Research Article

Development of Working Memory Skills among Sixth Standard Students

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Abstract

Previous research tracked the history of Working Memory studies which has demonstrated close relationships between working memory and students' scholastic attainment. The aim of the present study is to explore a method of improving working memory, using modified version of Dr. S. Malathi's(2004) working memory training module. Three hundred students aged eleven years who are studying in sixth standard are tested on measures of the phonological loop, visuo-spatial memory and central executive components of working memory test battery. The Achievement tests in English and Mathematics constructed and validated by the investigators are used. Fifty students are assigned to low working memory skill group on the basis of their performance, selected for the experimental study (Group? Rl X R2). It is observed that there exists significant relationship between working memory skills and performance in English and Mathematics. The results revealed that working memory training module resulted in significant improvements in tasks assessing the phonological loop, visuo-spatial memory and central executive components of working memory, achievement in English and Mathematics. The results are discussed in terms of implications for educational practice.

Keywords: Working Memory, Sixth Standard Students, Memory Training, Phonological Loop, Central Executive, Academic Achievement, English, Mathematics, Educational Research

INTRODUCTION

The term working memory refers to structures and processes provide temporary storage and manipulation of the information necessary for such complex cognitive tasks as language, comprehension, learning, and reasoning.

It is involved in the selection, initiation, and termination of information processing functions such as encoding, storing, and retrieving data. Working Memory is seen as the combination of a Central Executive which is assumed to be an attentional-controlling system, is important in skills such as chess playing, Visuo-Spatial Memory which manipulates visual images, and a Phonological Loop which stores and rehearses speech-based information and is necessary for the acquisition of both native and second-language vocabulary. Working Memory (WM) is responsible for temporarily maintaining and manipulating information during cognitive activity (Baddeley, 2000). It has been found to be closely related to a wide range of high-level cognitive abilities such as reasoning, problem- solving, and learning (Kyllonen & Christal, 1990).

The recent research has confirmed that the specificity of associations between working memory and attainment persist after differences in I.Q have been statistically controlled in children with learning difficulties (Swanson and Saez, 2003; Gathercole et al., 2006). The verbal working memory plays a crucial role in mathematical performance when children are younger. However, as they get older, other factors such as number knowledge and strategies play a greater role (Thevenot and Oakhill, 2005). This view is supported by recent evidence that working memory is a reliable indicator of mathematical disabilities in the first year of formal schooling (Gersten et al., 2005). There is growing evidence that mathematical deficits could result from poor working memory abilities. Low working memory scores have been found to be closely related to poor computational skills (Wilson and Swanson, 2001). Weak verbal working memory skills are also characteristics of poor performance on arithmetic word problems (Swanson and Sachse-Lee, 2001).

Reading disabilities can be characterized by marked difficulties in mastering skills including word recognition, spelling, and reading comprehension. In addition, WM is related to academic achievement in the domain of reading (Daneman &Tardif, 1987), writing (Abu-

Rabia, 2003), mathematics, and science (De Smedt, Ghesquiere, & Verschaffel, 2004; Gathercole, Pickering, Knight, & Stegmann, 2004). As WM plays an important role in cognitive activity, researchers are exploring ways of applying WM research to improve abilities such as fluid intelligence the ability to understand complex relationships and solve new problems and science achievement (Martinez, 2000).

This paper tracks the history of WM studies, synthesizes the definition of WM, contrasts measures of WM, summarizes the relationship between WM and English Achievement and Mathematics achievement, and discusses how to apply significant findings from WM research to improve English Achievement and facilitate Mathematics learning using working memory skills.

Objectives of the Study

This research has three main objectives:

- To find the level of working memory skills among Sixth Standard Students.
- To investigate the relationship between working memory skills and performance in the areas of English and Mathematics.
- To examine the influences of Working Memory skills training module on working Memory, Achievement in English and Achievement in Mathematics.

Tools Used in the Study

Working Memory Test Battery: Modified version of Dr. S. Malathi's Working Memory test battery (2004) is used for this study by the investigators is composed of six tests designed to tap the three subcomponents such as Central Executive, Visuo-Spatial Memory, and a Phonological Loop.

Working Memory Skills Improvement Training Module: To improve the working memory skills of the students, the investigators used the modified version of Training Module constructed by Dr. S. Malathi (2004) which consists of twelve mental exercises to tap the three subcomponents such as Central Executive, Visuo-Spatial Memory, and a Phonological Loop of Working Memory.

Achievement Tests: The Achievement tests in English and Mathematics constructed out of twenty five marks and validated by the investigators are used. The reliability of the test in English is found to be 0.773 and the test in Mathematics is found to be 0.835.

Methodology

Survey method has been adopted to collect data from three hundred sixth standard students. Working Memory skills are assessed by the modified version of test battery (Dr. S. Malathi, 2004) developed by the investigators. Fifty students are assigned to low working memory skill group on the basis of their performance, selected for the experimental study (See Table I).A single group pre- test and post-test design Group? Rl X R2 is implemented to investigate the effect of working memory skills improvement training module on the students of low working memory skills. Rl is the initial result without introducing the experimental factor. R2 is the result after introduction of the experimental factor. X represents the working memory skills training module.

Table I

Level of Working Memory

Variable	Level of Working Memory	Sample	Percentage
Working Memory	Low	50	16.67
	Average	210	70.00
	High	40	13.33

Analysis of data

The results of the analysis on the study are presented below.

Table- II

Relationship between Working Memory and

Achievement in English, Mathematics

Variable	Correlation Coefficient	LS
WM & Ach. In English	0.722	**0.01**

WM & Ach. In Mathematics	**0.810**	**0.01**

From the Table-II, it is observed that that there is 72% positive relationship between Working Memory and Achievement in English and is significant at 0.0llevel, 81% positive relationship between Working Memory and Achievement in Mathematics.

Table Ill

Mean performance of students' outcome before and after intervention of WM skills improvement training module

Variable			N	**Pre-Test**		**Post-Test**		t	LS
				M	SD	**M**	SD		
W M	Central Executive	LRST	50	3.23	1.14	7.30	1.18	17.84	0.01
		CRT	50	3.03	1.12	7.55	1.11	17.07	0.01
		BDRT	50	3.33	1.59	7.58	1.52	13.21	0.01
	Visuo-Spatial Memory	SADMT	50	3.13	1.09	7.15	1.67	18.13	0.01
	Phonological Loop	FDRT	50	3.27	1.01	6.90	1.03	20.46	0.01
		SROW	50	3.05	0.99	7.15	1.67	19.57	0.01
Achievement		English	50	14.8	1.57	24.8	2.98	14.52	0.01
		Maths	50	15.3	1.46	22.9	3.15	10.27	0.01

Note:

Listening Recall Sub Test - LRST
Counting Recall Test -
Backwards Digit Recall Test – BDRT
Static and Dynamic Matrices Tests - SADMT
CRT Forward Digit Recall Test - FDRT
Serial Recall of Words - SROW

From the Table III, it is inferred that there exists significant difference between pre test and post test scores of all components of working memory, performance in English and Mathematics at 0.0llevel.

Discussion

From the findings, it is clear that the deficits are severe for all the components such as Central Executive, Visuo-Spatial Memory, and a Phonological Loop measures. Working Memory test battery is able to identify children who are at risk of encountering academic difficulties associated with problems in different subjects, with different components of

working memory deficits. These findings lend further weight to previous evidence that the central executive in particular play a crucial role in the acquisition of complex cognitive abilities and skills such as literacy, comprehension, and arithmetic (Swanson, 1994; Yuill et al., 1989). The post test scores are significantly higher than the pre test scores indicates that the Intervention Training Module found to be effective in enhancing Working Memory.

The working memory skills training module facilitate students' Visuo-spatial working memory uses a kind of visual sketchpad of the brain which allows students to envision something, to keep it in their "mind's eye", to be better equipped to remember patterns, images, and sequences of events to meet everyday challenges which in turn assist students to perform efficiently and effectively in academics. Working memory skills provide a resource for the individual to integrate knowledge from long term memory with information in temporary storage (Swan & Saez, 2003, Swenze & Frankenberger, 2004). The working memory skills training module would have assisted students to complete independent activities, such as puzzles, reading and understanding the content, mental arithmetic to perform better in post-tests.

Working memory assessments may play a useful role in screening for children at risk of educational underachievement (Ford & Sibler, 1994; Gathercole & Adams, 1993). The working memory tests employed in the present study use stimuli and methods provide fluid and sensitive indicators of the student's ability to acquire knowledge and understanding in key aspects of the program to achieve better in post-tests.

If the children frequently fail in individual learning situations simply because they cannot store and manipulate information in working memory, their progress is acquiring complex knowledge and skills in areas such as literacy and mathematics will be slow and difficult. So the training of working memory in children with low working memory skills leads to substantial gains in academic attainments (Turley-Ames & Whitfield, 2003). Therefore significant post test scores in this study support that Working memory skills enhance to adhere to work plans, such as participating ingroup activities in the class, sustaining focus and interest throughout lectures, meeting deadlines to complete assignments, listening, recalling, prioritizing multiple activities, etc. to achieve academically in English and mathematics.

Conclusion

The present study proves the greater effectiveness of working memory improving exercises in enhancing working memory skills and achievement in English and Mathematics.

Poor working memory skills result in pervasive learning difficulties which act as a bottleneck for learning in many of the individual learning episodes required to increment the acquisition of knowledge (Gathercole, 2004).

A classroom based intervention should be designed to reduce memory related failures that lie at the root of substantial learning difficulties is strongly recommended. This study may enrich the educators and the findings of the study will serve as a database for the future research.

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