



**A Case Study: Sources of Difficulties in Solving Word Problems in an International
Private School**

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Abstract

This qualitative research explored the sources of difficulties students encounter when solving word problems and the role of teachers' in supporting their learners in the process of problem solving. Three teachers were purposively selected from a private school in Dubai, United Arab Emirates. Data was collected through observations and interviews. Findings revealed word problems trigger the basic and critical skills of students and give them the opportunity to collaborate. Moreover, there is no manual for teachers to use when doing word problems in class. Teachers need to provide positive reinforcement that directs children to read critically and solve effectively.

Keywords: Word Problems, Teaching Mathematics, Qualitative research



Introduction

Learning to think mathematically by making the abstract concrete for learners is an integral step in math education (Schoenfeld, 1992). Using word problems helps children connect reality to math (Barwell, 2011). A word problem is a problem designed to help students apply mathematics concepts to real life situations. Word problems are a combination of numbers and words in which students apply mathematics instruction in the context of problem solving (Pfannenstiel, Bryant, Bryant, & Porterfield, 2015).

Children can become independent and creative thinkers if they are guided and equipped with the right procedures and techniques from the impetus of instruction and solving a math problem requires higher order thinking skills. Some children find this challenging and teachers can assist their students by helping them develop the skills and confidence to solve word problems.

According to Gooding (2009), children's poor performance with mathematical word problems is a trend and it is vital to look at the causes of these difficulties, so that their teachers can help them overcome these hurdles. Barwell (2011), purports there must be an open approach to word problems for students who find it difficult. This approach will enable learners to become more effective readers and problem solvers by engaging students in understanding, mathematizing, analyzing, and communicating in the problem.

A word problem is a problem designed to help students apply mathematics concepts to real life situations. According to Lai (2015), problem solving is a cognitive process directed to achieve a goal when no obvious solution method is available to the problem solver. Some children find it difficult to solve word problems presented in a paragraph. It is easier for them if the problem is presented in numbers or a certain equation; therefore, they need to develop a full understanding of the problem before they attempt to solve it (Swanson, Orosco, & Lussier, 2014). Gooding (2009), suggests through continuous practice, learners can acquire a lot of skills and knowledge of which strategy to use in each scenario.

Research Questions

This research investigates the following questions:

- 1-What difficulties do students face in solving word problems?
- 2-How do math teachers support students in learning how to solve word problems?



Literature Review

In this literature review, I explored different domains related to difficulties in solving word problems, starting with some types of word problems, some of the difficulties middle school students encounter in solving such problems, and finally teachers' roles in supporting students' learning process.

Types of Word Problems

There are many types of word problems including addition/subtraction word problems, multiplication/division word problems, and multi-steps word problems. For example, consider the following question: There are 16 girls and 14 boys in a class. How many students are there in the class? The problem type here is combining or finding the total number of students. While if they were asked: How many more girls than boys in the class? Then the problem type is finding the difference. Finding the total is different than finding the difference. Barwell (2011), states understanding the structure of word problems, helps students become better readers and problem solvers. Also, according to Powell (2011), once students determine the type of question, they can use a diagram and an equation to solve the problem. When pupils know the schema for each type, understand how to sort out the problem, and write a solution method, they should be able to solve most word problems (Powell, 2011).

Difficulties in Solving Word Problems

Word problems are present in everyday living. For example, consider the problems: how will I get to my friend's house from my current location by 4:00 o'clock when it's already 2:30 PM and I don't have a car and not enough money to take a taxi? About how much is the total bill to pay in the grocery store? How much is the final price of a laptop if the original price was \$2,000 and the discount rate was 15%? Joe got 75 on his science exam, which is 5 points less than he achieved on the math exam. What was his score on the math exam? Five friends share the cost of 4 pizzas and a salad. Each pizza costs \$8 and the salad costs \$3. How much does each of the five friends pay? Problem solving is a necessary skill not only in mathematics but also in everyday living (Dela Cruz & Lapinid, 2014).

Powell (2011), purports regardless of the problem type, students need to learn a strategy for working through the problem. Some children cannot interpret word problems if they do not visualize the key elements in a diagram or a bar graph. The ability to visualize the problem can lead to successful problem solving (Dela Cruz & Lapinid, 2014). Another difficulty concerning the process of understanding the problem is students not understand the



assumption in the question inhibiting them from proceeding and translating the problem into a mathematical equation.

Some students have difficulties in analyzing word problems. They are either unable to translate, or translate incorrectly. According to Dela Cruz and Lapinid (2014), it is important to teach students how to think in solving such problems and explain to them that they can develop a lot of skills by practice. Students will acquire a lot of reasoning when they observe how others solving problems.

Some learners do not comprehend the problem and they tend to be confused. Others look for keywords when they read a problem instead of understanding it. This will lead incorrect translation. When students fail to translate the problem, they end up with an erroneous solution (Dela Cruz & Lapinid, 2014).

In addition, some students tend to use the wrong operation. For example, my mother plans to buy 12 house decors worth \$35 each. How much will she have to pay in all? Some students tend to use addition instead of multiplication. It is important to make a plan in solving a word problem. Pearce, Brunn, Skinner, and Lopez-Mohler (2013), assert reading skills played a significant role in solving word problems.

Carelessness of students can also be a source of difficulty in solving word problems. Some might copy the number given incorrectly. Instead of writing 1500, they copy it as 500, or even add a digit to it as 11,500. Although they understand the given and what operation to use, copying the given numbers incorrectly will lead them to an incorrect answer (Dela Cruz & Lapinid, 2014).

Some students tend to interchange the order of numbers in the question. Subtraction and division operations are not commutative. The minuend cannot be placed in the subtrahend's place and the same applies for divisor and dividend. For example, forty eight taken away from a number gives ten. The number forty eight here is in the subtrahend's place. The answer is obtained by adding the subtrahend to the difference and not by subtracting them as it may appear (Dela Cruz & Lapinid, 2014). Furthermore, the presence of unnecessary information in the problem can be distracting and considered as a source of difficulty. For example, John has 30 dollars. Jane has 25 dollars more than John and Jane is 160 cm tall. Find the amount of money that Jane has. It is obvious Jane's height is an unnecessary information in the question (Gooding, 2009). Gooding (2009) also suggests another source of difficulty can be the child is not using jottings. When asked to perform a certain calculation, the child



was doing it mentally instead of writing down the numbers and carrying out the calculation more effectively.

Some students treated word problems too realistically. For example, Edward earns 5 dollars for every bundle of newspaper he delivers. How many newspapers must he deliver in order to buy a toy car that costs him 28 dollars? If students were too realistic in their answer, they would say Edward must deliver 5.6 newspapers instead of 6. Another example can be Steven earned 33 dollars for delivering newspapers. How many did he deliver if each delivery was 5.5 dollars? (Barwell, 2011).

Role of the Teacher

The role of any educator in the classroom is to educate the children and prioritize the important things for them to learn. It can start by building self-confidence in every child. Teaching word problems is not an easy task. The most cited classroom practice was working the problem independently (Pearce, Bruun, Skinner, & Lopez-Mohler, 2013).

Classroom practices and strategies teachers use are crucial to foster student problem solving. Students must be able to recognize the types of word problems and the appropriate solution to solve the problem (Powell, 2011). The goal is to teach students a strategy to help them become more independent learners. For example, a cognitive strategy instruction can be used to teach young students with mathematical difficulties to enhance learning and improve their performance (Powell, 2011).

A cognitive strategy instruction consists of teaching cognitive and metacognitive strategies that can guide students to understand and be self-aware of the requirements. A cognitive strategy helps students' focus on the problem structure and increase their ability to understand the problem (Pfannenstiel, Bryant, Bryant, & Porterfield, 2015). This strategy is a vital component for students in the younger grades to solve effectively word problems (Pfannenstiel, Bryant, Bryant, & Porterfield, 2015).

Metacognitive strategy helps students plan, monitor, and modify their approach in solving a word problem (Pfannenstiel, Bryant, Bryant, & Porterfield, 2015). It addresses six components of word problem solving. First, to state the question, identify the important units and numbers, analyze the question, select the operation needed to solve, create a strategy to solve, and finally remove any unimportant information (Pfannenstiel, Bryant, Bryant, & Porterfield, 2015). There are three main steps aligned with these six components. The first step is to inspect and find clues, a verbal strategy. Students must read the problem, circle



important words and numbers and then cross out the unnecessary information. The second step is to plan and solve by drawing a diagram or a map then write an equation. This is intended to build algebraic readiness skills. The final step is to check the answer.

Both cognitive and metacognitive strategies have shown to increase students' understanding of word problems. Teachers must focus on teaching these strategy steps to their students by engaging all learners in an interactive process.

It is recommended teachers encourage their children to make a plan. Firstly, they read the word problem individually many times, then point out the important information in the question and the requirement, then they know what number sentence to use, solve independently, and finally check if the answer satisfies the question.

Students have to go one step at a time, reading and comprehending in order to be able to translate a word problem into a mathematical one (Dela Cruz & Lapinid, 2014). It might be a good suggestion to start by asking the student about the difficulties they encountered in solving a certain word problem. Most difficulties arise when the learner cannot imagine the context in which the word problem is written, so the child tends to find it hard and gets confused what number sentence to write. Therefore, the role of the teacher is to explore new methods of explaining the concept (Gooding, 2009).

According to Barwell (2011), motivated learners are more excited to interact and learn. Teachers need to identify the students who are disengaged in their class and find strategies to motivate them. Another suggestion is to give them a word problem based on a historical event or a sports game to maximize their engagement in class (Barwell, 2011).

Word problems can be challenging for some students. According to Swanson (2014), children need to be directed to consider relevant information within the context of increasing irrelevant information. Thus, students must follow multiple steps in solving such problems. They should learn the skill to read the subtext and understand the given information, mathematize the problem by writing a detailed plan, make mathematical connections, analyze, and then check.

Dixon, et al., (2014), affirms learners will develop deep conceptual understanding of word problems when their teachers provide them with rich, and meaningful learning activities. For example, if students are asked to write their own word problem, it eludes to their interests and they will be more engaged in valuable and meaningful mathematical thinking. For instance, invite students to write a word problem to a relatable event in their



lives, such as a trip, a football game, etc. Students that are able to create their own mathematical word problems will be positively influenced and this will reflect, not only on their understanding, but also on their problem solving skills and disposition towards mathematics (Dixon, et al., 2014).

Methodology

Research Design

Qualitative descriptive research methods were inducted to explore the sources of difficulties students' encounter in solving word problems rather than simply the types of word problems. In addition, the role of teachers in engaging their learners in the process of problem solving was researched. The goal was to understand how educators guide their children to make sense of word problems. To facilitate this research objective, data was collected using educational articles, interviews, and observations.

A purposively sample of three mathematics teachers from one international private school in Dubai were selected. All volunteered to participate in an interview. The three teachers have been teaching primary mathematics for more than four years. Multiple readings and analysis of the data collected from the interviews was conducted.

To ensure confidentiality, validity, and reliability in the research, the study was conducted in an ethical manner. Ethics are the standards of behavior to be adopted while interacting with participants during a research study. Participants must be respected and not seen as passive sources of data. Merriam (2009), stresses regardless of the type of research, validity and reliability are concerns that can be approached through careful attention to a study's conceptualization and the way in which the data are collected, analyzed, interpreted, and the manner in which the findings are presented. Merriam (2009), adds to a large extent, it depends on the ethics of the investigator. Since a qualitative approach to research is based upon different assumptions than traditional research, it is important to build different criteria in assessing (Merriam, 2009). Ethical protocols were implemented to ensure the research findings were credible, consistent, and can be transferred to other situations. Credibility was reassured throughout the interviews.

Data Analysis

To draw out themes across the three interviews, the data was analyzed thematically. Thematic analysis is a method for identifying, analyzing, and reporting patterns within data. It



emphasizes themes within data. Themes are patterns that are important to the description of a phenomenon. The themes then become the categories for analysis in the qualitative research.

Interviews were simultaneously coded and constructed categories or themes that capture relevant characteristics of the content. The first phase was to become familiar with the data, write codes, search for themes among those codes, then name the themes. According to Merriam (2009), to wait until all data are collected is to lose the opportunity to gather more reliable and valid data. Reliability refers to repeatability and consistency of findings. For example, if the study were to be done a second time, it must yield to the same results. While validity refers to the credibility of the results. If data are valid, they must be reliable.

Findings

This research explores the types of difficulties and perception of teachers with regard to teaching word problems for primary level. To this end, three mathematics teachers from grades three to six in one private school in Dubai were interviewed. Samar has ten years' of experience in teaching primary mathematics. Rana has five years' of experience as a primary mathematics teacher, and Mary has been teaching primary mathematics for circa fifteen years. These teachers were interviewed because they have extended experience in teaching mathematics for primary students. Moreover, teachers' deepening experience appears to translate into student benefits. For example, a teacher with five years of experience has the ability to integrate knowledge by using different pedagogical methods. Also, an experienced teacher has deeper understanding of students' needs and more awareness of the learning context. Moreover, an experienced teacher has the ability to make initiative judgments based on past experience. In interviewing teachers, they revealed some difficulties and challenges which happen in class when dealing with word problems in the primary level.

Samar

Samar believed, *“the vocabulary aspect of the question can be challenging”*. She gave an example when some students do not understand a particular word in a word problem. This can be challenging for them. Furthermore, some students do not break up the problem to make it easier for them to solve. She responded, *“we can ask the students to reread the problem, circle the numbers, underline the question, then solve and check”*. She stated, *“all teachers must ensure that all steps are clear for their students before they start to solve the word problem”*. Also, she mentioned, *“teachers can provide simple real life examples that will help students understand the problem”*. In addition, *“the instructor can use a diagram to*



demonstrate the given and what is required to find". Besides, *"explaining the meaning of complex words in a word problem can help students' understand the problem"*.

Additionally, she revealed peer tutoring of word problems can be very helpful. She responded by stating, *"when a higher performing student is paired with a lower performing student, this can offer students the opportunity to collaborate"*. Regarding if there was a relation between word problems and the development of mathematics skills, she responded, *"word problems trigger the basic and critical thinking skills of students"*. She gave an example of a teacher introducing real life word problem to her students.

She suggested critical thinking skills for children is raw and *"it is the role of the teacher to teach her students how to develop that"*. Then responded, *"practicing word problems builds the ability to solve other types of problems in different subjects"*. She related her response to subjects such as, Science, History, Economics, Physics, and Chemistry as they enhance higher order thinking skills needed for analysis in any of those disciplines. She gave an example of a Science question where the length of a glass tubing is 0.525m. How many inches long is the tubing? She added, *"solving word problems helps in improving the reading, comprehending skills, and decoding of words"*. Also, she stated *"planning steps to solve word problems is a strategy that students will need in their future career and dealing with day to day situations"*.

Rana

Rana stated, *"students who are guided on how to break up the problem into multi - steps before they attempt to solve it, are more able to understand its context and get it right"*. Then further elaborated by asserting, *"teaching students to underline the given information in the question can help students' understand the problem in a faster way"*. She added, *"the teacher can ask his/her students to re-state the problem in their own words"*. She agreed, *"students with academic difficulties can receive help by another student who has mastered the content in specific methods"*.

In addition, she purported, *"the teacher can ask the students to individually read the problem then state the given, write the quantities to be compared, and the required to find"*. Then added, *"word problems can help students deal with Geometry and Algebra in upper levels and are mandatory as they trigger the basic and critical thinking skills of students"*. She mentioned, *"word problems help students to think outside the box"*. Then she added, *"such exercises help students extend their thinking horizons and develop analytical skills"*.



Mary

Mary added, *“some students rush into solving the word problem without carefully reading the given and the required to find”*. Then she suggested the teacher in class can ask the learners not to rush in solving the word problem and spend enough time to read the problem. She believed, *“the language skills of the child will help him/her understand the differences between valid and invalid information and organize thoughts and actions”*. Also, *“teaching students to list the sub goals in the problem can be very helpful”*. She believed, *“teachers’ can ask their students to read the problem carefully, list the sub goals, then find the main goal”*.

She reflected, *“the teacher herself/himself can read out loud the problem and ask students to underline the important words in the question”*. Expanding further by positing, *“it can be very helpful if the teacher gave a hint for her students when solving the word problem”*. For example, *“ask students to find the sub goals required to solve the question or underline the unknown”*. She believed, *“critical thinking has to be inquiry based”*. Students have to discover new information. They have to think for themselves and not rely on their teacher to think for them. She alleged, *“word problems help students acquire both logical and creative abilities which can be very helpful when solving any other mathematical problems”*.

All teachers agreed word problems enable students to become independent thinkers and learners who create new designs and methods to solve the problem. Problem solving techniques can be applied in other domains and not only in mathematics. They theorized, *“there is no manual for teachers to use when doing word problems in class, but a good teacher will always know how to encourage the learners in her/his class to think critically and analyze before they proceed to solve any question”*.

Discussion and Conclusion

The themes that emerged from the data include: types of difficulties, types of support, and word problems related to the development of mathematical skills.

Types of Difficulties

When interviewing teachers regarding types of difficulties in word problems, Samar revealed the vocabulary aspect of the problem can be challenging. She commented, sometimes students do not understand particular words in the problem and this makes them feel frustrated and assume the problem is difficult to solve. This concurs with the literature review and stated that when students fail to translate the problem, they end up with an



incorrect solution (Dela Cruz & Lapinid, 2014). Rana suggested it would be effective if the teacher guides his/ her students to break up the problem into multi-steps before they attempt to solve it. Moreover, she said the teacher can encourage the students to read the problem several times in order to differentiate between valid and invalid information. According to Pearce et al (2013) reading skills played a significant role in solving word problems. This statement corresponds with Swanson (2014) when she highlighted children need to be directed to consider relevant information within the context of increasing irrelevant information. Mary added the language skills of the child can be a difficulty when solving word problems. When students know how to interact with the problem, then it is easier for them to solve it. However, more studies are needed in order to handle the uncertainty of the vocabulary aspect.

Types of Support

Regarding the type of support students' need when solving word problems, Samar responded by asking the students to circle the numbers in the question, list the given information, and underline the required to find can be very helpful to solve the problem. Also, she mentioned the instructor can use a diagram to demonstrate the given and the required to find. Mary added it is a good idea to teach students to list the sub goals in the word problem before they attempt to solve it. Moreover, Samar stated explaining the word problem based on a real life example can be very helpful for students to understand the problem. It was clear relating the problem to a real life example can encourage students to deeply understand it. According to Powell (2011), regardless of the problem type, students need to learn a strategy for working through the problem. Some children cannot interpret word problems if they do not visualize the key elements in a diagram. According to Dixon, et al, (2014), learners will develop deep conceptual understanding of word problems when their teachers provide them with rich, and meaningful learning activities.

Another type of support Samar cited was to explain the meaning of complex words in the problem. In some cases there are few a words in the problem that can be challenging to students. In an attempt to tackle that issue, Rana asks her students to re-state the problem in their own words. She added this can help them remember the given and the required to find. Samar stated peer tutoring can be helpful. She mentioned students learn more when they work as a team. It was evident peer tutoring is vital in every mathematics lesson as students enjoy working together and this builds trust among them. In addition, Mary added sometimes a



small hint given to students can guide them to think right from the very beginning. She believed the students must not rely on their teacher to guide them when doing word problems. According to Mary, critical thinking has to be inquiry based.

Word Problems Related to the Development of Mathematical Skills

Concerning the relation between word problems and the development of mathematical skills, Samar responded word problems trigger the critical thinking of the child and the teacher's role in class is not only to teach, but to monitor students' develop and think critically. Rana mentioned word problems help students think outside the box. On the other hand, Mary responded critical thinking is linked to inquiry based learning. She believed learners have to discover a method to solve the question without any help or hints from their teacher. It is preferable that this response requires more research to deepen comprehension.

Regarding if word problems have an effect on the ability of solving other problems in different subjects, Samar and Rana both cited word problems enhance the higher order thinking skills every child needs for analysis in other subjects and not only in mathematics. Samar also added these skills are needed in the upper levels in Algebra and Geometry and in the future careers of these children as well. Mary alleged word problems help students acquire both logical and creative abilities which can be very helpful when solving other mathematical word problem. One can conclude word problems enhance the higher order thinking skills of every child, but at the same time this requires a good teacher to encourage the child to develop that skill and guide him on how to make it transferrable to other subjects. At the end, it was clear without the guidance and support of the teacher, a word problem by itself cannot enhance the creativity of the learner.

Conclusion

This study explored the difficulties students encounter when solving word problems in one international private school in Dubai. Two teachers agreed word problems enable students' to become independent thinkers and learners. This research concludes word problems are very important as they teach the child how to think and come up with different methods to solve the problem.

A good teacher will always find ways to encourage their learners to accept every word problem is a new experience. Every child can take a real life situation and apply the learned skills principle to solve the problem. A mathematics lesson can be more alive and exciting when it involves solving word problems. Teachers can make such lesson engaging by using



real life examples and hands on materials. According to Barwell (2011), motivated learners are more excited to interact and learn.

Furthermore, word problems can be an effective assessment tool to teachers because they could measure the creativity in every child. Moreover, teachers can ask every child in their class to be the author in the story problem. This exercise helps children think where to focus in the problem. It will also indicate the student's understanding level of the question and what approach can be used when solving it. Unfortunately, some students do not make enough effort to solve the problem. Therefore, a good teacher has to convince their students to give themselves a chance and believe they can solve any question.

It was apparent positive reinforcement by the teacher directs students to read critically and solve effectively. As students learn skills to identify types of word problems, they will develop confidence and may attempt to solve more challenging ones.

Limitations

Access to international private schools and participants can be an arduous and protracted process in the Gulf and some participants involved in the process of this study did not feel comfortable to express their opinions. Also, the research quality might be influenced by the researcher's presence during data gathering which cannot be avoided during a qualitative research (Merriam, 2009). However, participants were informed their names will never be mentioned in this research. Finally, scope was a limit. If this study involved more participants at different primary levels, it would have been easier to generalize the results for a larger group.



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