Journal of Namibian Studies, 36 S1 (2023): 213-227 ISSN: 2197-5523 (online)

Word Problem Solving And Working Memory: A Correlation Study At 8th Grade

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Abstract

The impact of a student's reading comprehension skills is the second crucial individual talent in the effectiveness of word problem solving. The objective of the study was to Measure 8th grade student's working memory capacity, word problem solving ability, find out the relationship student's working memory and word problem solving at 8th grade and find out the effect of demographic variables (gender, age and area) on student's working memory and word problem solving ability. The population of this study was the male and female mathematics students of public schools of Lahore. Two measuring instruments were used for data collection about students working memory and word problem solving. Data analyses consisted of descriptive statistics. Cronbach's alpha used to explain consistency of measuring instruments used in research. The findings of the study shoes that strong relationship between working memory and word problem solving at 8th grade.

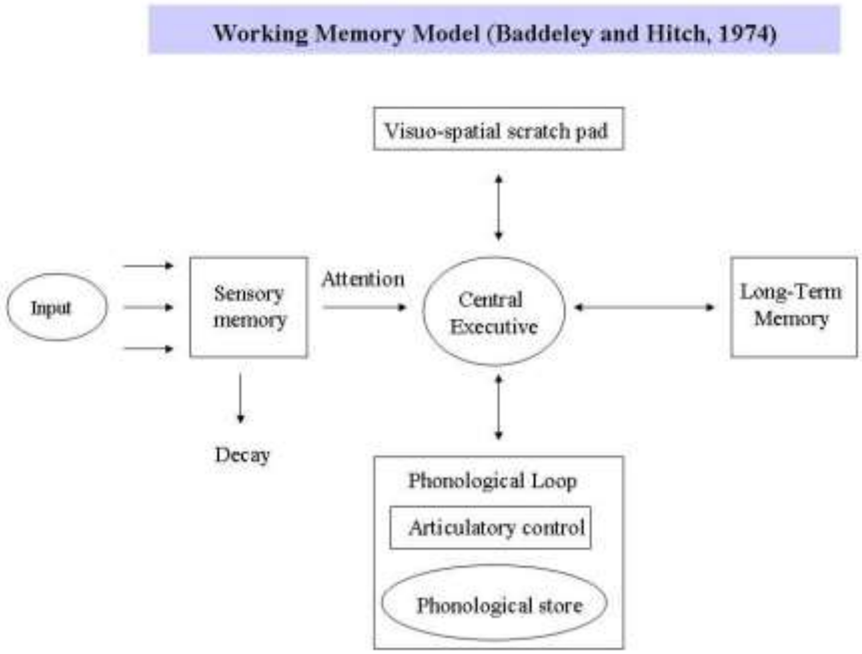
Keywords: working memory, word problem, 8th grade.

Introduction

According to Miyake and Shah (1999), working memory is the mental workspace that is used to actively maintain, control, and regulate pertinent information in order to complete challenging cognitive tasks. According to Kane and Engle (2004), working memory, or our capacity to receive and retain information. A working memory-related model was presented by Baddeley

(2000). This paradigm states that working memory is a domain-general component involved in a variety of regulatory processes, such as retrieving information from the long-term memory, and is in charge of controlling attention and processing. The phonological loop and the visual-spatial sketchpad are two slave systems that make up the modality-free central executive, a type of supervisory system that controls and regulates the occurring cognitive processes, and working memory. Baddeley (1996) characterised the retrieval of representations from long-term memory, focusing and switching attention, and coordination of the slave systems as functions of the central executive (Cowan & Alloway, 2008).

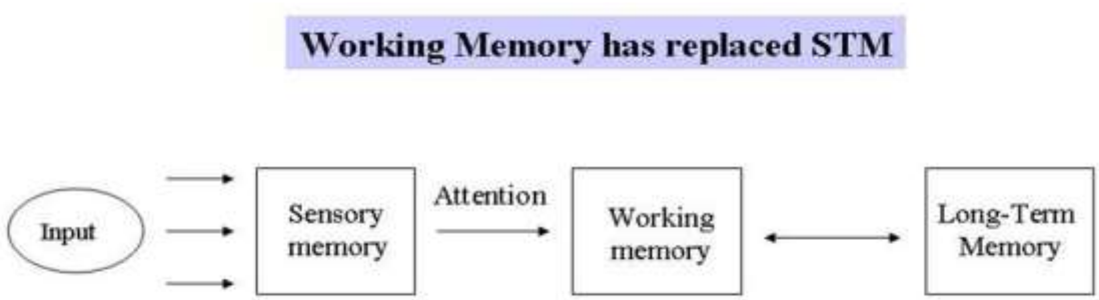
Information is manipulated and temporarily stored in working memory, which is made up of multiple parts that work together in concert. Research has been done on the predictive power of working memory and intelligence on academic achievement (Alloway, 2010). When children's school achievement was evaluated six years later, working memory skills at age five showed to be the best predictor of literacy and numeracy, whereas IQ was found to explain a lower fraction of variance. Similar results by Angelopoulou, & Drigas, (2021) highlight the importance of working memory abilities in addition to domain-specific literacy and math precursors in six-year-olds as indicators of first-grade school achievement. Math performance is also correlated with working memory; low working memory scores are strongly associated with subpar calculation and arithmetic word problem performance (Oberauer, 2019). An essential component of primary school mathematics curricula is word problems. This is due to the fact that word problems enable students to apply their formal mathematics knowledge and abilities to practical settings. The overwhelming body of research suggests that children's performance on word problems improves as they become more adept at (a) comprehending the fundamentals of arithmetic operations (Voitov, & Mrsic-Flogel, 2022) and (b) differentiating between word problem types based on mathematical operations (Panichello, & Buschman, 2021; Landi, et al., 2021).



The foundation of all mathematics curricula is the process of solving mathematical problems, which contextualises concepts and abilities for learning (Ibrahim, 1997). Broadly speaking, a problem is an issue or challenge that needs to be resolved. When a student is given an issue to solve in a classroom setting, it indicates that he is expected to respond appropriately and use his knowledge to solve the problem (Grover, et al., 2022). According to PISA 2012, issue solving is the ability of a person to understand a situation without a clear solution and come up with a solution (Peng, 2022). Effective thinking includes problem solving (Jackson, 2021). "An initiation into a scientific research" is what problem solving is all about. It involves learning to analyse an issue, model, investigate successful solutions, reason, use analogies, generalise, look at specific situations, and more. Whether a maths problem is purely mathematical or has a practical application, the process of solving it successfully depends on the solver's positive outlook and "the firm intention to reach the end" when working on a successful project. Finding a solution to an issue involves following a series of logical stages in a cognitive behavioural process called problem solving (Jones, et al., 2020). One of the mainstays of 21st-century issue solving is the application of critical thinking and the existence of relevant scenarios. Hard difficulties and relationships, as well as circumstances whose veracity, truth, and actuality we cannot be confident of, are typically what constitute problems (Zhang, et al., 2022). The foundation of all mathematics curricula is the process of solving mathematical problems, which contextually supports the concepts and abilities taught in the programme (Gray, et al., 2019).

The impact of a student's reading comprehension skills is the second crucial individual talent in the effectiveness of word problem solving, as shown by study findings (Shahrajabian, et al., 2023). Mathematical problem solvers need to possess more than only cognitive skills to comprehend and depict a problem scenario, develop algorithms for the problem, handle various kinds of data, and carry out the computation (Logie, et al., 2021). However, age-related changes in word problem solving are not fully explained by developmental changes in mathematical ability. There is evidence to support the requirement for cognitive processes that are more general—that is, not just related to mathematics. Taking on a word problem like "15 dolls are for sale, 7 dolls have hats," for instance. These are big dolls. What percentage of dolls are headless? entails cultivating a range of mental skills (Pongsakdi, et al., 2020). Kids need to retrieve pre-stored data (like 15 dolls), choose the right algorithm (15 minus 7) and use the problem-solving procedure to manage its implementation (like ignoring the unimportant data).

According to (Fuchs, et al., 2020), the Multi-Store Model's depiction of short-term memory (STM) is considerably too simplistic. The Multi-Store Model states that STM processes relatively little and can store little amounts of data for brief periods of time. The system is unitary. This indicates that there are no subsystems; it is a single system, or storage. There is no unified store in working memory.



An essential component of primary school mathematics curricula is word problems. This is due to the fact that word problems enable students to apply their formal mathematics knowledge and abilities to practical settings. The overwhelming body of research suggests that children's performance in solving word problems improves as they become more adept at (a) comprehending the fundamentals of arithmetic operations (e.g., Rasmussen & Bisanz, 2005), (b) differentiating word problem types based on mathematical operations (Fuchs, et al., 2021), and (c) employing selection strategies (Johann, et al., 202). However, advances in mathematics knowledge do not fully explain improvements in word problem solving skills. There is evidence that working memory and other general cognitive functions may be crucial. Taking on a word problem like "15 dolls are for sale, 7 dolls have hats," for instance. The dolls are big. What percentage of dolls are headless? Entails the growth of several mental skills (Pongsakdi, et al., 2020). Children must use problem-solving techniques to manage the algorithm's execution, acquire prestored information (such as 15 dolls), and access the relevant algorithm (15 minus 7).

According to Wen, & Dong, (2019), mathematical word problems are mathematical exercises that provide pertinent information about a topic as language instead of in the form of mathematical notation. Effective thinking includes problem solving (Periáñez, et al., 2021). A broad definition of thinking encompasses three fundamental concepts: (1) Though it is deduced from behaviour, thinking is cognitive. It must be deduced indirectly because it takes place inwardly, in the mind or cognitive system. (2) Thinking is the cognitive system's process of manipulating or performing operations on knowledge. (3) Thinking is focused and leads to action that either solves an issue or is in the direction of a solution (Theodoraki, et al., 2020). The process of thinking begins with an issue, whose resolution becomes a personal objective, which then guides the person's thoughts (Kalaycı, 2001). A cognitive solution to an issue is called problem solving. According to Kalahcı (2001), difficulties typically comprise of unclear, challenging, and relational conditions as well as actuality and correctness about which we cannot be confident. According to PISA 2012, issue solving is the ability of a person to understand a situation without a clear solution and come up with a solution (Teng, & Zhang, 2023). The three concepts that any definition of a problem should include are: the problem exists in some state at the moment, but it is ideal for it to exist in another state (Drigas, & Karyotaki, 2019).

Broadly speaking, a problem is an issue or challenge that needs to be resolved. When a student is given an issue to solve in a classroom setting, it indicates that he is expected to respond appropriately and use his knowledge to solve the problem (Hawes, & Ansari, 2020). The majority of experts view problem solving as the most complex cognitive activity, involving all of an individual's intellectual faculties (memory, perception, reasoning, conceptualization, language), as well as emotions, motivation, self-confidence, and situational control. These authors claim that problem solving is a higher intellectual activity.

Objective of the study

The objectives of the study were to:

1) Measure 8th grade student's working memory capacity.
2) Measure 8th grade student's word problem solving ability.
3) Find out the relationship student's working memory and word problem solving at 8th grade.
4) Find out the effect of demographic variables (gender, age and area) on student's working memory and word problem solving ability.

Significance of the study

The study's theoretical value lay in illuminating eighth-grade students' working memory and word problem-solving skills. We may learn whether or not the students can solve the word problems with the aid of this study. This study emphasizes the connection between students' word problem solving skills and working memory. The study will also describe the pupils' proficiency in word problem solving and working memory. Teachers will be able to focus on their pupils' working memory if this study's measurement of the relationship between working memory and word problem solving skills indicates that such a relationship exists. The study was important because it shed insight on the question of whether or not working memory affects pupils' ability to solve word problems. The results of this study may assist administrators in determining what modifications are required to improve students' working memory and word problem solving skills.

Hypothesis of the study

$H_0 1$: There is no significant mean difference between male and female students working memory at 8th grade.

$H_0 2$: There is no significant mean difference between male and female students' problem solving ability at 8th grade.

$H_0 3$: There is no significant relationship between students' working memory and problem solving ability at 8th grade.

Methodology

The nature of the current investigation was quantitative. This study employed the correlational approach to gather data from eighth-grade students to determine the relationship between working memory and mathematical word problem solving skills. The male and female maths students in Lahore's public schools made up the study's population. The population, its components, and the nature of the research objectives were taken into consideration when choosing the sample. In all, 200 people—100 men and 100 women—were involved in this investigation. The participants ranged in age from 12 to 14. Convenient sample procedures were used to get data from various government sector schools. Data regarding pupils' working memory was gathered using two measurement devices. The researchers used Pascal-Leon's (1970) figure intersection test to gauge the working memory of the students. The working memory test consisted of 36 items. The researchers created the problem-solving aptitude exam to gauge eighth-grade students' proficiency with mathematics problems. The test consisted of five sections that covered material from eighth grade maths. Students in the eighth grade at many public schools in the Lahore district provided the data. Students in the classes received questionnaires. No student returned the form home, and no one provided an answer. Version 15 of the Statistical Package of Social Sciences (SPSS-25) was used for data analysis. Descriptive statistics made up data analysis. Cronbach's alpha is used to explain why the measurement devices utilised are consistent.

ANALYSIS AND INTERPRETATION OF DATA

Table 1 Percentages, mean, standard deviation of 8th grade students working memory

Working memory	N	Percentage	Mean	Std. Deviation
Poor	9	4.5%	3.5556	.52705

Average	34	17.0%	5.0000	.00000
Good	157	78.5%	7.1274	.90388
Total	200	100.0%	6.6050	1.31439

Table 1 shows that 78.5% students have good working memory (mean=7.13, S.D=0.90) while 4.5% students have poor working memory (mean=3.53, S.D=0.53).

Table 2 Percentages, mean, standard deviation of 8th grade male and female students working memory

Gender	Working memory	N	Percentage	Mean	Std. Deviation
Male	Poor	1	1.0%	4.0000	.
	Average	13	13.0%	5.0000	.00000
	Good	86	86.0%	7.1047	.90786
	Total	100	100.0%	6.8000	1.13707
Female	Poor	8	8.0%	3.5000	.53452
	Average	21	21.0%	5.0000	.00000
	Good	71	71.0%	7.1549	.90472
	Total	100	100.0%	6.4100	1.45015

Table 2 shows that 86.0% male students have good working memory (mean=7.104, S.D=0.91) and 1.0% male students have poor working memory (mean=4.0, S.D=0.0) while 71.0% female students have good working memory (mean=7.15, S.D=0.90) and 8.0% female students have poor working memory (mean=3.50, S.D=0.53). So we conclude that male students have good working memory than female students.

Table 3 Percentages, mean, standard deviation of 8th grade students problem solving ability on the basis of their working memory

Working memory	N	Percentages	Mean	Std. Deviation
Poor	9	4.5%	13.7778	1.39443

Average	33	16.7%	14.0606	4.77585
Good	156	78.8%	14.3590	5.33757
Total	198	100.0%	14.2828	5.12095

Table 3 shows that Student with good working memory (78.8%) have problem solving ability mean=14.36 while students with poor working memory (4.5%) have problem solving ability mean=13.78.

Table 4 Percentages, mean, standard deviation of 8th grade male and female students problem solving on the basis of their working memory

Gender	Working memory	N	Percentage	Mean	Std. Deviation
Male	Poor	1	1.0%	14.0000	.
	Average	13	13.0%	16.3846	2.81480
	Good	86	86.0%	17.1047	3.71651
	Total	100	100.0%	16.9800	3.60129
Female	Poor	8	8.2%	13.7500	1.48805
	Average	20	20.4%	12.5500	5.22620
	Good	70	71.4%	10.9857	5.10326
	Total	98	100.0%	11.5306	4.98700

Table 4 shows that Male students who have good working memory (86.0%) have mean=17.10 and male students who have poor working memory (1.0%) have mean=14.00 .while female students who have good working memory (71.4%) have mean=10.99 and female students who have poor working memory (8.2%) have mean =13.75.

H_{o1}: There is no significant mean difference between male and female students working memory at 8th grade.

Table 5: Independent sample t test for mean difference between male and female student's working memory

Variables	N	Mean	df	t-value	Significance
Male	100	6.80	198	2.116	0.036
Female	100	6.41			

At the p≤0.05 level of significance, Table 5 demonstrates that the t value (2.116) is significant. Therefore, it is determined that there is a significant mean difference between male and female students' working memory at the eighth grade, rejecting our null hypothesis that there is no significant mean difference.

H_{o2}: There is no significant mean difference between male and female students' problem solving ability at 8th grade.

Table 6 Independent sample t test for mean difference between male and female students' problem solving ability

Variables	N	Mean	df	t-value	Significance
Male	100	16.98	196	8.28	0.00
Female	100	11.53			

At the p≤0.05 level of significance, Table 6 demonstrates that the t value (8.28) is significant. In light of this, it is determined that there is a significant mean difference between male and female students' problem solving abilities at the eighth grade, rejecting our null hypothesis that there is no significant mean difference.

H_{o3}: There is no significant relationship between students' working memory and problem solving ability at 8th grade:

Table 7 Independent sample r test for mean difference between male and female student's working memory and word problem solving ability

Variables	**N**	**R**	**Significance**
Working memory and Problem solving	100	0.02	0.78

At the p≤0.05 threshold of significance, Table 7 demonstrates that the r value (0.02) is not significant. Therefore, it is believed that there is no meaningful correlation between eighth-grade students' working memory and their capacity for problem-solving.

Findings

- 78.5% students have good working memory (mean=7.13, S.D=0.90) while 4.5% students have poor working memory (mean=3.53, S.D=0.53).
- 86.0% male students have good working memory (mean=7.104, S.D=0.91) and 1.0% male students have poor working memory (mean=4.0, S.D=0.0) while 71.0% female students have good working memory (mean=7.15, S.D=0.90) and 8.0% female students have poor working memory (mean=3.50, S.D=0.53).
- Male students who have good working memory (86.0%) have mean=17.10 and male students who have poor working memory (1.0%) have mean=14.00 .while female students who have good working memory (71.4%) have mean=10.99 and female students who have poor working memory (8.2%) have mean =13.75.
- Student with good working memory (78.8%) have problem solving ability mean=14.36 while students with poor working memory (4.5%) have problem solving ability mean=13.78.
- At the p≤0.05 level of significance, the t-test indicates that the value (2.116) is significant. Therefore, it is determined that there is a significant mean difference between male and female students' working memory at the eighth grade, rejecting our null hypothesis that there is no significant mean difference.
- The t-test indicates that the t-value (8.28) is significant at the p-value of less than 0.05. In light of this, it is determined that there is a significant mean difference between male and female students' problem solving abilities at the eighth grade, rejecting our null hypothesis that there is no significant mean difference.
- At the p≤0.05 threshold of significance, the test indicates that the r value (0.02) is not significant. Therefore, it is believed that there is no meaningful correlation between

eighth-grade students' working memory and their capacity for problem-solving.

Conclusion

Our data indicates that the majority of pupils possess good working memory. Male students outnumber female students in terms of those with strong working memories, and those with strong working memories are also adept at solving problems. Male students outnumber female pupils in terms of those with strong working memory and problem-solving skills. The mean difference between male and female students' working memory and their ability to solve problems is likewise statistically significant. Our data leads us to the conclusion that there is no meaningful correlation between eighth-grade pupils' working memory and their capacity for problem-solving.

It was concluded that the main goals of problem solving are to engage students in community service, support the development of general knowledge and common sense, and prepare them for the problems of life. Students' understanding can be improved by occasionally being prompted to create their own difficulties. This may inspire them to be adaptable and recognise that there are other perspectives on an issue. In order to help the students concentrate on the underlying principles in addition to the mathematics, the teacher might also provide a theme to the issues that they make up, such as helping others or caring for the environment.

Recommendations

There are limitations in the present study that must be addressed. These are as follows.

- Teachers need to emphasise to their students the value of maths. Since students who understand the true goal of studying mathematics will become more driven to learn.
- Since maths is sometimes thought of as a dull topic, teachers should employ a range of instructional techniques and resources, such as exercises, audiovisual aids, and models, rather than just textbooks, to keep all of their students engaged.
- Students with low fluid intelligence—more likely to be described as having an innate ability—can yet achieve

excellent academic standing. This is an encouraging discovery for pupils with low fluid intelligence.

- Students who devote more time to their studies are more likely to have a deep conceptual comprehension of the material, so curriculum creators should design their curricula to allow for significant amounts of study time.
- Students should have the appropriate opportunity to interact with teachers and other students in order to improve their meaningful learning rather than memorization. Considering that dialogue can occasionally result in novel findings.
- Only give pupils credit for their work and accomplishments when it is due. When praising a student, teachers should be precise and use their professional judgment to determine how often is best for each individual in the class.
- Encourage students to strive harder and again when they make mistakes or receive bad grades rather than letting them give up on their failure. Exam systems should be designed with the belief that students who persevere in learning can overcome obstacles more readily and develop a strong sense of motivation.

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