Effect of Multisensory teaching strategy in learning selected Mathematical Concepts among Students with Hearing Impairment

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Abstract: *The purpose of this study was an attempt to examine the effect of multisensory teaching strategy in learning selected mathematical concepts among students with hearing impairment. The study was an experimental method using pre-test and post-test design with control group. The sample of the study was 10 students studying 6th standard in Special school for the hearing impairment, and the sample was chosen through purposive sampling procedure. The sample (10) was divided into control (5) and experimental (5) based on Teacher Made Test scores. The tools developed by the researcher and used in this research was a Teacher Made Test (TMT) and a multisensory intervention package on selected mathematical concepts contains three domains namely fraction, triangle and ratio respectively. Multisensory Intervention was given to experimental group and control group was taught by conventional classroom teaching method. To analyze the collected data "Mann Whitney U-test" was used. The Mann Whitney U-Test analysis reveals a significant improvement in learning selected mathematical concepts through multisensory teaching strategies. Gender wise analysis reveals no difference in learning selected mathematical concepts and locality of residence wise analysis reveals urban students learnt selected mathematical concepts better than rural SwHI. The study reveals the benefits by providing multisensory teaching strategy to learning mathematical concepts among students with hearing impairment.*

Key Words: Multisensory teaching strategy; mathematical concepts; children with hearing impairment.

1. INTRODUCTION:

Children with hearing loss have difficulty with all areas of academic achievement, especially reading and mathematical concepts. Children with mild to moderate hearing losses, on average, achieve one to four grade levels lower than their peers with normal hearing, unless appropriate management occurs. Children with severe to profound hearing loss usually achieve skills no higher than the third- or fourth-grade level, unless appropriate educational intervention occurs early[1 6]. The level of achievement is related to the quantity, quality and timing of the support services children receive.

Engagement in mathematical processes such as problem-solving, developing logic and reasoning and communicating mathematical ideas depends upon children having good communication skills[2 10]. In comparison with their hearing peers, deaf/hearing-impaired children miss out on various concepts and vocabulary that hearing children pick up incidentally. Deaf/hearing-impaired children find it difficult to understand verbal and written mathematical problems**.** [3 16] states that in order to solve written problems correctly deaf/hearing- impaired children need to correctly interpret every one of the words contained in the problem's text. In terms of verbal problems deaf/hearing-impaired children attempt to simplify the problems by converting them into understandable linguistic forms.

A beneficial learning environment encourages and enables children to construct their own meaning out of mathematical problems, because as [4 20] notes "Infants and toddlers learn predominantly through their senses and motor skills, therefore their physical environment is of utmost importance". When children are given responsibility for their own learning, individual styles of learning are catered for and a variety of resources are made available to meet children's individual needs[5 1].

Multi-sensory approaches (involving visual, auditory, and tactile-kinesthetic techniques simultaneously) have been shown to be effective in many settings [6 7]. The idea that learning experienced through all the senses is helpful in reinforcing memory has a long history in pedagogy. The term is used to refer to any learning activity that combines two or more sensory strategies to take in or express information. Multisensory focuses on if a child is not learning in the way you teach, change your teaching strategy and teach the child in the way he learns. Multisensory techniques are frequently used for children with learning differences [7 24]. Multisensory techniques enable students to use their personal areas of strength to help them learn. They can range from simple to complex, depending on the needs of the student and the task at hand. In ascertaining the efficacy of employing these approaches to enhance student performance, attitudes and practices of teachers need to be addressed. While there needs to be, additionally, empirical

research on the various multi-sensory approaches to teaching mathematics, the readiness of teachers to embrace these approaches needs to be determined[8 18].

It is generally found that hearing impairment student are almost equal in terms of their academic pursuits except for science and math, in which the hearing impaired generally show low or poor performance[3 16].

2. NEED AND SIGNIFICANCE OF THE STUDY:

Teachers know that students learn in different ways. In order for instruction to reach all students, teaching methods must relate to each child's own learning preference style. [9 23] stated that students may have more than on inelegancy and this result in a deeper and richer understanding of mathematical concepts through multiple representations; enables all students to learn mathematics successfully and enjoyably; allows for a variety of entry points into mathematical content; and focuses on students' unique strengths. Knowing that no one method of learning is appropriate for all children, teachers should have a variety of mathematics strategies from which to choose, therefore appealing to all learning preference styles. Using a variety of materials allows students to gain experience for understanding and using mathematics[10 22]. For these reasons, school systems encourage their teachers to search for new and better ways to help children learn.

It is generally found that hearing impairment student are almost equal in terms of their academic pursuits except for science and math, in which the hearing impaired generally show low or poor performance. Mathematics is often said to be an organized structure of knowledge if one can understand the structure, then he/she capable of surviving in the world of mathematics. [8 18,11 19] brings about the salient features of mathematics that contribute to effective citizenship. Mathematics as an expression of human mind reflects the active will, the contemplative reason and the desire for aesthetic perfection. Through mathematics a child can receive complex learning environment that incorporate real life mathematics activities. Student learns by making connections through a variety of experiences. The main aim of teaching mathematics in school is: to developed the sense of appreciation of scientific invention and discoveries. It inculcates the habit of hard work. It enriches the student's power of observation and expression. It develops knowledge and skill of learner. So in the life of various impaired person it will help to develop structure understanding[12 3,13 4].

Mathematics help to absorb the new ideas to change, cope with ambiguity, perceive the pattern and solve the unconventional problems in the life of hearing impaired children[14 11]. It will be helpful to develop the problem solving attitude in hearing impaired child' life. Through mathematics thinking strategies can be thought for developing arithmetic skills such children[1 6]. But it is quite obvious that many children face a lot of difficulties in understanding mathematical concepts and so is true for children with hearing impairment. The common difficulties faced by these children in learning mathematics are limitation in organizing ideas, method and devices used for solving the mathematics[14 8].

As per the available literature, Mathematics is found to be abstract subject particularly at secondary level. Hence, the researcher felt a need of finding out the effect of multisensory strategy in learning Mathematical Concepts by the children with hearing impairment. Multisensory strategy was selected to make learning active, interesting, and concrete and above all activity centered.

3. OBJECTIVES OF THE STUDY:

- To find out the effect of multisensory strategies in learning selected mathematical concepts among SwHI.
- To find out the effect of multisensory strategies in learning selected mathematical concepts among SwHI with regard to their gender.
- To find out the effect of multisensory strategies in learning selected mathematical concepts among SwHI with regard to their locality.

Hypothesis

- There will be no significant effect of multisensory strategies in learning selected mathematical concepts among students with hearing impairment.
- There will be no significant difference between boys and girls in learning selected mathematical concepts through multisensory strategies.
- There will be no significant difference between rural and urban students with reference to learning selected mathematical concepts through multisensory strategies.

4. METHOD:

The investigator adopted experimental method and employed purposive sampling method under non-probability technique in this current study to select the sample of 10 students with hearing impairment studying 6th standard in a special school for the hearing impaired.

Tool 1: Teacher Made Test (TMT)

The tool Teacher Made Test (TMT) employed in the current study was developed by the researcher. TMT as a tool for the present study based on the content of the instructional package developed for intervention. The TMT used for the present study was developed on the basis of selected from three mathematical concepts which included fraction, triangle and ratio. TMT was designed to evaluate the extent to which selected mathematical concepts were grasped by the students with hearing impairment when taught through multisensory instructional package. To construct the appropriate tool for the assessment of the selected mathematical concepts the researcher had done need analysis with the Experts(10) in the field of special education such as Subject experts, Special Educators, Hearing Impaired Teachers, Integrated school teachers of SwHI.

Based on the suggestions and recommendation of the experts the researcher had constructed Teacher Made Test (TMT) to find out the level of selected mathematical concepts of students with hearing impairment. TMT consisted of 30 close ended multiple-choice questions from selected three mathematical concepts such as ratio(10), fraction(10) and trigonometry(10).

Tool -2: Multisensory Instructional package

To teach selected mathematical concepts a multisensory instructional package was prepared for the intervention. Three mathematical concepts were selected from 6th standard Mathematics Text Book. Further, out of the selected concepts, only basic concepts and problems were selected. To construct the appropriate intervention instructional package to teach selected mathematical concepts the researcher had done need analysis with the Experts(10) in the field of special education such as Subject experts, Special Educators, Hearing Impaired Teachers, Integrated school teachers of SwHI.

Reliability & Validity

To establish the reliability of the tool TMT for the students with hearing impairment population by using test-retest method. The collected data were then tested for the reliability coefficient (0.90) to find out the reliability of the tool. After finding out the reliability coefficient, the tool was used to assess the selected mathematics concepts from the sample. Content Validity Ratio (0.78) obtained from the experts for the lesson plans of the Multisensory instructional package indicates that the package developed was highly valid.

Data collection procedure

The sample for the current study, students with hearing impairment were studying in special school for the hearing impaired. The researcher got consent from the selected sample and head of the institution to gather data. Thereafter, the researcher selected the sample by matching the baseline from their earlier records of marks in Mathematics. Ten students with hearing impairment were grouped into experimental and control groups. Then experimental group received intervention package through multisensory strategy and control group was taught through traditional method for 3 weeks. To clear the doubts of students with hearing impairment sign language interpretation service was also provided. After the intervention, post test was conducted using TMT to assess the level of the selected mathematical concept to both experimental and control groups.

5. DATA ANALYSIS WITH RESULTS AND DISCUSSIONS:

Hypothesis 1: There will be no significant effect of multisensory strategies in learning selected mathematical concepts among students with hearing impairment.

Table 1 : Mean and standard deviation of experimental and control group in learning mathematical concepts

Group	N	Minimum	Maximum	Mean	Std. Deviation
Control	5	14	19	16.40	2.074
Experimental	5	21	26	23.00	1.871

Table 1 shows that, the mean value of control group is (16.40), which is less than the mean value of experimental group (23.00). Standard deviation of experimental group (1.871) which is less than standard deviation of control group (2.074).

Table 2 : Summary of hypothesis testing

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Math score is the same across categories of Groups.	Independent-Samples Mann-Whitney U Test	.008[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

[1] Exact significance is displayed for this test.

Table 2 shows that, the significance level of Mann-Whitney 'U' value is .008 is less than the significance level of 0.05. It is inferred that, there is a significant differences between experimental and control group in learning mathematical concepts. Hence the null hypothesis is rejected and the alternative hypothesis is accepted.

Result: This result reveals that the multisensory teaching strategies have significant effect in learning selected mathematical concepts among SWHI.

Hypothesis 2: There will be no significant difference between boys and girls in learning selected mathematical concepts through multisensory strategies.

Table 3 : Mean and standard deviation of male and female students in learning mathematical concepts

Gender	N	Minimum	Maximum	Mean	Std. Deviation
Male	4	15.00	23.00	19.5000	3.69685
Female	6	14.00	26.00	19.8333	4.44597

Table 3 shows that, the mean score of male students is (19.5000), which is less than the mean score of female students (19.8333). Standard deviation of male students is (3.69685) which is less than standard deviation of female students (4.44597).

Table 4 : Summary of hypothesis testing

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	.914[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

[1]Exact significance is displayed for this test.

Table 4 shows that, the significance level of Mann-Whitney 'U' value is .914 is higher than the significance level of 0.05. It is inferred that, there is no significant differences between male and female students with hearing impairment in learning mathematical concepts. Hence the null hypothesis is accepted.

Result: This result reveals that, the male and female categorization is not having a significant factor in learning selected mathematical concepts among SWHI.

Hypothesis 3: There will be no significant difference between rural and urban students with in learning selected mathematical concepts through multisensory strategies.

Table 5 :Mean and standard deviation of rural and urban students in learning mathematical concepts

Area	N	Minimum	Maximum	Mean	Std. Deviation
Rural	5	14.00	19.00	16.4000	2.07364
Urban	5	21.00	26.00	23.0000	1.87083

Table 5 shows that, the mean score of rural students is (16.4000), which is less than the mean score of urban students (23.0000). Standard deviation of urban students is (1.87083) which is less than standard deviation of rural students (2.07364).

Table 6 : Summary of hypothesis testing

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score is the same across categories of Locality.	Independent-Samples Mann-Whitney U Test	.008[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

[1]Exact significance is displayed for this test.

Table 6 shows that, the significance level of Mann-Whitney 'U' value is .008 is less than the significance level of 0.05. It is inferred that, there is a significant differences between rural and urban students with hearing impairment in learning mathematical concepts. Hence the null hypothesis is rejected and the alternative hypothesis is accepted.

Result: This result reveals that, the rural and urban categorization is having a significant factor in learning selected mathematical concepts among SWHI.

6. MAJOR FINDINGS WITH DISCUSSION:

The data analysis result reveals that the multisensory teaching strategies have significant effect in learning selected mathematical concepts among SwHI. The results are on line with [10,12,15,17,18,19,21 & 24]. Gender wise result reveals that, there is no significant differences between male and female SwHI in learning mathematical concepts. Locality of residence wise reveals that, the urban category students learnt selected mathematical concepts better than rural category SwHI.

7. CONCLUSION:

The placement and the teaching methods for SwHI are both extremely important in the education of the student. Based on both theoretical foundation and experimental research studies, it is important for teachers to be aware that not all students are at equal levels of mental maturity in mathematics. So, various modalities of presentation need to be incorporated teach math lessons. One of the recommended technique/strategy is Multi-sensory approach. Also many a times it is not possible for the teacher to explain particular topics due to the limitation of the students. In such case multisensory intervention package can be a way out for teaching the students some difficult topics. In the current study it is revealed that the multisensory teaching strategies have significant effect in learning selected mathematical concepts among SwHI. So, it recommended that the multi-sensory teaching strategy can be adopted by mathematics teacher to teach various concepts to SwHI.

8. SCOPE OF THE STUDY:

- The study will be helpful to the parents, special educators and general educators to understand the benefit of multisensory approach.
- Activities with multisensory strategies will help the student with hearing impairment in learning mathematical problems.
- Based on the findings of the study we can administrate appropriate training strategies for the better rehabilitation of hearing impaired students and also the findings of the study may give directions for further research in this area.

9. RECOMMENDATION AND SUGGESTION:

- The package used by the researcher was multisensory: however this can be made with the use of recorded sounds and wooden form.
- The researcher selected a very limited number of samples for present study. However, further researches can be done on large groups.
- The intervention package made for this study was based on only mathematics subjects. However, such packages can be used for teaching concepts from all the subjects included in the school curriculum.

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