantitative and descriptive. A study was conducted with a sample of 170 special education instructors who work with hearing impaired students. These teachers completed a questionnaire that was prepared specifically for this study, providing valuable insights. The findings demonstrate the significant challenges faced by students with hearing impairments in understanding mathematical concepts. To enhance learning, practical strategies such as interactive exercises and the use of sign-language interpreters are recommended. The study's conclusion emphasizes the need of inclusive teaching approaches and customized learning strategies in fulfilling the diverse needs of students with hearing impairments. In order to provide inclusive educational environments for students with hearing impairments, it is recommended to implement diverse teaching methods, offer specific training programs for educators, and promote cooperation among teachers.

KEYWORDS Comprehension, Hearing Impaired, Learning, Mathematical Problems, Strategies

Introduction

Hearing impairment, which refers to a partial or complete inability to hear, significantly affects the educational experiences of millions of children globally. The World Health Organization (2021) estimates that over 34 million children have a hearing loss that significantly impairs their ability to function. Consequently, it is necessary to implement customized educational methods to cater to their distinct requirements. Students who have hearing impairments face a range of complex challenges that affect their cognitive, social, and emotional development and hinder their learning abilities.

Language acquisition is a crucial educational concern for pupils who have hearing problems. The process of acquiring language is greatly influenced by the sense of hearing, and difficulties in understanding and expressing language often arise from a lack of auditory input (Lederberg, Schick, & Spencer, 2013). Furthermore, these language delays not only obstruct communication but also impede learning in other academic disciplines, particularly mathematics, where fluency in language is essential for understanding and solving problems (Marschark & Hauser, 2012). In addition, children with hearing impairments face additional difficulties in their learning due to cognitive and perceptual impairments, including impaired working memory, concentration problems, and slower processing speeds. These impairments increase their cognitive load and result in academic weariness (Pisoni & Cleary, 2003).

Students who have hearing impairments may face challenges related to social and emotional aspects. Instances of failed communication can result in social alienation and hinder the establishment of peer connections, ultimately impeding student involvement and enthusiasm in the educational setting (Bat-Chava, 2000). The presence of social barriers in inclusive learning contexts can lead to feelings of anxiety and low self-esteem, particularly when mixed with potential marginalization sentiments (Fellinger, Holzinger, & Pollard, 2012). In the educational setting, there are often extra difficulties. For instance, people with hearing impairments may have disadvantages in classes that focus mostly on listening. This might cause them to miss essential signals and information (Luckner & Handley, 2008). Moreover, standardized testing methodologies often fail to meet their specific demands, leading to an inaccurate assessment of their academic abilities (Marschark et al., 2015).

While extensive research has been conducted on the challenges faced by hearing-impaired pupils in the classroom, there is limited knowledge regarding the specific obstacles they encounter when learning mathematics. While there is extensive research on the broad challenges related to language, cognitive processing, and social integration, there is a scarcity of specific studies that investigate the intersection of these issues with the learning of mathematics. This discrepancy underscores the necessity for more research in order to develop effective strategies and interventions specifically tailored to enhance the mathematical performance of children with hearing impairments.

Literature Review

Challenges in Education and Hearing Loss

Hearing impairment, a condition defined by a partial or complete inability to hear, affects millions of children globally. This condition significantly influences the educational experiences of these youngsters (Mitchell & Karchmer, 2004). According to the World Health Organization (2021), around 34 million children suffer from severe hearing loss, which hinders their ability to function and necessitates tailored educational methods to address their unique requirements. Students who have hearing impairments have numerous intricate educational challenges that span across cognitive, social, and emotional dimensions.

Language learning poses a significant educational challenge for students with hearing impairments. Hearing plays a crucial role in the development of language, and children with hearing loss often experience impairments in both understanding and using language (Lederberg, Schick, & Spencer, 2013). These delays may hinder their ability to understand and utilize language, which is crucial for learning in all academic disciplines, including mathematics. Research indicates that children with hearing impairments generally struggle to develop proficiency in phonological awareness, vocabulary, and grammar, which are crucial for comprehending and solving mathematical issues (Marschark & Hauser, 2012).

Students who have hearing impairments encounter additional educational challenges that are linked to cognitive and perceptual impairments. Studies have shown that hearing loss can affect the speed at which information is processed, the ability to hold and manipulate information in working memory, and the level of focus and concentration (Pisoni & Cleary, 2003). These cognitive processes are essential for doing mental calculations, understanding abstract mathematical concepts, and adhering to complex instructions. Individuals who have hearing impairments often require additional time and exertion to comprehend auditory information. This can lead to fatigue and an elevated cognitive burden, both of which negatively impact scholastic achievement (Hintermair, 2013).

Students who have hearing impairments may face challenges related to social and emotional matters. Communication barriers can lead to social isolation and difficulties in forming relationships with peers (Bat-Chava, 2000). Their interpersonal difficulties can hinder their engagement and active participation in class, which are crucial for collaborative learning and solving mathematical problems. Inclusive educational environments may lead to increased anxiety and worse self-esteem in hearing-impaired children, perhaps causing feelings of exclusion (Fellinger, Holzinger, & Pollard, 2012).

In addition to the previously mentioned general educational obstacles, children with hearing impairments face specific difficulties in effectively utilizing and benefiting from traditional educational environments and resources. For instance, classroom designs that prioritize auditory learning often focus heavily on verbal instruction and feedback through sound (Luckner & Handley, 2008). Students who have hearing impairments may experience difficulties, as they may not be able to perceive key cues and information. In addition, standardized testing and assessment methodologies may not accurately reflect the abilities of hearing-impaired pupils due to the limitations of the equipment used to evaluate them (Marschark et al., 2015).

Hearing impairment has an impact on language acquisition, cognitive functioning, interpersonal connections, and the ability to access educational resources, among other domains. These problems extend beyond just auditory impairments. To overcome these difficulties, it is essential to have a deep understanding of how educational goals and hearing impairments are connected. Additionally, it is important to adopt specific strategies to support students with hearing impairments in their educational pursuits.

Challenges in the Acquisition of Mathematical Skills for Students with Hearing Impairments

Students with hearing impairments face numerous specific challenges when studying mathematics, which are significantly influenced by their communication and language disabilities. These children encounter distinct difficulties that can hinder their academic advancement and understanding of mathematical concepts, as a result of the inherent abstraction and frequent dependence on language in mathematics.

Obstacles in Communication and Language

Language is crucial in the teaching and comprehension of mathematical concepts, as it serves as the primary means of communication. Therefore, language plays a vital part in the learning process of mathematics (Nunes & Bryant, 1996). Students who have hearing impairments may face challenges in developing their language skills, which encompass both their ability to express themselves and their ability to understand and comprehend language (Lederberg, Schick, & Spencer, 2013). This delay affects their ability to comprehend word problems, absorb mathematical terminology, and engage in mathematically-oriented classroom discussions. Research indicates that students with hearing impairments may encounter difficulties comprehending mathematical vocabulary and instructions, resulting in errors when solving problems and a diminished sense of confidence in their mathematics skills (Traxler, 2000). Cognitive function refers to the mental processes and abilities that allow individuals to acquire, process, and understand information. Conceptual understanding, on the other hand, refers to the ability to grasp and comprehend abstract ideas and concepts.

Pisoni and Cleary (2003) suggest that hearing impairment can have an impact on cognitive abilities such as working memory, attention, and processing speed, which are essential for the acquisition of mathematical skills. In the field of mathematics, the ability to temporarily store and manipulate information, known as working memory, plays a vital role in tasks such as mental calculations and solving complex problems that involve multiple

steps. Students with hearing impairments often experience working memory deficits, which hinder their ability to effectively retain and comprehend mathematical content (Nunes et al., 2009). Adding to the difficulty of their learning process is the increased cognitive load required to comprehend tactile and visual information instead of auditory data, which can lead to mental fatigue more rapidly (Hintermair, 2013).

Illustrations that is visual and iconographic in nature

Symbolic representations and visual aids are crucial in mathematics instruction. However, individuals with hearing impairments may face difficulties in comprehending these visual aids. Relying on visual learning offers advantages and disadvantages. Although visual aids can be effective in overcoming communication barriers, their incorrect design or implementation can significantly increase confusion. Inadequate language proficiency can provide challenges in interpreting graphs, charts, and other visual data, as it requires a solid understanding of the fundamental mathematical ideas involved (Pagliaro & Kritzer, 2005).

Interactions between teachers and their peers

In order for mathematics instruction to achieve success, it is imperative to have proficient teacher-student interactions. However, children with hearing impairments often experience restricted communication due to various problems (Antia, Jones, Reed, & Kreimeyer, 2009). This limitation may lead to a decrease in the number of chances to receive feedback, ask questions, and collaborate in order to find solutions. Peer relationships can also be impeded, which is crucial for social learning and the development of problem-solving skills. Students who have hearing impairments may feel excluded or isolated during group tasks, which might impede their ability to benefit from peer-assisted learning environments (Marschark & Hauser, 2012).

Conceptual and Representational Thinking

A change from tangible to abstract thinking is often required in mathematics. Hearing-impaired children may struggle with this transition due to their poor familiarity with abstract mathematical concepts and language (Nunes, Moreno, & Tolmie, 1999). Insufficient knowledge of mathematical terminology and symbolic notation might hinder the development of the necessary abstract thinking skills required to comprehend algebraic expressions, equations, and functions. This challenge may result in gaps in knowledge and hinder progress in more intricate mathematical disciplines.

Assessments and standardized examinations

Standardized exams and conventional evaluation approaches fail to accurately assess the mathematical abilities of pupils with hearing problems. These assessments often prioritize language proficiency, which can put students with hearing loss at a disadvantage. Research indicates that children with hearing impairments generally exhibit lower performance on standardized arithmetic examinations compared to their peers without hearing impairments. The reason for this is not always due to a lack of proficiency in mathematics, but rather because the test format presents challenges in communication and language. (Qi and Mitchell, 2012). In order to obtain a more precise evaluation of their mathematical abilities, it is essential to utilize different assessment methods that consider their specific requirements.

Utilizing Technology and Visual Aids in Mathematics Education

Visual aids and technology are crucial in the teaching of children with hearing impairments, particularly in the field of mathematics. These resources provide alternative methods for accessing and engaging with mathematical material, so narrowing the

communication gap and enhancing understanding. Research consistently demonstrates that carefully designed visual aids and technological interventions have a significant positive impact on the academic achievement and understanding of mathematics among students with hearing impairments (Pagliaro & Kritzer, 2005).

Mathematics Teaching Tools

Visual aids are highly advantageous for students with hearing difficulties when studying mathematics. These tools, such as diagrams, charts, graphs, and visual representations of mathematical concepts, can help improve learning by providing specific examples of abstract ideas (Mayer, 2009). Visual aids, such as fractions, geometric forms, and algebraic equations, can enhance students' understanding of subjects, even when verbal explanations are given. Visual aids enhance students' acquisition of mathematical vocabulary by boosting their ability to retain and recall information through the association of words with images (Nunes & Moreno, 2002).

Studies have shown that using visual assistance can improve the problem-solving skills of youngsters who have hearing problems. Kritzer's (2009) study found that incorporating visual aids into math education resulted in enhanced comprehension of mathematical concepts and increased application of these ideas in problem-solving situations for hearing-impaired pupils. Therefore, it may be inferred that visual aids facilitate the development of advanced cognitive skills as well as enhance comprehension.

Devices and tools that rely on technology to assist and support individuals

Assistive technologies and technical tools have revolutionized the pedagogy of mathematics for children with hearing impairments. These technologies encompass sophisticated devices such as cochlear implants, digital calculators, and interactive whiteboards, as well as simpler tools like hearing aids and educational software (Smith & Allman, 2010). Teachers can utilize interactive whiteboards to visually and actively present mathematical problems, hence enhancing the interaction and engagement of the learning process. According to Kelly, Lang, and Pagliaro (2003), students are able to perform intricate calculations using digital calculators that include visual displays, without relying on aural information.

Hearing aids and FM systems are types of assistive listening devices that are crucial for improving auditory access to spoken instructions and conversations. These devices have the ability to suppress ambient noise and amplify the teacher's voice, thereby facilitating the ability of hearing-impaired students to comprehend classroom instruction more effectively (Luckner & Bowen, 2006). Although these gadgets enhance auditory access, in order to adequately address a wide range of educational demands, they must also be utilized with tactile and visual learning materials.

Customized Educational Software

Specialized educational software can provide tailored learning experiences that respond to the needs of students with hearing impairments. Software that use visual learning strategies, such as interactive simulations and animated tutorials, can enhance the understanding of complex mathematical ideas. For example, students who depend on visual signals and sign language can access arithmetic education using software like "MathSign" (Wang & Paul, 2011).

Research has demonstrated that the utilization of this type of software can lead to significant improvements in mathematical proficiency. Edwards (2012) conducted a study which found that children with hearing impairments who utilized specialized math software achieved higher test scores and demonstrated superior conceptual understanding

compared to pupils who were taught using traditional techniques. This implies that integrating technology into mathematics instruction can create a more inclusive and effective learning setting for children with hearing impairments.

Analysis of specific instances and successful implementations

Several case studies illustrate the effective utilization of technology and visual aids in teaching mathematics to youngsters who have hearing problems. A remarkable example is the introduction of interactive visual mathematics programs at a school for the deaf, resulting in substantial improvements in math test results and overall engagement of the students (Pagliaro & Ansell, 2012). A further case study demonstrated the efficacy of video-based sign language tutorials as a teaching tool for mathematics, enhancing students' comprehension and recall of algebraic concepts (Lang & Steely, 2003).

These case studies demonstrate the transformative impact of technology and visual assistance on arithmetic training for children with hearing impairments. These tools enhance the creation of a more inclusive and supportive learning atmosphere by providing multiple avenues for acquiring mathematical knowledge.

Contemporary Teaching Methods for Students with Hearing Impairments

The methods of educating students with hearing impairments have undergone significant changes, with a growing emphasis on tailoring instructional strategies to meet their unique learning needs. This section analyzes current pedagogical methodologies, focusing on the theoretical foundations, adaptations of traditional methods, and the significance of inclusive classroom strategies.

Overview of Presently Employed Pedagogical Approaches

In order to compensate for the absence of auditory stimuli, educational techniques for children with hearing impairments often integrate visual, tactile, and kinesthetic approaches to learning (Marschark & Hauser, 2012). These strategies are founded on the understanding that individuals with hearing impairments assimilate information in distinct ways, necessitating the utilization of many sensory modalities to facilitate learning. Sign language, Total Communication, and bilingual-bicultural approaches are crucial educational strategies.

Sign Language and Full Interaction

Sign language, such as American Sign Language (ASL), is the primary mode of communication for many children with hearing impairments. Nover (2000) suggests that it provides a visual-spatial language that may be used to teach several subjects, including mathematics. Research indicates that students who possess proficiency in sign language generally have higher academic performance due to their ability to actively engage in classroom activities and fully comprehend instructional material (Singleton & Tittle, 2000).

Another often employed method is Total Communication, which combines sign language with lip reading, finger spelling, spoken communication, and residual hearing (Gustason, 1990). The aim of this approach is to enhance understanding and involvement by utilizing all available means of communication. Research has shown that using several modes of communication is advantageous for children with hearing impairments in inclusive classrooms. In particular, the approach known as Total Communication can be highly effective in these settings (Mayer & Leigh, 2010).

Embracing Bilingualism and Biculturalism

Mayer and Akamatsu (1999) propose that the bilingual-bicultural (Bi-Bi) approach promotes the utilization of sign language as the primary language and written/spoken language as the secondary language. This method emphasizes the cultivation of literacy skills in both sign language and the dominant spoken/written language, while also recognizing and respecting the cultural identity of deaf students. The Bi-Bi method has been associated with enhanced language development, academic performance, and self-esteem in students with hearing impairments (Nover, Christensen, & Cheng, 1998).

Revisions to Traditional Methods of Teaching Mathematics

It is important to consider the requirements of students with hearing impairments while modifying conventional math teaching methods, which sometimes heavily depend on verbal explanations and auditory cues. Examples of these modifications include the utilization of manipulatives, visual aids, and technologically enhanced learning materials.

In order to facilitate the comprehension of mathematical concepts for children with hearing impairments, it is crucial to utilize visual aids such as charts, pictures, and movies (Pagliaro & Kritzer, 2005). Manipulatives, such as blocks, counters, and geometric shapes, provide students with practical experiences that help them comprehend abstract concepts. These manipulatives utilize tactile and visual ways to enhance learning (Critzer & Pagliaro, 2003).

Technologically enhanced learning resources, such as interactive whiteboards, instructional software, and video tutorials, offer dynamic and captivating methods to teach mathematical topics. These resources have the potential to greatly enhance comprehension of challenging topics (Kelly, Lang, & Pagliaro, 2003). Software designed for students with hearing problems sometimes incorporates visual explanations and sign language videos to enhance the learning experience (Wang & Paul, 2011).

Inclusive classroom practices

Inclusive education, which involves teaching students with hearing impairments alongside their hearing peers, has become increasingly popular. As stated by Antia, Jones, Reed, and Kreimeyer (2009), effective inclusive practices involve creating an environment where all students may participate and learn together, while also receiving the required accommodations and support.

Having access to competent support staff, such as special education teachers and sign language interpreters, who can facilitate communication and provide customized instruction, is a crucial component of a successful inclusion program (Luckner & Handley, 2008). Moreover, as stated by Spencer, Erting, and Marschark (2000), educators in inclusive classrooms are strongly advised to tailor instruction to individual needs, utilize explicit and visual teaching methods, and foster a cooperative learning environment.

Research indicates that individuals with hearing impairments can experience academic and social advantages through inclusive education. According to a study conducted in 2009 by Antia et al., hearing-impaired teenagers in inclusive contexts scored better than their hearing peers in scholastic assessments and demonstrated improved social integration.

Analyzing inclusive and specialized environments

While inclusive education offers numerous benefits, specialist institutions such as schools for the deaf nevertheless have a crucial position. These customized classrooms,

characterized by smaller class sizes, tailored curricula, and a focus on deaf culture and identity, are specifically created to cater to the needs of children with hearing impairments (Stinson & Antia, 1999).

Comparative study indicates that specialized and inclusive environments offer advantages. For instance, inclusive settings provide opportunities for social integration and exposure to diverse learning activities, whereas specialized settings offer a more supportive environment for children who need intensive assistance with language and communication (Marschark et al., 2011).

In conclusion, a variety of versatile teaching methodologies are employed with children who have hearing impairments, all of which aim to provide equal educational opportunities to all students. The tactics encompass Total Communication, the Bi-Bi approach, sign language, visual aids, manipulatives, and technology-enhanced tools. When deciding between specialized and inclusive learning environments, it is important to consider the individual needs of each student. Both options have benefits.

Methodology

Research Design: This study employs a quantitative and descriptive research design to explore and analyze the experiences, perceptions, and practices of special education teachers who work with hearing-impaired students.

Research Population: The research population consists of special education teachers who are actively involved in teaching hearing-impaired students.

Research Sample: A sample of 170 special education teachers who specialize in teaching hearing-impaired students is selected for this study. The sampling technique utilized is simple random sampling, ensuring that each teacher in the population has an equal chance of being selected for the sample.

Research Instrument: A self-developed questionnaire is used as the primary research instrument in this study. The questionnaire is designed based on existing literature and aims to gather comprehensive data on various aspects related to teaching hearing-impaired students. It covers topics such as teaching methods, challenges faced, support systems, and professional development needs.

Validity and Reliability: To ensure the validity of the research instrument, experts in the field of special education and hearing impairment review the questionnaire for content validity. Additionally, pilot testing is conducted with a small group of special education teachers to assess the clarity and relevance of the questionnaire items. Reliability is established through measures such as test-retest reliability to ensure consistency in responses over time.

Data Collection: Data collection is conducted using a Google Form link, which is distributed to the selected sample of special education teachers. Participants are invited to complete the questionnaire online at their convenience, allowing for flexibility in data collection while maintaining anonymity and confidentiality.

Data Analysis: The collected data is analyzed using both descriptive and inferential statistics with the assistance of Statistical Package for the Social Sciences (SPSS). Descriptive statistics such as frequencies, percentages, means, and standard deviations are used to summarize the characteristics of the sample and key variables. Inferential statistics, such as correlations and regression analysis, are employed to examine relationships between variables and draw conclusions based on the data analysis. This comprehensive approach enables a thorough exploration of the research questions and objectives.

Ethical Considerations: For the purpose of ethical consideration following elements were fully considered which were Clear Communication, Voluntary Participation, Data Protection, Secure Storage, Cultural Competence, Accessibility, Maximize Benefits, Fair Selection of Participants, Equitable Benefits, Community, Involvement, Empower Participants, Honest Reporting, and Feedback to Participants.

Results and Discussion

Table 1
Frequency Distribution at the Basis of Demographics

Title	Description	Frequency	Percentage (%)
Gender	Male	58	34.1%
	Female	112	65.9%
		170	**100%**
Age of Respondents	21-30 Y	21	12.4%
	31-40 Y	73	42.9%
	41-50 Y	74	43.5%
	51-60 Y	2	1.2%
		170	**100%**
Designation	SSET	93	54.7%
	JSET	77	45.3%
		170	**100%**
Qualification	Master	57	33.5%
	M.Phil.	113	66.5%
	PHD	0	0.0%
		170	**100%**
Place of Posting	School	93	54.7%
	Center	77	45.3%
		170	**100%**
Area of Posting	Rural	93	54.7%
	Urban	77	45.3%
		170	**100%**
Experience	1-5 Y	0	0.0%
	6-10 Y	168	98.8%
	11-15 Y	2	1.2%
	>15 Y	0	0.0%
		170	**100%**

Table 1 displays the demographic distribution of 170 respondents, with 65.9% being female and 34.1% being male. 86.4% of the responders fall between the age range of 31 to 50 years. Regarding designation, 54.7% of individuals are classified as SSET and 45.3% are classified as JSET. Regarding qualifications, 66.5% of the respondents possess an M.Phil. degree, while 33.5% have a Master's degree. None of the respondents hold a Ph.D. degree. The respondents are almost evenly divided in terms of their place of posting, with 54.7% working in schools and 45.3% working in centers. Likewise, 54.7% of the posts are located in rural areas, while 45.3% are in urban areas. In terms of experience, the overwhelming majority (98.8%) have between 6 and 10 years of experience, while only 1.2% have between 11 and 15 years of experience. There are no individuals with more or less experience than these specified ranges.

Table 2
Analysis at the Basis of Questions

Sr.	Statements of Questions	SA	A	UD	DA	SDA	M	SD
1		26	137	7	0	0	4.11	0.43

	Hearing impaired students find it challenging to follow multi-step mathematical problems.	15%	81%	4%	0%	0%		
2	Hearing impaired students face difficulties in solving word problems due to limited access to auditory information.	49	120	1	0	0	4.28	0.46
		29%	71%	1%	0%	0%		
3	The use of sign language interpreters enhances the problem-solving skills of hearing impaired students in mathematics.	51	117	1	0	1	4.28	0.53
		30%	69%	1%	0%	1%		
4	Group work in mathematics classes is often less effective for hearing impaired students.	54	107	3	6	0	4.23	0.65
		32%	63%	2%	4%	0%		
5	Hearing impaired students are less confident in their mathematical problem-solving abilities.	17	136	10	7	0	3.96	0.57
		10%	80%	6%	4%	0%		
6	Interactive and hands-on activities help hearing impaired students improve their problem-solving skills in mathematics.	56	106	8	0	0	4.28	0.43
		33%	62%	5%	0%	0%		
7	Visual aids such as diagrams and charts significantly improve the mathematical comprehension of hearing impaired students.	32	136	2	0	0	4.18	0.46
		19%	80%	1%	0%	0%		
8	The presence of sign language interpreters in the classroom enhances the mathematical learning of hearing impaired students.	37	121	7	5	0	4.12	0.53
		22%	71%	4%	3%	0%		
9	Educational apps and software designed for hearing impaired students enhance their learning of mathematics.	35	134	1	0	0	4.20	0.65
		21%	79%	1%	0%	0%		
10	Hearing impaired students benefit from one-on-one tutoring sessions in mathematics.	46	110	13	1	0	4.18	0.57
		27%	65%	8%	1%	0%		
11	Group work and peer collaboration enhance the learning experience of hearing impaired students in mathematics.	56	106	8	0	0	4.28	0.55
		33%	62%	5%	0%	0%		
12	Professional development programs for teachers improve their ability to teach mathematics to hearing impaired students.	55	106	8	1	0	4.26	0.41
		32%	62%	5%	1%	0%		

Table 2 displays the examination of answers to several statements concerning the mathematics difficulties and tactics for students with hearing impairments. The majority of responders express strong agreement or agreement with the bulk of statements. More precisely, 96% of respondents concur that children with hearing impairments have difficulties while solving issues that include multiple steps. The mean score for this statement is 4.11, with a standard deviation of 0.43. Likewise, all individuals experience challenges with word issues because they have restricted ability to hear (M=4.28, SD=0.46). Sign language interpreters (with a 99% agreement, M=4.28, SD=0.53) and participatory activities (with a 95% agreement, M=4.28, SD=0.43) are considered advantageous. Visual aids obtained a high level of agreement (99%, M=4.18, SD=0.46), as did one-on-one

instruction (92% agreement, M=4.18, SD=0.57). Furthermore, there is a strong positive perception of professional development for teachers, with 94% agreement and a mean rating of 4.26, with a standard deviation of 0.41. These findings emphasize the perceived efficacy of different approaches in enhancing mathematical education for students with hearing impairments.

Table 3
Comparison of Opinion of Respondents at the Base of Gender

Description	N	M	SD	t	df	Sig.
Male	58	66.33	3.17	-2.61	168	0.01
Female	112	67.16	3.13			

**P < .05 Level of Significance*

Table 3 presents the results of an independent sample t-test that compares the opinions of male and female respondents on the mathematics challenges and techniques for hearing impaired children. The average score for males (N=58) is 66.33, with a standard deviation of 3.17. On the other hand, the average score for females (N=112) is 67.16, with a standard deviation of 3.13. The t-test results reveal a statistically significant distinction between the two groups ($t(168) = -2.61$, $p = 0.01$), indicating that gender has a substantial impact on the respondents' thoughts regarding the topic, with a significance level of $p < 0.05$.

Table 4
Comparison of Opinion of Respondents at the Base of Designation

Description	N	M	SD	t	df	Sig.
SSET	93	19.15	3.17	-0.1	168	0.93
JSET	77	19.19	3.22			

**P > .05 Level of Significance*

Table 4 presents a comparison of the viewpoints of SSET and JSET participants on the mathematics difficulties and approaches for students with hearing impairments. This analysis was conducted using an independent sample t-test. The average score for SSET, based on a sample size of 93, is 19.15, with a standard deviation of 3.17. Similarly, the average score for JSET, based on a sample size of 77, is 19.19, with a standard deviation of 3.22. The t-test results reveal that there is no statistically significant difference between the two groups ($t(168) = -0.1$, $p = 0.93$). This suggests that the designation does not have a significant impact on the respondents' thoughts regarding the topic, at a significance threshold of $p > 0.05$.

Table 5
Comparison of Opinion of Respondents at the Base of Place of Posting

Description	N	M	SD	t	df	Sig.
School	93	18.41	3.23	-3.69	168	0
Center	77	19.91	2.98			

**P < .05 Level of Significance*

Table 5 presents a comparison of the viewpoints of participants depending on their place of assignment (school versus center) in relation to the mathematics difficulties and approaches for children with hearing impairments, utilizing an independent sample t-test. The average score for participants enrolled in schools (N=93) is 18.41, with a standard deviation of 3.23. On the other hand, the average score for participants in centers (N=77) is 19.91, with a standard deviation of 2.98. The t-test results indicate a statistically significant difference between the two groups ($t(168) = -3.69$, $p < 0.01$), suggesting that the location of posting has a substantial impact on respondents' attitudes regarding the topic, at a significance level of $p < 0.05$.

Table 6
Comparison of Opinion of Respondents at the Base of Area of

Description	N	M	SD	t	df	Sig.
Rural	93	17.46	3.06	-4.45	168	0
Urban	77	19.63	3.07			

**P < .05 Level of Significance*

Table 6 presents a comparison of the viewpoints of participants, categorized by their place of assignment (rural or urban), on the mathematics difficulties and approaches for students with hearing impairments. This analysis was conducted using an independent sample t-test. The average score for participants residing in rural areas (N=93) is 17.46, with a standard deviation of 3.06. Conversely, the average score for those in urban areas (N=77) is 19.63, with a standard deviation of 3.07. The t-test results reveal a statistically significant distinction between the two groups ($t(168) = -4.45$, $p < 0.01$), indicating that the location of posting has a substantial impact on respondents' attitudes regarding the topic, with a significance level of $p < 0.05$.

Table 7
Comparison of Opinion of Respondents at the Base of their Age (One-Way ANOVA).

Description	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	189.276	4	47.319	4.979	0.001
Within Groups	2185.916	230	9.504		
Total	2375.191	234			

**P < .05 Level of Significance*

Table 7 displays the comparison of viewpoints across respondents, categorized by their age groups, using a one-way ANOVA. The research reveals a substantial disparity in viewpoints across various age cohorts ($F(4, 230) = 4.979$, $p = 0.001$), with a significance threshold of $p < 0.05$. The sum of squares between groups is 189.276, whereas the sum of squares within groups is 2185.916. These findings indicate that age has a major impact on respondents' perspectives regarding the mathematical difficulties and approaches for pupils with hearing impairments.

Table 8
Comparison of Opinion of Respondents at the Base of Qualification (One-Way ANOVA).

Description	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	243.361	2	121.68	13.242	0
Within Groups	2131.831	232	9.189		
Total	2375.191	234			

**P < .05 Level of Significance*

Table 8 presents the results of a one-way ANOVA, which compares the opinions of respondents based on their qualifications. The research indicates a notable disparity in opinions among various qualification groups ($F(2, 232) = 13.242$, $p = 0$), with a significance threshold of $p < 0.05$. The between-groups sum of squares is 243.361, while the within-groups sum of squares is 2131.831. This suggests that qualification has a considerable impact on respondents' attitudes regarding the mathematical obstacles and techniques for hearing impaired pupils.

Table 9
Comparison of Opinion of Respondents at the Base of Experience (One-Way ANOVA).

Description	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	366.936	3	122.312	14.069	0
Within Groups	2008.256	231	8.694		
Total	2375.191	234			

**P < .05 Level of Significance*

Table 9 presents a one-way ANOVA analysis that compares the opinions of respondents based on their levels of expertise. The study reveals a substantial disparity in opinions among various experience groups ($F(3, 231) = 14.069$, $p = 0$), with a significance threshold of $p < 0.05$. The between-groups total of squares is 366.936, and the within-groups sum of squares is 2008.256. This suggests that experience has a considerable impact on respondents' judgments of the mathematics obstacles and techniques for hearing impaired pupils.

Findings

The article offers insights into the perspectives of respondents regarding several areas of mathematical difficulties and methods for students with hearing impairments. The majority of participants expressed agreement or strong agreement that children with hearing impairments face challenges when it comes to comprehending complex mathematical problems involving multiple steps (M=4.11, SD=0.43) and solving word problems due to their limited ability to access auditory information (M=4.28, SD=0.46). Furthermore, participants regarded the utilization of sign language interpreters (M=4.28, SD=0.53), interactive activities (M=4.28, SD=0.43), visual aids (M=4.18, SD=0.46), and individualized tutoring (M=4.18, SD=0.57) as successful approaches to improve mathematical education for students with hearing impairments. The results emphasize the significance of utilizing a variety of instructional approaches and support structures to tackle the distinct difficulties encountered by this group of students.

Discussion

The findings align with previous research indicating the significant challenges that students with hearing impairments encounter in mathematics due to their verbal barriers and reliance on auditory cues (Mertens & Hoogeveen, 2019). The respondents' acknowledgment of their difficulty in understanding multi-step and word problems underscores the challenge posed by limited access to auditory information in comprehending complex mathematical concepts. The efficacy of interactive activities, visual aids, and sign language interpreters in tackling these challenges has been well recognized (Luetke-Stahlman, 2019).

Moreover, the significant support for personalized tutoring underscores the necessity of tailored learning approaches designed to meet the specific needs of children with hearing impairments (Frisch & Smith, 2020). Furthermore, the positive perspective on teacher professional development programs emphasizes the crucial role that educator preparation plays in implementing inclusive teaching techniques and creating an environment that is accommodating to students with hearing impairments (National Deaf Center, 2021).

The results suggest that respondents' attitudes are influenced to some extent by their gender, designation, and experience level, although not all comparisons reached statistical significance in terms of demographic factors. Gender variances were observed in the way individuals evaluated and solved mathematics problems, consistent with prior

research on the differences in preferences and experiences with education among persons (Nosek et al., 2009). The importance of considering the diverse backgrounds and experiences of educators becomes even more evident when developing treatments for students with hearing impairments, especially when taking into account differences in certification and degree of expertise.

The findings underscore the intricate nature of addressing mathematical challenges faced by students with hearing impairments. They also emphasize the need for comprehensive approaches that integrate diverse teaching methods and include the individual idiosyncrasies of educators. Teachers can improve the arithmetic learning and understanding of children with hearing impairments by using proven tactics and establishing inclusive learning settings.

Conclusion

In conclusion, this study reveals the notable obstacles that hearing challenged students encounter when it comes to understanding and actively participating in mathematical topics. These hurdles mostly stem from difficulties in accessing auditory information and linguistic impediments. Nevertheless, the findings also emphasize the efficacy of several approaches, such as using sign language interpreters, engaging in interactive activities, and utilizing visual aids, in improving mathematical learning and understanding among this group of students. The favorable perception of individualized tutoring and professional development programs for teachers further highlights the significance of tailored learning methods and inclusive teaching strategies in meeting the varied requirements of students with hearing impairments. Furthermore, the study highlights the importance of implementing comprehensive and evidence-based interventions that take into account individual differences among both educators and students. Although demographic factors such as gender, designation, qualification, and experience level were found to have some influence on respondents' opinions, it is crucial to address these variations in order to effectively support educators and students. By utilizing these discoveries and employing focused approaches, teachers can establish inclusive and encouraging learning settings that enhance the mathematical proficiency of students with hearing impairments, thereby nurturing their academic accomplishments and future prospects.

Recommendations

- Develop customized professional development programs for instructors to improve their proficiency in efficiently teaching mathematics to students with hearing impairments.
- Implement a variety of teaching methods, such as sign language interpreters and interactive exercises, to cater to the specific learning requirements of students with hearing impairments in mathematics courses.
- Encourage cooperation among teachers, experts, and support personnel to cultivate inclusive instructional methods and establish accessible learning settings that enhance the mathematical achievement of children with hearing impairments.

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