Identifying the Performance Numbering Skills in Mathematics among Children with Hearing Impairment

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ABSTRACT

Children with hearing impairments often face significant challenges in learning mathematics, primarily due to difficulties in acquiring basic numerical concepts and developing strong arithmetic skills. These challenges are not solely a result of hearing loss but are also linked to cognitive and developmental factors that affect their understanding of fundamental math concepts such as sequencing, comparison (greater/lesser), and number naming. This paper explores the impact of these struggles on their mathematical learning and highlights the importance of critical thinking skills in overcoming these barriers. Critical thinking, which involves logical reasoning, problem-solving, and systematic evaluation, plays a crucial role in enhancing arithmetic abilities. The study emphasizes the need for targeted educational interventions and personalized teaching strategies to improve the mathematical proficiency of children with hearing impairments. The involvement of parents and educators is essential in providing the necessary support to help these children develop essential mathematical skills, which are vital for leading independent and confident lives. The findings suggest that addressing these challenges through tailored approaches can significantly improve the arithmetic learning outcomes of children with hearing impairments.

Keywords: *Basic Numbering Skill, Sequencing, Greater Lesser, Number Naming and Hearing Impairment*

INTRODUCTION

Mathematics is an art of human understanding, as stated by William Thurston. Language plays an important role in acquiring arithmetic skills. Children with hearing impairments may struggle with arithmetic, not due to their hearing loss, but because of their cognitive development. Critical thinking skills are crucial for developing arithmetic abilities in children with hearing impairments. These skills are particularly important in arithmetic, as they can enhance the quality and meaningfulness of learning. Critical thinking is the ability to think logically and systematically when evaluating, solving problems, and conducting research (Runisah et al., 2017). It is also defined as the ability to solve problems (Rasiman, 2015).

For children with hearing impairments, strong numerical skills are essential for living independently and confidently. While children with normal hearing develop their mathematical skills through understanding, children with hearing impairments face challenges in mastering basic numerical concepts. Word problems and story-based problems, which are typically introduced at the preschool level, often present additional difficulties for these children.

However, children with hearing impairments can improve their understanding through various methods. Despite this potential for growth, the current state of numerical skills among primary-level children with hearing impairments reveals many challenges that must be addressed. Parents and educators play a crucial role in developing the numerical skills of children with hearing impairments.

REVIEW OF LITERATURE

Ellen Ansell and Claudia M. Pagliaro (2023) investigated *"the relative difficulty of signed arithmetic story problems for primary level deaf and hard-of-hearing students"* The study examines the difficulty and strategy use of arithmetic story problems in American Sign Language for K-3 deaf and hard-of-hearing students. Results show that students respond differently to these problems, with difficulty based on the operation used rather than the story. The study suggests factors affecting problem difficulty should be addressed for better instruction.

Wahyu Andriyani, Suparman et al. (2021)investigated a study on *"Developing Critical Thinking of Students with Hearing Impairment for Computational Thinking in Mathematics with E Module Design"*This research focuses on designing an e-module using computational thinking to enhance critical thinking skills in students with hearing impairments. Using a qualitative descriptive approach, the study analyzes data from VII grade students at Special Junior High School of Djojonegoro Temanggung. The findings can guide mathematics teachers in creating e-modules that promote both mathematical understanding and critical thinking skills, benefiting students with hearing impairments.

Santos, S., & Cordes, S. (2021) investigated a study on *"Math abilities in deaf and hard of hearing Children"* Deaf and hard of hearing (DHH) children often fall behind their hearing peers in mathematics, starting as young as three years old and continuing throughout adulthood. This review explores the math abilities of DHH children and suggests that limited language access may delay the acquisition of early number concepts and interfere with problem-solving. It also explores the role of executive functions in mathematical learning and proposes future research to understand the relationship between language and numerical concepts.

M Suarsana et al (2021) conducted a study on *"Mathematical word problem solving abilities of hearing-impaired students*" This study examines the ability of students with hearing-impaired problems in solving mathematical word problems. The research involved eight seventh-grade students from the School for the Hearing-Impaired in Singaraja, Bali, Indonesia. The results showed that students with hearing-impaired problems struggled with understanding mathematical concepts and problems, and there was no significant difference in performance between students with lower hearing difficulties and those with hearing impairments.

S I Leton, Wahyudin and W B D Dosinaeng (2019) investigated a study on *"Hearing-impaired student ability to solve the problem in math"*The study investigates the mathematical connection abilities of grade 8 hearing-impaired students in three schools. The research used a qualitative case study design, with six subjects chosen based on language, speech, intelligence, and social-emotional spread. Results showed that students can solve non-routine questions with high difficulty by using patterns found through images, making preliminary plans, and using media related to the problem.

Robyn Zevenbergen, Merv Hyde, & Des Power (2014)investigated a study on *"Language, Arithmetic Word Problems, and Deaf Students: Linguistic Strategies Used to Solve Tasks"* This paper explores the relationship between language and arithmetic performance in deaf and hearing-impaired students in South-East Queensland, Australia. Results show that while hearing students' solutions were similar, deaf students' performance was delayed, indicating a delay in language acquisition and a impact on problem-solving abilities.

Nair Prithi Govindan and Dr. Ramaa S (2014) conducted a study on "*mathematical difficulties faced by deaf/hard of hearing children***"** Mathematics education is crucial for learners and facilitators, especially for deaf and hard of hearing children. Difficulties in mathematics hinder enjoyment of numbers and are often due to a lack of emphasis on education and reduced incidental learning opportunities. A study assessed 25 deaf and hard of hearing children using the Arithmetic Diagnostic Test for Grade-IV. Results showed that while they could solve simple computational tasks, they struggled with language-based problem-solving.

Silvia Pixner, Martin Leyrer and Korbinian Moeller (2014)investigated ***"****Number processing and arithmetic skills in children with cochlear implants"* A study comparing 45 children with a cochlea implant and controls revealed that hearing impaired children show general and specific numerical/arithmetic impairments. They show dyscalculia symptoms, slow multiplication and subtraction, and less accurate number line estimations. However, they also experience difficulties with place-value processing. Despite initially atypical language development, children with CI can acquire arithmetic skills in a qualitatively similar fashion to their normal hearing peers.

Nair Prithi Govindan, Dr. Ramaa S (2013) investigated a study on *"Analysis of Errors Made by Children with Hearing Impairment"*The study identifies and addresses errors made by children with hearing impairments in the Arithmetic Diagnostic Test (ADT) for Grade –IV. The errors were analyzed qualitatively for mathematical concepts like numeral, addition, subtraction, multiplication, and division. The results show that children can attempt simple tasks, but errors increase as difficulty increases. Common errors include carrying over and borrowing problems, and multiplication and division are poorly attempted tasks. This highlights the need for developing strong number concepts and language and reading skills.

Donna fisher smiley, James w. Thelin, dee m. Lance and robert a. Muenchen (2009) conducted a study on *"Problem-Solving Ability in Elementary School-Aged Children with Hearing Impairment"* The study evaluated the problem-solving ability of children with hearing impairment (HI) compared to normal hearing (NH) children. It found no significant differences in solving mathematical equations involving language and computation. Problem-solving ability was related to language ability, not hearing ability, in HI children.

Heather A. Rowley (2005)conducted a study on**"***Teaching strategies in mathematics: differences in sign language use"*The proposed project aims to address the issue of insufficient clarity of sign communication among Deaf teachers in schools. It will develop and implement a lesson plan for three different mathematical concepts, using native ASL, nonnative ASL, and Signed English. The research will be conducted on first-year deaf students at Gallaudet and NTID college campuses. The goal is to determine the most effective mode of sign language for teaching mathematics, providing recommendations for current Deaf teachers and teacher preparation programs.

Heather Maltzan (2005) investigated a study on *"Deaf students and problem solving in mathematics*" Research on mathematics education for deaf students reveals a gap in improvement. Deaf students' problem-solving skills are below hearing counterparts. Causes include language, communication, semantic understanding, educational environment, and strategies. Implications include reading, vocabulary, and cognitive education. Future research should include online resources for teachers to access research findings and incorporate them into instructional methods.

Merv Hyde, Robyn Zevenbergen & Des Power (2003) conducted study on *"Deaf and Hard-of-Hearing Students' Solving of Arithmetic Word Problems"* The study in South-East Queensland, Australia, examined the performance of deaf and hard-of-hearing students in solving arithmetic word problems. It found that deaf students were delayed in language acquisition, impacting their ability to solve problems. The study recommends direct teaching of analytic and strategic approaches to address these challenges.

Robyn Zevenbergen, Merv Hyde, & Des Power (2001)conducted a study on *"Language, Arithmetic Word Problems, and Deaf Students: Linguistic Strategies Used to Solve*

*Tasks"*This paper explores the relationship between language and arithmetic performance in deaf and hearing-impaired students in South-East Queensland, Australia. Results show that while hearing students' solutions are similar, deaf students' performance is delayed, highlighting the impact of language acquisition on their problem-solving abilities.

Per Frostad and Ann Ahlberg (1999) conducted a study on *"Solving Story based Arithmetic Problems: Achievement of Children with hearing impairment and their interpretation of meaning"* The study examines Norwegian school children with hearing impairments' mastery of three elementary arithmetic problems in a nonreading format. Results show semantic structure affects difficulty level, and students from grade 1 solve problems better than grade 4 students. Children interpret problems in three ways.

Keith Mousley; Ronald R Kelly (1998) investigated a study on *"Problem-solving strategies for teaching mathematics to deaf students"* Three teaching strategies were used to improve problem-solving performance among first- and second-year deaf college students in mathematics courses at the National Technical Institute for the Deaf (NTID). These strategies included sign language explanations, visualizing problem-solving processes, and observing teachers modeling analytical processes. The results showed that these strategies significantly improved the problem-solving abilities of deaf and hard of hearing college students.

Numbering Knowledge of Children with Hearing Impairment

The numbering knowledge of children who are deaf or hard of hearing is often significantly limited when compared to their typically hearing peers. Research consistently shows that these children experience delays in acquiring arithmetic knowledge, exhibit a limited repertoire of mathematical skills, and acquire new concepts at a slower pace. Additionally, their mathematical abilities tend to cover a narrower range of arithmetic topics. These challenges in developing fundamental numerical skills can impact their overall mathematical competence, making it crucial to understand and address the underlying factors that contribute to these delays. Providing targeted interventions and support is essential to help children with hearing impairments overcome these difficulties and develop a stronger foundation in arithmetic.

Importance of Developing Numbering Skills in Children with Hearing Impairment

Developing strong numbering skills is crucial for children with hearing impairments, as these skills are important for both their learning and daily life. Basic math skills help children with tasks like counting money, telling time, and solving problems, which are necessary for independence and confidence.

Children with hearing impairments often face delays in learning basic math concepts, such as number recognition, sequencing, and comparing numbers. These delays can make it harder for them to understand more complex math later on and can affect their overall school performance. Additionally, learning numbers and math concepts helps improve their language skills, as math often provides clear, visual examples of new words and ideas.

Good numbering skills also help children develop critical thinking and logical reasoning, which are important for both school and everyday decisions. It also helps them engage with other children and teachers in group activities and discussions, making them feel more included in the classroom.

Since children with hearing impairments may face challenges in learning math, it is important for teachers, parents, and caregivers to provide extra support and use teaching strategies that meet their needs. Early help, practice, and encouragement can make a big difference in improving their math skills and boosting their confidence.

METHODOLOGY

The sample comprised of ten children with hearing impairment in the age group 9-11 years. The design adopted was descriptive survey. The tool included ten components namely missing numbers, joining the numbers, count the pictures and write the numbers, matching numbers with number names and choose the equal, big and small number questions for assessing the current level of numbering skill among children with hearing impairment. The results obtained were analyzed and discussed based on five components with respect to gender and age.

VARIABLES FOR THE STUDY

A good research study depends on how effectively the variables are selected. The types of variables also decide the nature of analysis. The research should contain information on the nature of analysis. The research should contain information on the nature and number of independent variables and dependent variables used in the study **(Mani 2002)**.

Selection of proper variable is an important ingredient of a good research.

- The main independent variables are gender, age.
- The main dependent variable included in the study was the knowing the current level of numbering skills among children with hearing impaired. (the tool was prepared by the researcher based on the Tamil Nadu mathematic text book).

S.No	Variables	Levels
1.	Gender	☞ Boys ☞ Girls
2.	Age	☞ 9-10 Years ☞ 10-11 Years

SCORING PROCEDURE

The scoring is based on the individual performance of the child. The score '1' given for correct response and score '0' given for wrong response.

Result 1: Performance of students in Numbering Skills among Children with Hearing Impairment

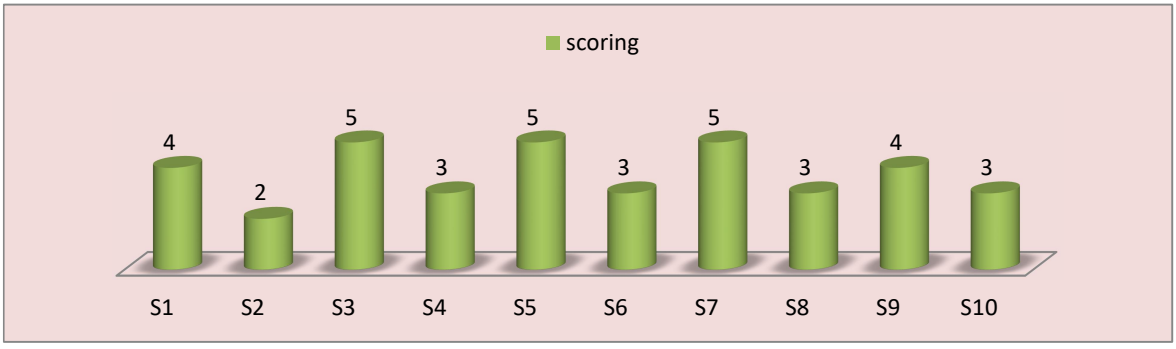

Figure 1: Performance of students in Numbering Skills among Children with Hearing Impairment

Figure 1 shows the performance of the students in numbering skills among children with hearing impairments. Comparing these 10 students the student 2 scoring low mark and student 3, 5 & 7 scored 5 mars in the numbering test.

Result 2: Performance of students in Numbering Skills among Children with Hearing Impairment with respect to gender

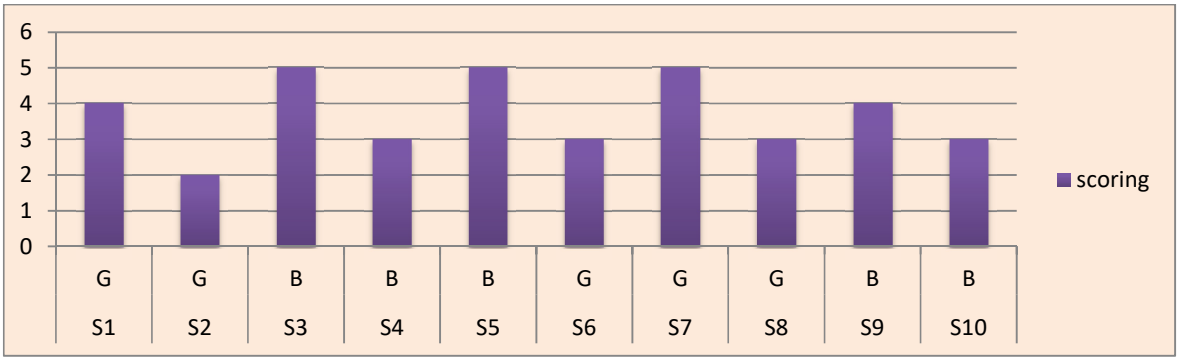

Figure 2: Performance of students in Numbering Skills among Children with Hearing Impairment with respect to gender

The above Figure 2 reveals the Performance of students in Numbering Skills among Children with Hearing Impairment with respect to Gender (B-Boys, G-Girls). It shows boys and girls are performed equally in all the components.

Result 3: Performance of students in Numbering Skills among Children with Hearing Impairmentwith respect to Age

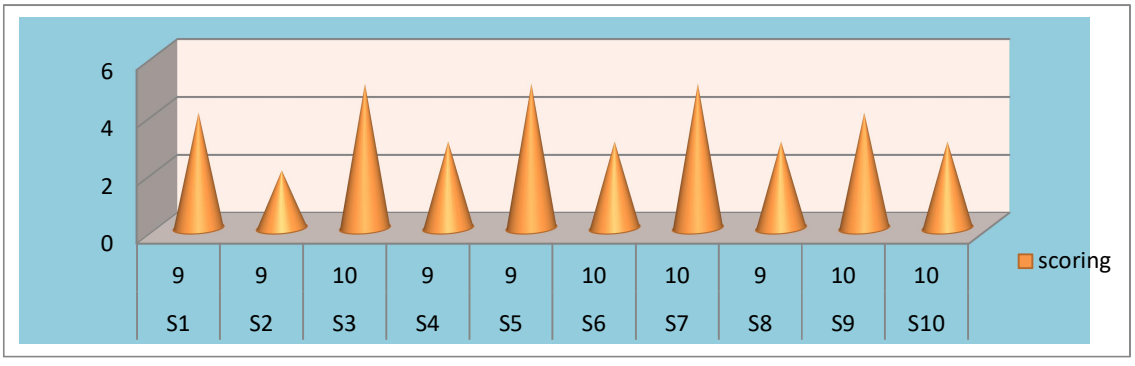

Figure 3: Performance of students in Numbering Skills among Children with Hearing Impairment with respect to Age

The above figure compares the status of numbering skills among children with hearing impairment with respect to age 9- 10 years and 10-11 years under each component. The students got high marks in the age of 10-11 years than 9-10 years students. But the students were not scored full marks in any of the age group.

CONCLUSION

Children with hearing impairments face challenges in arithmetic, primarily due to cognitive and language development issues rather than hearing loss itself. Critical thinking skills are vital for enhancing their understanding of numerical concepts. The study revealed that older children (10–11 years) performed better than younger ones (9–10 years), but none scored full marks. Boys and girls showed equal performance across all components. Parents and educators play a crucial role in supporting these children. Improved teaching strategies and targeted interventions are needed to bridge gaps in numerical skills and help children with hearing impairments achieve greater independence and confidence.

REFERENCES

1. Ellen Ansell, Claudia M. Pagliaro (2023). The Relative Difficulty of Signed Arithmetic Story Problems for Primary Level Deaf and Hard-of-Hearing Students https://academic.oup.com/jdsde/article/11/2/153/343155.
2. M Suarsana et al (2021). Mathematical word problem solving abilities of hearing-impaired students Journal of Physics: Conference Series1778 (2021) 012006 IOP Publishing doi:10.1088/1742-6596/1778/1/012006.
3. Wahyu Andriyani, Suparman, et. Al. (2021). Developing Critical Thinking of Students with Hearing Impairment for Computational Thinking in Mathematics with E Module Design psychology and education 58(1): 4613-4621 ISSN: 00333077.
4. Stacee Santos and Sara Cordes (2021).Math Abilities in Deaf and Hard of Hearing Children: The Role of Language in Developing Number Concepts Psychological Review. Advance online publication. https://doi.org/10.1037/rev0000303.
5. Donna Fisher Smiley, James W. Thelin, et. Al. (2019). Problem-Solving Ability in Elementary School-Aged Children with Hearing Impairment, Journal of Educational Audiology vol. 15.
6. S I Leton et al (2019). Hearing-impaired student ability to solve the problem in math Journal of Physics: Conference Series doi:10.1088/1742-6596/1321/2/022111.

7. Laura Hess (2015). Early Childhood Mathematics for Children who are Deaf or Hard-of-Hearing: Amplifying Opportunities to Develop Foundational Math Skills All Graduate Plan B and other Reports. 482. https://digitalcommons.usu.edu/gradreports/482.
8. Nair Prithi Govindan and Dr. Ramaa S (2014).mathematical difficulties faced by deaf/hard of hearing children Conflux Journal of Education pISSN 2320-9305 eISSN 2347-5706 Volume 2, Issue 7 http://cjoe.naspublishers.com.
9. Silvia Pixner, Martin Leyrer and Korbinian Moeller (2014).Numberprocessingandarithmeticskillsinchildrenwithcochlearimplants Original Research article doi: 10.3389/fpsyg.2014.01479.
10. Nair Prithi Govindan, Dr. Ramaa (2013). Analysis of Errors Made by Children with Hearing Impairment. International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438.
11. Heather Maltzan (2005). Deaf students and problem solving in mathematics. Rochester Institute of Technology https://scholarworks.rit.edu/theses.
12. Heather A. Rowley (2005) Teaching strategies in mathematics: differences in sign language use Rochester Institute of Technology http://scholarworks.rit.edu/theses.
13. Robyn Zevenbergen, Merv Hyde, & Des Power (2001). Language, Arithmetic Word Problems, and Deaf Students: Linguistic Strategies Used to Solve Tasks Mathematics Education Research Journal. Vol. 13, No.3, 204-218.
14. Merv Hyde, Robyn Zevenbergen & Des Power (2003). Deaf students solving arithmetic problems. American Annals of the Deaf, 148, 56-64.
15. Per Frostad, Ann Ahlberg (1999). Solving Story-Based Arithmetic Problems: Achievement of Children with Hearing Impairment and Their Interpretation of Meaning. Journal of Deaf Studies and Deaf Education 4:4 .
16. Keith Mousley; Ronald R Kelly (1998).Problem-solving strategies for teaching mathematics to deaf students. American Annals of the Deaf; 143, 4; Academic Research Library pg. 325.