

Vol 3 Issue 4 Jan 2014

Impact Factor : 1.6772 (UIF)

ISSN No : 2249-894X

*Monthly Multidisciplinary
Research Journal*

*Review Of
Research Journal*

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Welcome to Review Of Research

RNI MAHMUL/2011/38595

ISSN No.2249-894X

Review Of Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

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RECALL OF MATHEMATICAL TERMS AMONG STUDENTS WITH AND WITHOUT HEARING IMPAIRMENT

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Abstract:

Mathematics is an important subject of learning for all including children with hearing impairment in schools. The prescribed Mathematics textbooks contain several typical mathematical terms. Understanding and recalling of these terms play an integral role in learning Mathematics. The major factors influencing the recall of mathematical terms are familiarity, concreteness, imagery and signability (Lang & Pagliaro, 2007). The present study aimed to compare the abilities of students with and without hearing impairment in recalling the mathematical terms. The study further aimed to look at the relationship(if any) between the identified factors and the recalling abilities of students with hearing impairment. 45 students from each of the special and mainstream schools participated in the study. The scores obtained on 'Test of Word Recall' and rating scales were treated statistically using 't' test and Pearson correlation. The result obtained revealed the recalling abilities of students without hearing impairment better than that of their hearing impaired peers. The study further found that only signability and imagery have potential influence on the recalling abilities of students with hearing impairment.

KEY WORDS:

Recall, Familiarity, Concreteness, Imagery, Signability, Mathematical Terms, Students with Hearing Impairment, Students without Hearing Impairment

INTRODUCTION

Mathematics is a key area of learning for all children including children with hearing impairment in schools. Mathematics is considered as the vehicle to train children to think, reason, analyse and articulate logically (NPE, 1986). It lays a strong foundation in understanding Science, Engineering, Technology and Economics. Hence, Mathematics is considered as a compulsory subject of study in schools. The applicability of Mathematics is seen in almost all walks of life.

The children with hearing impairment also learn Mathematics in schools like their hearing peers. The curriculum followed for teaching Mathematics in special schools is same as that of their hearing peers. The teaching - learning is done in a systematic and graded manner. At lower levels, the focus is on developing basic mathematical vocabulary, concepts, simple operations, patterns etc. As they progress, Algebra, Geometry, complex solutions etc. are added to their curriculum.

Mathematics vocabulary plays an integral role in the understanding and learning of the subject. Mathematics is a language, and to be fluent in that language, one must be able to use and understand its vocabulary. With the use of vocabulary quizzes and mathematically-centered vocabulary activities, teachers work on improving the Mathematics vocabulary in students. However, for some students, it is very hard to remember and recall. Without a solid foundation, students are often unable to successfully learn new mathematical concepts with good confidence. Many of the students had never been exposed to consistent

Title: " RECALL OF MATHEMATICAL TERMS AMONG STUDENTS WITH AND WITHOUT HEARING IMPAIRMENT ".Source: Review of Research [2249-894X] PRATIMA SINGH AND SUNI MATHEW yr:2014 vol:3 iss:4

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mathematical terminology in their elementary education, which led many to an unfavourable impression of Mathematics. They would miss problems not because they did not know how to do them, but because they did not understand the words that were being used. Hence, teaching of Mathematics vocabulary is vital. Most of the research studies conducted in the area of Mathematics education found that the children with hearing impairment lag behind their hearing peers in Mathematics (Swanwick, Oddy, and Roper, 2005, Bhagat & Mathew, 2003).

Memory plays a major role in the mathematics learning of students. There are powerful connections between memory, intelligence and learning (Lang and Pagliaro 2007). The information, which is stored in the long term memory, is being recalled in situations when there is a need to solve problems. The ability to do this varies across students. According to Lang (2007), the constructivist perspective in learning mathematics and problem solving emphasizes the importance of both short-term memory and long-term memory. The quality of the input into working memory and of the operations that takes place helps in problem solving in Mathematics. Semantic memory, on the other hand, is used to activate concepts during mathematical problem solving and to make a representation of these problems. Marschark, Lang, and Albertini (2002) reported a number of studies focusing on both working and semantic memory which have shown that deaf and hearing individuals encode information in qualitatively different ways.

There are several factors affecting the recall of mathematical terms among students. Signability, imagery, familiarity, and concreteness are the major ones (Lang & Pagliaro, 2007). Signability is the usage of sign based codes by the individuals to gain and retrieve knowledge and skills. According to Marschark et. al. (2002), those who are signers often use sign language-based coding. Students who are signers often use more sign language-based coding than speech-based coding in memory tasks. On the other hand, imagery is the ability to perceive mental pictures, not through the retina of the human eye but through the mind's eye (Lang & Pagliaro, 2007). Imagery serves as a mental blackboard and aids students in the recall of what they have learnt. The familiarity of a word or sentence is generally dependent upon the frequency of its occurrence and reinforcement received by the individual. According to Lang and Pagliaro (2007), concreteness is defined as the real or actual thing that can be felt with the hands and seen with the eyes. The concreteness of the knowledge gained has an influence on the recall of the same. 'Higher the concreteness, better the learning.' Researches with students with hearing impairment have pointed to the possible relationships between familiarity, concreteness, imagery and signability of words (Emmorey, Klima, and Hickok, 1998).

NEED

Research studies conducted in abroad and India revealed that students with hearing impairment lag behind their hearing peers in Mathematics. Some of the research studies conducted further revealed that the achievement of students in Mathematics at recall level is at par with their hearing peers (Bhagat, 2003, Marschark, 2001). However, both groups differ in word problem solving abilities. One of the factors responsible for developing problems solving abilities is the recalling abilities of students. Very few researches had been carried out in abroad to study the recalling abilities of students with and without hearing impairment and to study the factors affecting the recall of mathematics terms, facts and concepts (Lang and Pagliaro, 2007). Additionally, the relationship between signability, concreteness, imagery, familiarity and the recalling abilities, if identified will enable the teachers to identify the learner's characteristics for Mathematics learning and can plan appropriate strategies for better learning. Hence, the study was initiated.

OBJECTIVES

The study mainly aimed to compare the abilities of students with and without hearing impairment in recalling mathematical terms. Further, the research aims to study the relationship between (i) familiarity (ii) concreteness (iii) imagery and (iv) signability of mathematical terms and recalling abilities of students with hearing impairment.

EXPLANATION OF KEY TERMS

(i) Recall: means the ability of the students in remembering the mathematical (Geometry) terms presented by the researcher,

(ii) Familiarity: means how well the individuals knew the meaning of the term,

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(iii)Concreteness: means a real or actual thing that can be grasped with the hands or seen with the eyes and opposed to a definition of abstractness defined as an idea or concept in the mind -not a thing that can be touched,

(iv)Imagery: means the formation of mental pictures in the human mind,

(v)Signability: means how easy it would be for the students to use an appropriate sign for each of the selected mathematics terms,

(vi)Mathematics Terms: Means vocabulary selected from the Mathematics text books of standard VI, VII & VIII based on the unit 'Geometry',

(vii)Students with Hearing Impairment: means children with hearing loss of 60 decibels or more in better ear in the conversational range of frequencies and studying in special schools, and

(viii) Students without Hearing Impairment: means children having normal range of hearing and studying in mainstream schools.

HYPOTHESES

- i. There exists no significant difference in the abilities of students with and without hearing impairment in recalling mathematical terms,
- ii. There exists no significant relationship between familiarity and abilities of students with hearing impairment in recalling mathematical terms,
- iii. There exists no significant relationship between concreteness and abilities of students with hearing impairment in recalling mathematical terms,
- iv. There exists no significant relationship between imagery and abilities of students with hearing impairment in recalling mathematical terms, and
- v. There exists no significant relationship between signability and abilities of students with hearing impairment in recalling mathematical terms.

Method

Research Design: Exploratory survey research design was followed

Sample

The sample selected for the present study included 45 students with hearing impairment from special schools, and 45 students without hearing impairment from mainstream schools on a random basis using lottery method. All of them were pursuing secondary education at the time of study.

Tools

1. Test of Word Recall

Test of word Recall is a teacher made mathematics vocabulary test developed based on the unit 'Geometry' from 6th, 7th and 8th standards. The test consists of 18 items to assess the recalling ability of students. The mode of presentation of the test is through PPT. The validity of the test was drawn with the help of subject and field experts. Table 1 shows the vocabulary included in the test.

Table 1: Test of Word Recall: Selected Vocabulary

Unit	Subunits	Items		
Geometry	Shape	Square	Rectangle	Sides
	Measurement	Length	Breadth	Area
	Lines	Point	Parallel line	Perpendicular
	Angle	Bisector	Interior angle	Right angle
	Triangle	Equilateral Triangle	Isosceles Triangle	Scalene Triangle
	Circle	Circle	Centre	Diameter

2.RATING SCALES

Based on the selected mathematical vocabulary, four 'Rating Scales' were also developed by the researchers to rate the familiarity, imagery, signability and concreteness of the mathematics vocabulary selected for the study. Familiarity rating scale was prepared to rate how well the students with hearing impairment knew the meaning of the term. Concreteness rating scale was prepared to rate how well the students with hearing impairment possess the concreteness of the selected terms. Signability rating scale was prepared to rate each term with its degree of signability. Imagery rating scale was also prepared to rate 'when I see this word, my mind develops a mental picture of it'. The keys used for rating are mentioned in table 2.

Table 2: Keys for Rating

Factors	Rating			
Familiarity of mathematical terms	1 (No Idea)	2 (Some what Familiar)	3 (Familiar)	4 (Very Familiar)
Imagery of mathematical terms	1 (Strongly disagree)	2 (Disagree)	3 (Agree)	4 (Strongly agree)
Signability of mathematical terms	1 (very difficult to sign)	2 (difficult to sign)	3 (easy to sign)	4 (very easy to sign)
Concreteness of mathematical terms	1 (Not concrete)	2 (Less concrete)	3 (Concrete)	4 (Very concrete)

TREATMENT AND PROCEDURE FOR DATA COLLECTION

The researchers contacted the special and mainstream (regular) schools for permission and finalization of the schedule for data collection. Based on schedule, the test of word recall was administered on the selected participants personally. They were requested to understand and follow the instructions given by the researcher prior to participation. On completion of viewing the power point presentation of Test of Word Recall, students were asked to write down the maximum number of words which they could recall from the presented list. All the response sheets were collected. As a next step, familiarity rating scale was given to the selected participants personally. They were requested to follow the instructions and rate each word given in the scale based on the descriptive scale given. On completion, the fully filled rating scale from the selected participants were collected. The same procedure was followed for data collection based on the other three rating scales. The responses on the test and the four rating scales were evaluated based on the developed scoring keys. The qualitative data was converted to quantitative data for the convenience of analysis.

RESULTS AND DISCUSSION

Recalling abilities of students with and without hearing impairment

The research study found a significant difference in the abilities of students with and without hearing impairment in recalling mathematical terms'. The abilities of students without hearing impairment ($M=14.73$, $SD=1.60$) in recalling the mathematical terms was found better than that of the students with hearing impairment ($M= 10.71$, $SD= 2.51$, $t_{cal}= 4.769$, $t_{tab}= 2.63$, $p=0.01$). Inferior recalling abilities of deaf children is well documented in the literature (Burnip and Lawson, 2000; Swanson and O'Connor, 1981). Learning mathematics is very important for all including students with and without hearing impairment. The poor recalling abilities of students with hearing impairment as compared to hearing peers might be due their poor language abilities. Globally, language is considered as the vehicle for education. This holds true for mathematics education too. A strong language base is required for mathematics learning. Generally, Mathematics has a number of technical terminologies like square, hypotenuse, circle etc., which needs to be learnt and meaning to be elicited and reinforced in order to recall and use. However; students with hearing impairment have the most difficulty in understanding these words (Bhagat & Mathew, 2006) in order to recall. This might have affected their performance in recalling the mathematical terms.

Reading competencies of students with hearing impairment also require due attention here. There are several research studies reporting the importance of reading in mathematics learning. Wood et.al (1986) mentioned that mathematical problems of any type in linguistic form demand reading on the part of learners. Pau (1995) reported that, mathematical skills are directly linked with the reading competence. Very often, it is observed that students with hearing impairment read the mathematics terms like the hearing children. However; they find difficulty in comprehending the terms (Bhagat & Mathew 2006). There are also a group of students with hearing impairment who have difficulty even in reading the mathematics terms. Since the present study demanded adequate reading skills from students with hearing impairment in order to recall the mathematics terms, the students with hearing impairment might have faced difficulties in reading and recalling some mathematical terms correctly.

Relationship between familiarity, concreteness, imagery and signability of mathematical terms and recalling abilities of students with hearing impairment

The study found no significant relationship between (i) familiarity (ii) concreteness and abilities of students with hearing impairment in recalling mathematics terms. Though familiarity plays a significant role in learning and retrieval of information, the present study did not yield any significant relationship ($r_{cal}=0.2447$, $r_{tab}=0.296$, $p=0.05$). This may be because of the nature of test items and its administration followed in the study. The test items were in the print format with no pictures or symbols. As a part of study, students were asked to read the terms given in the rating scale and rate them accordingly. Most of them might have used print to print matching (print on the PPT and print on the rating scale) rather than relating the terms with their past experiences. From the present study, one can infer that concreteness of terms does not have a significant relationship ($r_{cal}= -0.074$, $r_{tab}=0.296$, $p=0.05$) with the recalling abilities of students with hearing impairment. On studying the terms selected for the study, it can be seen that all terms do not possess the characteristic of 'concreteness'. The students participated in the study have recalled both concrete and not so concrete (abstract) terms. They might have used some other strategies for recalling the terms, which needs to be explored. Hence the result.

In contrast to the above, the present study found a significant relationship between (i) imagery ($r_{cal}= 0.3709$, $r_{tab}=0.296$, $p=0.05$) (ii) signability ($r_{cal}= 0.4688$, $r_{tab}=0.384$, $p=0.01$) and abilities of

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students with hearing impairment in recalling of mathematical terms. Images are mental pictures drawn by the students to learn and retrieve the data. Because of the difficulties in verbal or auditory coding for learning, they use visual coding by developing mental pictures in their minds for retention. As compared to hearing peers, the students with hearing impairment very often use mental pictures and relate the same with the given words while learning. In this study also, students with hearing impairment might have had the mental pictures for all the selected terms used in the study. Hence they could recall these terms when assessed. Researchers like Krakow and Hanson (1985) and Hanson (1990) studied, deaf signers and serial recall in the visual modality. They reported that, signability play an important role in learning and retention. Marschark (2002) mentioned that, many students with hearing impairment use sign language based coding and there is a relationship between sign language to memory. The present study supports the same.

CONCLUSION

Thus the present study arrived at the conclusion that the recalling abilities of students with hearing impairment fall behind their hearing counter parts. Hence it is very essential for teachers to identify the reasons for the same. Though the factors like familiarity, imagery, signability and concreteness are identified as the possible factors that can influence the recalling abilities, the present study found only signability and imagery as the potential factors influencing the recalling abilities of students with hearing impairment.

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