



Understanding Secondary Students' Ability to Solve Real-Life Mathematical Word Problems

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ABSTRACT

This research proposed the predictive value of reading comprehension and knowledge retention in mathematics on Grade 10 students solving mathematical word problems in District Malakand, Khyber Pakhtunkhwa, Pakistan. A causal-comparative (ex post facto) quantitative research design was used where the study did not manipulate variables and tested relationships between the existing variables. The sample size was 28,885 secondary-level students, a representative sample of 355 Grade 10 students was chosen by non-proportionate cluster sampling. The data were gathered using three sets of researcher-designed and validated measures; a Reading Comprehension Test, a Mathematical Knowledge Retention Test, and a Mathematical Word Problem Solving Test. Frequency distributions percentages

were done using SPSS in descriptive analysis. The results have shown that most students had difficulties with solving word problems: most of them either have given a wrong answer or have been able to extract information with no application of relevant formulas, with a smaller percentage having been able to solve the problems entirely. Not entering the range of low performance was explained by weaknesses in reading comprehension and remembering mathematical knowledge, which demonstrated the interrelation between these abilities in solving the problem. The findings highlight the importance of instructional plans, which combine reading and mathematical abilities, use a variety of teaching approaches to meet the needs of various learning styles, and give stepwise instructions with positive feedback. These results offer practical lessons that teachers can use to develop the problem solving skills of the secondary students of mathematics.

Keywords: Understanding reading, Mathematical knowledge retention, Word problem solving, secondary education, Predictive analysis.

INTRODUCTION

Mathematics education is important in the development of logical thinking, reasoning, and problem solving skills in students. Solving word problems is regarded as one of the most complicated and crucial skills of the mathematics learning process because it implies involving both linguistic knowledge and mathematical thinking. Word problems are especially significant as they provide the relation of mathematical concepts to the real life situation so that students could apply their knowledge to the significant situation. It is however known that a number of students in the secondary level have great problems when it comes to solving mathematical word problems.

The capacity of the students to understand the language in which the problem is formed is one of the main issues in getting the solutions to mathematical word problems. Mathematical word problems are not simple tasks that involve numerical data, but they demand that a student should be able to read, understand the information presented in a text, extract the appropriate data and express it mathematically. Studies reveal that reading comprehension is an essential requirement of effective problem solving because, students should comprehend the problem first and only then they are able to solve it (Valenzuela et al., 2024). In the same manner, it has been demonstrated that the poor reading comprehension skills frequently result in the poor performance in solving mathematical problems, which confirms the fact that the language and mathematics learning are interdependent (Luna et al., 2024).

Besides reading comprehension, the capability of students to retain is also important in word problem solving. The retention allows learners to remember past acquired mathematical concepts, formulas, and processes which are necessary in solving problems correctly. The students might not be able to use the right strategies without retention or forget some steps needed to arrive at solution. The cognitive requirement of the word problems then goes beyond the process of simple

computation and encompasses both the memory, reasoning and understanding process so as to work together at the same time.

Recent research also states that there are several cognitive elements that determine the capability to solve mathematical word problems such as understanding, reasoning and visualization. As an example, the application of reading techniques and interventions based on comprehension has been discovered to have a considerable positive effect on the performance of students in the domain of solving word problems (Mishra, 2024; University of Kansas, 2024). Furthermore, the new research points to the fact that the language comprehension problems may directly act as an impediment in the performance of the students in mathematical problem-solving tasks, especially when the latter imply the intricate linguistic constructions (Daroczy et al., 2026).

Although the literature on this field is accumulated, the study of the skills of students to solve the tasks of a real-life mathematical word problem in the secondary level, especially in the context of the developing educational environment, remains a topic of necessity. Numerous researches have been conducted on either reading comprehension or mathematical performance in isolation with a few research studies having been conducted on the actual capacity of students to utilize mathematical knowledge in real life problem scenarios.

As such, the current research paper would explore the capability of the present-day secondary students in solving mathematical word problems in real life, with the view of giving an insight on their problem solving skills. Such skills are vital in enhancing teaching methods, coming up with effective interventions, and the general performance of the students in mathematics in real world situations.

LITERATURE REVIEW

The problem solving of mathematical word problems have always been considered an important aspect of mathematics education because it involves the combination of mathematical abilities, language comprehension and thought process. Word problems, contrary to the mundane mathematical tasks, require students to process textual information, locate information that is pertinent, and perform pertinent mathematical operations. This multidimensional character renders the word problem solving to be a complicated affair to many learners, especially in the secondary level.

Mathematical Word Problem Solving

Word-problems are important in relating mathematics to real-life. They are aimed at building the students analytical skills and problem solving capabilities through mathematical concepts in a contextualized form. Nevertheless, studies show that a significant percentage of students are not able to cope with word problems because of the inability to comprehend the problem structure and find a solution strategy (Purcar et al., 2024). They result in students coming to wrong solutions because they tend to respond to superficial responses like the use of key words instead of having to engage in deep understanding.

Moreover, word problems can be solved only by means of representation. Students that can formulate what they can mentally or visually, in response to problem situations, are able to perform better when compared to symbolically manipulative students. Visual reasoning has been found to enhance the understanding and accuracy in solving problems (Purcar et al., 2024).

Reading Comprehension and Word Problem Solving

The reading comprehension is consistently found to predict success in the mathematical word problem solving. The word problems are written down in texts and, therefore, the students have to decode the language and then interpret it first before using it in the mathematical procedures. A number of research studies have observed a close association that exists between the reading comprehension and problem-solving performance.

An example of this is a study by Valenzuela et al. (2024) who discovered that students who had a higher reading comprehension score performed much better in solving mathematical word problems that focused on understanding of the textual information prior to getting into the computation. On the same note, Luna et al. (2024) demonstrated a high level of correlation between reading comprehension and mathematical performance, meaning that students with poor comprehension skills have difficulties in solving problems.

Recent studies also indicate this association. Boctot et al. (2025) have shown that reading comprehension is a good predictor of comprehension of mathematical word problems among the students indicating that it is a foundational element in mathematical learning. Also, research by Obina et al. (2025) found that the level of low reading comprehension was linked to poor performance in the solution process of word problems which indicates that the comprehension difficulty has a direct correlation on the problem-solving strategies.

Cognitive Factors in Word Problem Solving

In addition to reading comprehension, mathematical word problems present a problem that involves the integration of more than one cognitive process such as memory, reasoning, and visualization. Word problems are considered to present a high cognitive burden on learners because they have to deal with linguistic and mathematical information at the same time. Recent research underlines the need to combine reading and mathematical cognition. The research done at the University of Kansas (2024) indicates that the combination of decoding abilities, language understanding, number sense, and working memory is needed to solve the word problem effectively. This means that performance of students is not determined by the knowledge of mathematics alone but also the ability of their cognitive skills.

In addition, interventions based on improving comprehension strategies have been found to boost the performance of students in solving problems. As an illustration, using metacognitive reading skills and interactive learning aids go a long way in improving the capacity of students to analyze and solve word problems (Shao et al., 2025).

Retention and Problem-Solving Ability

Another important issue that affects the performance of students in mathematical word problem is retention, which is the capacity to memorise and recall the information that was learned previously. Problem solving will also involve the student reciting mathematical concepts, formulae, and processes that they had studied in earlier lessons. The lack of retention can also lead to the students being unable to use the proper strategies or forgetting the necessary steps in the solution process. Though not many studies have specifically studied retention when applied in word problem solving, the existing data only indicates that conceptual mastery and memory is essential in the success of problem-solving. Students with high conceptual learning and retention capabilities are in a better position to transfer the learned concepts into new and unknown issues. This brings into the limelight the fact that learning should be reinforced and long term retention encouraged in mathematics teaching.

Research Gap

Although it has been well researched that mathematical word problem solving and reading comprehension are two related topics in mathematics, there is still a gap in literature concerning the capabilities of students to solve mathematical word problems in real life at the secondary level, especially in developing nations. Primary-level students have been the target of many studies or they have been studied individually in relation to reading comprehension and mathematical performance. Further in-depth research involving the application of the skills by the students in the real world are required.

Thus, the current research will address this gap by examining the skills of secondary students in solving mathematical word problems in the real life and offer meaningful information to the educators and policymakers to enhance teaching and performance outcomes.

Objective of the study

To investigate the relationship between reading comprehension and students' ability to solve real-life mathematical word problems at the secondary level

Hypothesis

H₀ 1: There is no significant relationship between reading comprehension and students' ability to solve mathematical word problems at the secondary level.

Research Design

The research design that was used in this study relied on a causal-comparative (ex post facto) quantitative research design under a post-positivist paradigm. Its design is suitable in investigating the relationships between the available variables without experimental control (Phillips and Burbules, 2000).

The research design was to test a mediational hypothesis where reading comprehension and retention of mathematical knowledge is the predictor to the ability of Grade 10 students to solve mathematical word problems. Pilot study was carried out initially to create and test the research model and all instruments. The

data then came to the main phase where quantitative data were collected using standardized tests.

Population of the Study

The study population of this study was all students of Grade 9 and Grade 10 of every secondary school in District Malakand, Khyber Pakhtunkhwa, Pakistan. Officially, the district has 189 government and non-governmental secondary schools with a cumulative number of 28,885 students in secondary level (BISE Malakand).

Table 3.1 shows the population in a more detailed breakdown.

Table 3.1 Population of the Study

Institutions	Schools	Students (Grade 9)	Students (Grade 10)	Total Students
GHS for Boys	41	4,542	4,870	9,412
GHS for Girls	33	2,954	2,543	5,497
GHSS for Boys	6	1,726	1,255	2,981
GHSS for Girls	10	899	682	1,581
PS for Boys	54	4,251	2,924	7,175
PS for Girls	45	1,255	984	2,239
Total	189	15,627	13,258	28,885

Source: BISE Malakand

Sample and Sampling Technique

The sample was chosen by non-proportionate cluster sampling. Three tehsils of the District Malakand were considered as clusters. A total of 18 schools were conveniently identified using six schools in each tehsil. Simple random sampling was used to select 20 Grade 10 mathematics students in each of the selected schools.

This process left 355 Grade 10 students as the final sample. The sampling technique made the sample diverse and representative but at the same time feasible to the study.

Table 3.2 Sample of the Study

District	No. of Tehsils	No. of Secondary Institutions	No. of Schools Sampled	Total Secondary Students	Grade 10 Students (Total)	No. of Students Sampled
Malakand	3	189	18	28,885	6,125	355

Instruments

Three researcher-developed tests were used for data collection:

1. Reading Comprehension Test
2. Mathematical Knowledge Retention Test
3. Mathematical Word Problem Solving Test

Each of the instruments was well constructed, piloted and tested first during the preliminary stage of the study in order to achieve content validity, reliability and suitability with Grade 10 students.

Data Collection Procedure

The researcher was able to personally visit the 18 identified schools to administer the tests. Principals and headmasters of the respective schools were contacted in advance. Students were made well aware that they could only do it out of their own free will and that the test was going to be used as research only and that the information they would give would not affect their academic records in any way. The instructions to be followed prior to the test were standardized to achieve uniformity and reduce errors. No ethical concerns on human participants, particularly the minors, were compromised.

Data Analysis

Analysis of data was conducted in the form of SPSS. Data were summarised by descriptive statistics such as means, standard deviation and percentages.

Table 4.3: Students achievement on Word Problems Solving Test (N=355)

ITEM NO	Selected Area	Correct Responses	Correct (%)	Area wise correct (%)
1	Variation	58	16	16%
2	Ratio and Proportion	37	10	10%
3	Arithmetic	56	16	16%
4		21	6	
5		26	7	
6	Algebra	69	19	10%
7		36	10	
10		22	6	
8		44	12	
9	Geometry	56	16	14%

The table4.3 presents area wise data of all the sections which are provided to test the problem solving skills of the students. They are Variation (Item No. 1), Ratio, and Proportion (Item No. 2), Arithmetic (Item No. 3), Algebra (Item No. 4,5,6,7 and 10), Geometry (Item No.8 as well as item 9). In the bellow table of word problem, the responses column indicates that the pattern of scoring on the solution of the word problems means that the students did not respond or responded incorrectly to the problem, then extraction of data indicates that the students had abilities of extracting data, then use correct formula to obtain the solution of the problem, used the assistance of the incorrect calculative point showed the students who attempted to take the data, used the correct formula and then resolute the complete problem means that the frequency of the students who had the abilities to extract the data and used the correct formula to solve the problem.

Table 4.3.1: Students performance on the solution of word problem related to “variation”.(Item No.1) (N=355)

Responses	f	Percent(%)	Valid (%)	Percent	Cumulative (%)	Percent
Incorrect /not attempt	112	31.5	31.5		31.5	
Data Extraction	118	33.2	33.2		64.8	
Using Correct formula	26	7.3	7.3		72.1	
Applied wrong calculation	41	11.5	11.5		83.7	
Solved complete problem	58	16.3	16.3		100	
Total	355	100	100			

Item 1: Variation in any point of a cylinder pressure of water is in direct proportion to the depth of the surface. At a depth of 3 cm pressure = 51 Newton/cm². Locate pressure at a depth of 7cm. Table 4.3.1 shows the frequencies and the percentage scores of the responses of the students regarding word problem concerning variation. The information demonstrates that 31.5 percent of the participants gave a wrong answer to the question, which depicts the difficulty in comprehending the topics introduced in the issue. Conversely, 33.2 percent of the respondents could extract data of the problem, yet they could not use the appropriate formula to resolve the problem. This shows that the students could find the relevant information, but they were not aware of how to make use of the information to solve the problem. This can be attributed to failure to retain the knowledge in the area of concern in the field of math. Performance in application of accurate formula was only seen in 7.3% of the students. Only 11.5 percent of the respondents could use the right formula to solve the problem, Nevertheless, this figure remains fairly low, which means that the mathematical levels of students may have the room to be improved. Moreover, it is only 16.3 percent of the respondents who could solve the whole problem accurately which means that more preparation and development should be done in mathematical solution of mathematical word problems. All in all, these results demonstrate that students should be taught to better understand and apply mathematical concepts, primarily with resolving word problems. Besides, this poor performance is attributed to inappropriate teaching approaches to ensure that the students with other learning styles understand the concepts better. Such techniques can be visual aids, practical exercises, and teamwork among others. It is also necessary to mention that those outcomes can also be affected by the fact that student may know the subject he is studying better, know more about a language and be more engaged into the learning process. As such, additional investigation can probably be required to investigate these factors in greater depth.

Table 4.3.2: Students' performance on the solution of word problem related to "Algebra". (Item No.10) (N=355)

Responses	F	Percent(%)	Valid Percent(%)	Cumulative Percent(%)
Incorrect/no attempt	217	61.1	61.3	61.3
Data Extraction	70	19.7	19.8	81.1
Using Correct formula	5	1.4	1.4	82.5
Applied wrong calculation	6	1.7	1.7	84.2
Solved complete problem	57	15.8	15.8	100.0
Total	355	99.7	100.0	

Question 10: Ahmad is five times older than Hassan. Divide the age of Ahmad and Hassan in case their total age is 18 years. The frequencies and percentage respondents of the students when it comes to word problem solution are presented in table 4.3.2. Of the 355 students, 217 (61.1) students answered wrongly. The second response was most widespread and was data extraction out of the problem with 70 students (19.7) choosing the alternative. The number of students who solved the formula correctly (5 students 1.4) and those students who solved the formula incorrectly (6 students 1.7) were only 5 and 6 respectively. Nevertheless, 56 students (15.8%) could solve the entire problem. The findings show that most of the students had difficulties in giving answers to the word problems. The percentage of students who gave wrong answers was very high, and this shows that they were not able to comprehend the concepts being tested. The second most frequent responses were data extraction, which discovered that there were some students who could find the corresponding information in the problem but could not use it appropriately. The number of students who used the right formula to arrive at the correct solution was very low and the number who arrived at the correct solution using the correct formula was even less. These results indicate the necessity of specific training in skills of solving mathematical word problems and emphasis on mastering the concepts underlying it. The skills of solution of mathematical word problems can be taught to students with the help of teachers, who can offer a student to solve the problems in the classroom, stimulate his or her interest to find the information, and teach him or her how to choose and use suitable formulas. Besides, instructors are also able to give feedback which will assist the students in making corrections on their calculations.

Findings

- The performance analysis of the students in their solving mathematical word problem showed that most students had difficulties in all the content areas such as Variation, Ratio and Proportion, Arithmetic, Algebra and Geometry. The percentage of students who could extract the relevant data of the problems was rather great, however, only a minor fraction were able to use the appropriate formulas and a relatively small percentage of students were able to solve the problems entirely. This identifies serious flaws in mathematical understanding, conceptual, and procedural knowledge indicating that better instructional methods could be used to maximize problem-solving competencies.
- The variation (Table 4.3.1) The analysis of students response to word problem shows that there is a lot of gap of understanding and application. Approximately, 31.5% of pupils gave wrong responses which shows that they did not understand the concept. A small percentage (33.2) might draw the appropriate information out of the problem yet they could not use the appropriate formula and so they partially understood and had poor procedural abilities. The percentage of students who used the correct formula was only 7.3% and 11.5% used the correct formula with calculation errors. Moreover, it was only 16.3% who successfully solved the problem to the full which indicates that they have mastered all the mathematical procedures and use them correctly.
- Such findings indicate that the students not only have difficulties with conceptual knowledge but also with the concept-to-problem-solving-step translation. The factors could be the effective teaching strategies, the lack of visual aids, hands-on activities, or collaborative learning, which are necessary to remain able to cover the different learning styles. There are other variables like underlining knowledge, linguistic level and the measure of engagement which can also affect performance. In general, these results contribute to the importance of specific interventions to enhance understanding, memorization, and performance of students in the mathematical word problems solving.
- As the analysis of the answers of students to the word problem on ages (Table 4.3.2) shows, most of the students experienced severe challenges in resolving the problem. Among 355 students, 217 (61.1% replied that they did not understand the basic mathematical principles in a way to answer correctly). Only a smaller number of 70 students (19.7%), could derive appropriate data out of the problem, and failed to apply the correct formula, demonstrating a partial understanding, but a low level of procedural ability. Only 5 students (1.4%) were able to use the appropriate formula, and the 6 students (1.7%) used the formula and included errors in their calculation. In the meantime, 56 students (15.8) managed to solve the problem to the end, and they proved to know and correctly use the mathematical processes.
- These results indicate that students are struggling with both conceptual learning and procedural learning that is associated with word problem solving. The fact that it is not that successful underlines the need to use special methods of

teaching, including guided practice in the skills of seeking the required information, selecting the correct formula, and correctly calculating. The step-by-step demonstrations, the regular feedback, and the cooperative problem-solving can be used to develop the problem-solving skills of the students, as they have an opportunity to correct their mistakes and to be able to use mathematical knowledge.

DISCUSSION

The findings of this research reveal that the performance of secondary students in solving mathematical word problems related to real life situations was low as most of them could not interpret the statement of problems, use relevant formulae and reach solutions. These results coincide with the recent studies according to which the problems of students in word problems are not only computational but are closely associated with the failure to comprehend reading and process information (Valenzuela et al., 2024; Boctot et al., 2025). Effective word problem solving assumes that the students can comprehend the text, find necessary details and apply them to mathematical formulas; any of these steps may fail and provide wrong or incomplete solutions (Valenzuela et al., 2024). Moreover, the high percentage of students who were able to retrieve data but failed to use appropriate formulas indicates that the understanding is not enough students should also combine their mathematical understanding with methods of interpretation. This is consistent with the results that better understanding and reasoning solutions can promote performance on mathematical word problems (Shao et al., 2025).

The low numbers of correct complete solutions probably indicate the incompleteness of the linguistic and procedural knowledge, and the intervention should be aimed at the enhancement of the skills of students to understand the contexts of complex problems and make use of relevant mathematical processes. Enhancing reading comprehension has been indicated to result in the improvement of word problem performance, which implies that the use of instructional methods that combine reading and mathematics instruction could be quite effective (Noriega et al., 2025). All in all, these results emphasize the complexities of word problem tasks that students have to deal with linguistic complexity, information retrieval and processing, and correct mathematical thinking. This emphasizes the need to develop instructional interventions that develop both literacy and mathematical problem solving skills simultaneously and not as separate skills.

CONCLUSION

The current research indicates that secondary students experience a lot of difficulties in understanding word problems involving mathematics in real life. The results show that most students gave the wrong answers or could not use the right formula but could only extract information whilst a small percentage of the students could solve the problems. These findings show that there are weaknesses in mathematical reasoning as well as reading comprehension, which implies that the

complexities in problem statement comprehensions and the application of relevant procedures exist to cause poor performance. The research has highlighted the need to adopt integrated teaching models that can build literacy and mathematical abilities of students simultaneously. Student comprehension, analysis of problems, and accuracy of procedure related to word problems can be improved by including activities that improve the translation of word problems into mathematical formulations. What is more, educators should embrace various pedagogical strategies such as visual aids, practical tasks, guided practice, and feedback systems to meet the needs of various learning styles and enhance the overall problem-solving skills. On the whole, the performance of students in mathematical word problems needs to be enhanced holistically, as it is necessary to consider not only the field of computation but the level of understanding of the concept and its analytical capability, as well as reading comprehension. These interventions may promote greater performance and equip students to address quantitative problems in real life.

Recommendations for Teaching

- Integrate Reading and Math: Prepare those activities that will improve reading comprehension, and, mathematical reasoning to promote comprehension of word problems.
- Employ Varied Instructional Strategies: Incorporate visual aids, activities and group work to accommodate the various learning styles and improve conceptual knowledge.
- Give Step-by-step Instructions and Feedback: And motivate students to extract information, use the correct formula and calculate results with proper care and provide constructive feedback to fix mistakes.

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