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UNDERSTANDING STUDENTS WORKING MEMORY LIBERATES MATHEMATICS LEARNING - A DIAGNOSTIC APPROACH

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Abstract

The present study aims to investigate relationship between working memory and achievement in mathematics. The investigator had employed descriptive survey method and used Proportionate stratified random sampling technique to draw the sample. The sample consists of 300 ninth standard students from English medium schools in Puducherry. Standardized instrument, namely digits backward test (DBT- WISC-III UK, 1992) for working memory and self constructed Mathematics Diagnostic cum Achievement Test (MDAT) were used to collect data. Mean, standard deviation and correlation were the statistics used to analyse the data. High working memory capacity students had significantly performed well in mathematics than low working memory capacity students.

Keywords: *Working Memory, Diagnosis, Achievement in Mathematics*

INTRODUCTION

"It is necessary to look at what students could do well, instead of seeing

What they could not do"- (Gardener,1983)

Mathematics is a universal language, the gate way for all knowledge and way of thinking which all need to make sense of the world and an important for some other subjects for solving many world problems. Mathematics provides the opportunity to all the students to develop their understanding, concentration, and memory, thinking power, problem solving capacity, decision making, logical & reasoning power among the learners which are the essential requirement of the technological world we live and the hold relation to many careers. Such a wonderful subject can be learn, enjoy and applied in real life only when it is understand properly. A meaningful learning of any concept is the base for better understanding ; but students in mathematics classroom face many difficulties due to the lack of meaningful learning or understanding and these difficulties create mathematics phobia in the minds of the learners though the study of mathematics holds a central role in education system. Working memory acts as an important factor for understanding individual differences in mathematics achievement among children. In mathematics class to solve a mathematics problem student require to hold the information in working memory and retrieve the other information from long term memory and should related to the required problem. The main focus of this paper is to investigate relationship between working memory and achievement in mathematics and the ways to overcome limitations to liberate mathematics learning.

WORKING MEMORY

Working memory capacity is a system influences understanding in conceptual areas (Dalal Alenezi 2008) and responsible for providing temporary storage and manipulation required for any mental process, and its role in learning mathematics cannot be neglected. This is where thinking, understanding and problem solving (in its genuine sense) take place.

According to Johnstone (1984), working memory is "that part of the brain where we hold information, work upon it, organize it, and shape it, before storing it in long-term memory for further use." The working memory space is very limited in terms of both its capacity (amount of information it can hold) and its duration (length of time it can hold information).Working memory capacity is the controlling factor in understanding and the conscious part of the mind

that is holding ideas and facts while it thinks about them. It is a shared holding and thinking space where new information coming through the perception filter consciously interacts with itself and with information drawn from the long-term memory store in order to make sense. Johnstone (1997).

High working memory capacity students tends slightly to:

- Understand mathematics ideas easily
- Think they are good in mathematics;
- Think that every one should study mathematics in secondary school;
- Think mathematics is useful subject.

Low working memory students tend

- slightly to feel they are short of time during the mathematics examinations;
- They make many mistakes and cannot remember how to do things. (Dalal Alenezi 2008).

Influences of Working Memory in Mathematics Achievement: Literature Review

- Low working memory students are less likely to use direct memory recovery to solve arithmetic tasks; Count more slowly and inaccurately than children with normal ability. (Geary *et.al*, 1991; Bull & Johnston, 1997). Have weak or incomplete networks of number facts in long term memory (Geary *et.al*, 1991; Hitch & McAuely, 1991).
- Low working memory students typically perform poorly on measures of phonological loop function (Hitch & McAuely, 1991)
- Christou,(2001) found a collapse in students' performance in solving algebra problems when the questions demanded more capacity that the working memory capacity of the student found high correlation between achievement in mathematics and working memory capacity ($r = 0.4$, $p < 0.001$).
- Alenezi, (2008) found students with high working memory capacity perform better in mathematics than those with lower working memory capacity.
- Johnstone (1980) showed that a sudden drop in the learner's performance was apparent when any task load exceeded the upper limit of the learner's working memory capacity.

Significance of the study

This study is important because it will help the educationists and teachers to understand better individual differences working memory among students, recognize the most important

crucial factor which act as predictors for mathematics achievement and to modify their instructional strategies to suit the minds of the learners.

Objectives

- The present study aims to investigate relationship between working memory and achievement in mathematics.

Hypotheses

- There is no significant relationship between working memory and achievement in mathematics.

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Limitations of the study

In this study the participants comprised of standard IX students of English medium high schools in Puducherry only.

Methodology

In this study descriptive research design was adopted. This involved collection of quantitative and qualitative data in an attempt to answer the research questions. In this section sample, variables, tools and data collection procedure are presented. Normative Survey Method was adopted for data collection.

Sample and Sample procedures

The Proportionate stratified random sampling technique was used to select 300 ninth standard respondents from Six English medium schools - 2 each of government, aided and private.

Variables of the study

Independent variable: Student's performance in mathematics

Dependent variable: Students working memory space

Tool used

Mathematics Achievement Test

This test was piloted on 300 ninth standard students. The achievement test for mathematics consisting of 188 items was developed by the researcher and administered to determine the students' achievement on mathematics. Content reliability and validity for this achievement test were ascertained with the help of two professors, eight assistant professors and two mathematics teachers in education having above 15 years of experience in teaching mathematics. The help of four mathematics teachers, currently teaching ninth standard in government schools were also utilized. Thus, the test to assess achievement consisted of 188 items.

Digit Span Backward Test for Working Memory:

To measure working memory space for every sample digit span backward test (DBT) in Wechsler Intelligence Scale for Children–3rd UK Edition (WISC-III UK) (1992) was used .In this test the researcher reads a series of number sequences to the child at the rate of one per second, and the child is required to repeat each sequence in the reverse order. Two tasks are given for each number of digits. Discontinue digits backward after failure on both the trails of any item .When students fail to recall both sets of numbers containing the same number of digits the previous level was taken to represent the working memory. The sample of the students were divide into three groups namely who succeed to remember reverse up to 3 digits were named as low working memory capacity,4,5digits were named as intermediate working memory and 6,7 were named as high working memory capacity.

Data collection

This study was conducted during the academic year 2012 to 2013 in six different English medium schools (2 each of government, aided and private). In this study two instrument namely

digits backward test (DBT) for working memory and Mathematics Achievement Test (MAT) were used to collect data. In this study proportionately 50 students from Six English medium schools - 2 each of government, aided and private which were selected. Totally participants of this study were 300 ninth standard students.

Administration of the instrument:

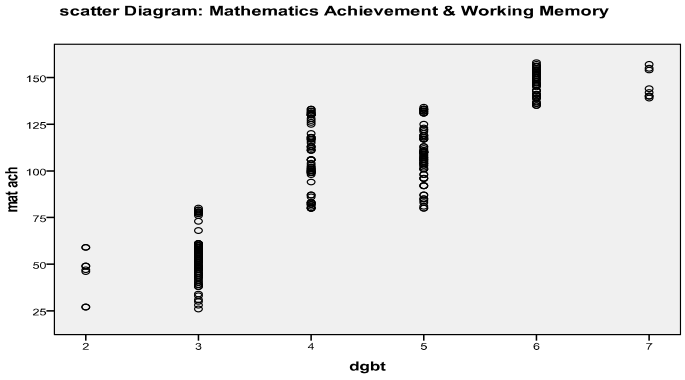
Researcher gives oral description about the aim of the study; procedures of the test in front of all the candidates to familiar with the objectives of the study, before providing the instruments. After that, students were instructed to ready with pen and pencil the data sheets and mathematics achievement test were distributed and responses. They were given ample time to go over the questionnaire items and answer them. Then the questionnaire was collected back. After that individual test DBT was conducted and the responses were recorded.

Data analysis, findings and discussion

The findings of the study are presented in Table-1. Findings were analyzed through SPSS 17.0 program. Mean, standard deviation and correlation were used to obtain the result.

Table – 1: Relationship between Mathematics achievement and Working memory

Working memory space	Number of students	Percentage	Mean score in Mathematics Achievement Test
Low - digits 2,3	95	31.6%	52.87
Intermediate - digits 4,5	144	48%	108.13
High - digits,6,7	61	20.4%	147



The finding of the study reveals that mathematics performance was related to measure working memory capacity. The value obtained using Pearson product correlation was 0.883, significant at $p<0.01$ .This correlation can be illustrated in the scattered table. It can be seen that high working memory capacity students perform better in mathematics than those with lower working memory capacity.

Overcoming Working Memory Limitations

Working memory problems are identified as an important learner factor causes learning difficulty. If we want to help learner's effective strategies like Recitation method, whole part methods, spaced and unspaced methods should be adopted to minimize the working memory demands in the classroom activities. There are to reduce working memory demands and achieve success in learning situations. Cognitive load theory recognizes three methods that can help students to accommodate the limitations of working memory (Eggan & Kauchak, 2007): *Chunking, Automaticity, Dual processing*.

Conclusion

By understanding learners working memory capacity teachers can encourage their student's strength and capability. Also students in their turn can develop positive attitude towards life and become more successful and enterprising in their path of human resource development. Instead of neglecting low achieved students teachers must try to diagnose the weakness in mathematics with understanding working memory level of their students and practice the different methods like chunking, automaticity and dual process to liberate mathematics learning.

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