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Students' Difficulties in Translating Worded Problems into Mathematical Symbols

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Abstract: This paper sought to identify the difficulties encountered by students in translating worded problems into mathematical equations in a private sectarian school in Manila. The study examined the students' difficulties and level of performance in translating worded problems into mathematical symbols. A 20-item problem solving test involving the four fundamental operations was given during the third quarter of the school year 2012-2013 to 204 Grade 5 students. Scores in this test measured their performance level in translating worded problems while interpretation of their mistakes identified their difficulties in translating worded problems. Results indicate that 40% of the respondents are below the satisfactory level in translating worded problems. Carelessness, lack of comprehension, interchanging values, and unfamiliar words are some of the common difficulties encountered by the respondents in translating worded problems.

Key Words: mathematics difficulties; problem solving skills; elementary students; translating worded problems into mathematical symbols

1. Introduction

Problem solving has been and will be a necessary skill not only in Mathematics but in everyday living.

Part and parcel of problem solving is to translate word problems into mathematical equation. However, students especially in grade school have difficulties in analyzing and interpreting word problems.

Students most especially in grade school can easily perform an indicated operation but when this is given in verbal forms, students need to first identify what operation is involved by translating this into a mathematical sentence before actually performing the operation and arriving at the correct answer.

1.1 Problem Solving Heuristics

According to Polya (1957) solving problem is a practical skill. Students will learn problems when they observe and imitate what other people do when solving problems. Our conception of the problem is getting differ when we are shifting point of view in the problem. Krulik & Rudnick (1996), on their book about teaching reasoning and problem solving, found that the ability of students to recognize words is fundamental to reading. Being able to visualize the problem can lead to a successful problem solving.

The Grade 5 students' ability in solving word problems according to Bardillion Jr. (2004) depends on how students translate phrases into mathematical symbols. Polya distinguished four phases in solving a problem. The first is to understand the problem so that we could see clearly the given tasked, the second is devising a plan, third is to carry out the plan and

the fourth is to look back at the completed solution.

1.2 Translation of Worded Problems

Translating worded problems nowadays is one of the most difficult tasks for a student especially in the elementary level. It is considered a big hindrance in learning Mathematics. Translation from words to symbols is undeniably one of the solution processes in solving word problems that can be considered critical.(Bardillion, Jr. 2004).The study of Bardillion Jr. embarked on symbolic translation of the students exposed to Filipino verbal translation is directly related to problem solving ability and attitude of first year high school students.

According to Mayer (1989, as cited by Yared, 2003), one common problem in translating sentences into symbolic language is that individuals end up remembering materials that are consistent only with their prior schemas. Bardillon Jr. cited Yared (2003) that the ability to mathematize expression is the most directly linked with success in problem solving.

Yeo (2009) found that some students have slow progress in solving the problem due to their inability to translate the problem into a mathematical form. Some students have also difficulties in solving the problem because they do not comprehend the problem as they found the problem confusing.

In the study conducted by Aniano (2010), the level of difficulties in translating phrases to symbols was one of the factors that determine the problem solving skills of students. It was seconded by Vista (2010) that students' comprehension in translating phrases into symbols affects the students' performance in problem solving.

Yared(2003) on the other hand, cited Mayer (1982, 1989) and Matlin (1992) that problem solver ends up to simplifying problems even to the extent of misrepresenting the information given.

This study addressed the performance level of grade five students in translating worded problems into mathematical symbols and the difficulties encountered by grade five students in translating worded into mathematical symbols.

2. METHODOLOGY

The study made use of both quantitative and qualitative methods.

2.1 Participants

Grade five students were chosen as respondents. There were five sections in grade five level and each section was heterogeneous. All 204 students in grade five participated in the study.

2.2 Research Instrument

The data of the study was obtained through a researcher-made test. The test consisted of twenty (20) items involving four fundamental operations in which every operation consisted of five (5) items. A table of specification was also used to ensure that the number of items was equally distributed. Each item was given a weight of one (1) point. This researcher-made test measured the performance level of Grade 5 students in translating worded problems into mathematical symbols. Students were required to translate the worded problems into mathematical symbols. It was face and content validated by an English Coordinator, Mathematics Coordinator, School's Vice Principal for Academic Affairs and two Mathematics experienced teachers.

To avoid inconsistency in measuring the answers of the students, inter-rater reliability was used. Three inter-raters were tasked to check and re-check each item answered by each student correctly. Each rater went through the items and determined whether they were correctly translated or not into mathematical symbols. Miles & Huberman's (1994) formula was used as a statistical measure of inter-rater agreement

Miles & Huberman's (1994) formula:

$$Reliability = \frac{\text{Agreement}}{Agreement + Disagreement} \times 100 \quad \text{(Eq. 1)}$$

The computed reliability coefficient is 87.25% which shows consistency in the way the raters marked students translation.

2.3 Procedures

The researcher requested for permission from the participating school's Director and Principal. The researcher-made test was distributed

at the time when students have already covered addition, subtraction, multiplication and division of decimal numbers during the third quarter of the school year.

The test was administered by the researcher himself. Students were instructed to write the mathematical equation of each word problem in the questionnaire. They were tasked to determine which operation that could best be performed to solve the word problem. Students were given fifty (50) minutes to answer the entire questionnaire.

2.4 Data Analysis

The researcher adopted norms for interpretation from the school's standard of the participating school to answer the performance level translating worded problems into mathematics symbols of Grade 5 students.

Table 1 shows the norms for interpretation adopted from the school's standards.

Table 1
Norms for Interpretation

Score	Description
18-20	Outstanding
14-17	Very Satisfactory
10-13	Satisfactory
6-9	Poor
0-5	Very Poor

Such is the participating school's grading system where the base score is equivalent to 70%.

The common mistakes respondents had in each item were determined and interpreted to determine students' difficulties in their translation. The following difficulty categories "misinterpretation of the problem" and "lack of comprehension of the problem posed" were adopted from the work of Yeo (2009). Other difficulties which the researcher deemed not falling under Yeo's framework were also documented and analyzed, such as the use of incorrect operation, carelessness, interchanging values, and unfamiliar words.

3. RESULTS AND DISCUSSION

3.1 Students' Performance in Translating Worded Problems

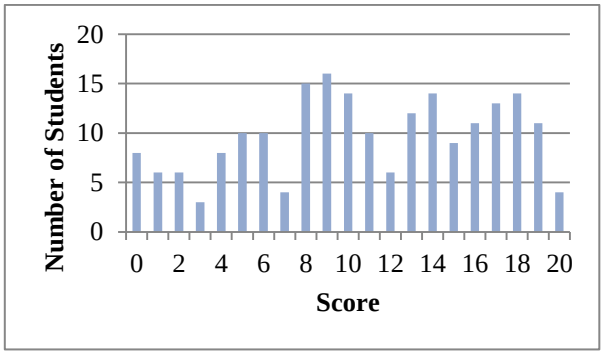


Fig. 1. Scores in translating worded problems into mathematical symbols.

Fig. 1 shows the students' scores in translating worded problems into mathematical symbols. It appears that 4 out of 204 students got a perfect score while 8 out of 204 got a score of 0 in the test. It shows in the graph that the distribution of scores is inconsistent since the bars vary in height.

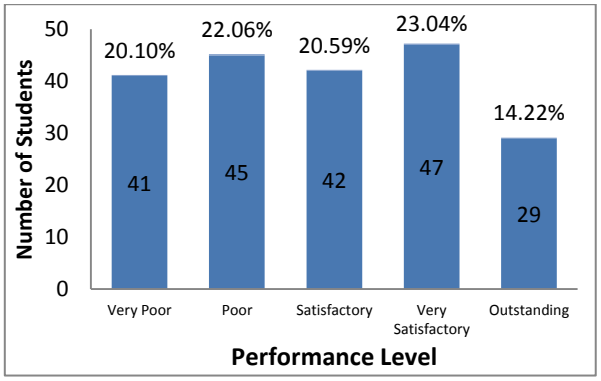


Fig. 2. Level of performance in translating worded problems.

It was found out in Fig. 2 that 42.16% of the participants are below the satisfactory level of performance in translating worded problems to mathematics symbols in which 20.10% belongs to very poor performance and 22.06% described as poor. On the other hand, 14.22% of the participants have outstanding performance level in translating worded problems to mathematical symbols. In general, almost 58% of grade 5 students meet the satisfying score in translating worded problems to mathematical sentences.

3.2 Students' Difficulties in Translating Worded Problems

Below are scanned works of students showing difficulties in translating worded problems into mathematical symbols. All students' works were analyzed and were carefully chosen to represent other similar solutions.

From Yeo (2009)

1. Misinterpretation of the Problem

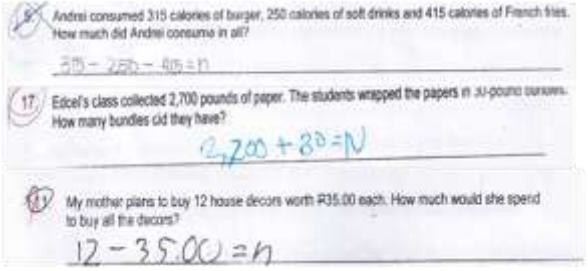


Fig. 3. Answers showing misinterpretation of the problems.

Students failed to translate the problem due to misinterpretation. According to Yeo(2009), students misinterpret the problem when they reflect solutions that are opposite or contrary to the correct solution. Please see students' solutions in Fig. 3.

About 19 out of 53 students, who answered item number 5 incorrectly, misinterpreted the problem. In Fig. 3, the student answered item number 5 as "315 – 250 – 415 = n" when it should be "315 + 250 + 415 = n." He equated the phrase "how much" to mean subtraction. While in question number 11, where 42 out of 80 misinterpreted the problem, this student thought that the "how much" refers to subtraction when it should be multiplication.

On the other hand, one student thought that "how many" in item number 17 refers to addition which should be division. This happened to 66 out of 135 students who got an incorrect answer in this item. Students looked for keywords when they read a problem instead of trying to understand what the problem is all about and this had lead them into a wrong translation into mathematical symbols.

2. Lack of comprehension of the problem posed

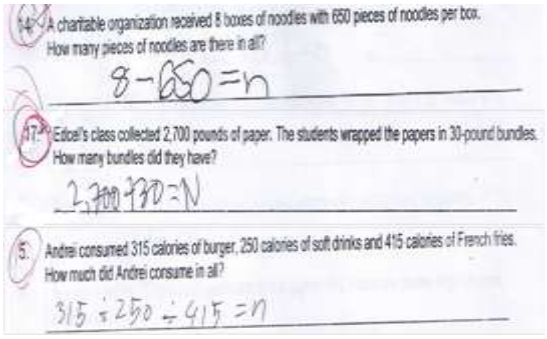


Fig. 4. Answers showing students did not fully comprehend the problems.

Fig. 4 shows the incorrect answers of students who did not comprehend fully the problems. They got difficulties encountered in translating worded problems as "they were unable to visualize and did not comprehend the problem at all" (Yeo, 2009)

In Fig. 4, a student answered item number 14 by just writing the given value in the order as they appear in the problem and just guessed the fundamental operation. This happened to 50 out of 94 students who failed to answer the same question

correctly. The same happened with different students who answered item numbers 17 and 5.

These categories are formed aside from those of Yeo's.

3. Incorrect use of Operation

Table 2. Mean of Incorrect Answer

Operation	Mean number of students	%
Addition	47.4≈47	23.24%
Subtraction	80.4≈80	39.41%
Multiplication	96.8≈97	47.45%
Division	149.8≈150	73.43%

It appears in Table 2 that division is the fundamental operation most grade 5 students have difficulty with. This consists of 150 students, which is 73.43% of the sample population. Division was seconded by Multiplication in which almost 50% got mistakes.

The mean of incorrect answers was determined by getting the mean score of correct answers in each of the four fundamental operations. Since there are five questions for each operation, the researcher tallied those students who got correct answer in each question then added the total number of correct answers to the other items with the same operation and divided by five. Since there are 204 respondents in the study, the researchers subtracted the mean score of correct answers from the total number of the respondents.

4. Carelessness

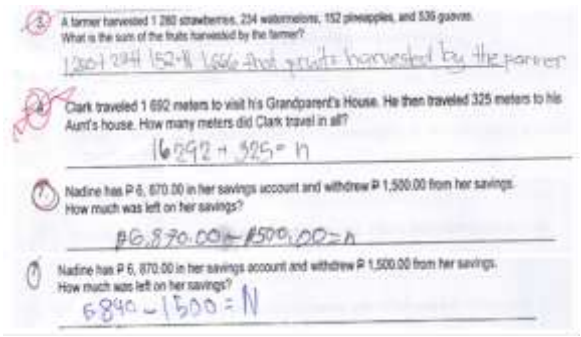
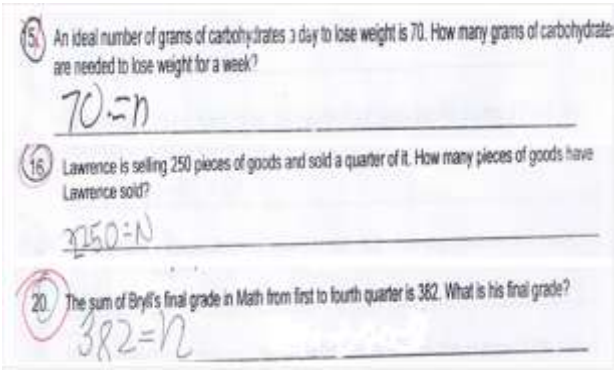


Fig. 5. Answers showing careless mistakes.

Sixteen (16) out of 59 students who got an incorrect answer in item number 3 made careless mistakes. In the figure shown above, a student answered the number 3 item incompletely, he got the correct arithmetic operation which is addition but missed out 536 guavas. On the other hand in question number 4, the student incorrectly wrote the given as 16292, when it's supposed to be 1692.

The same is reflected in item number 7, instead of P1500.00, and P6870.00, the student wrote P500.00 and 6840.

Fig. 5 shows that some students who got mistakes in the test knew the operation but tend to miss out, added new value or wrote a different value because of carelessness. In all items, few students made careless mistakes.



5. Interchanging Values

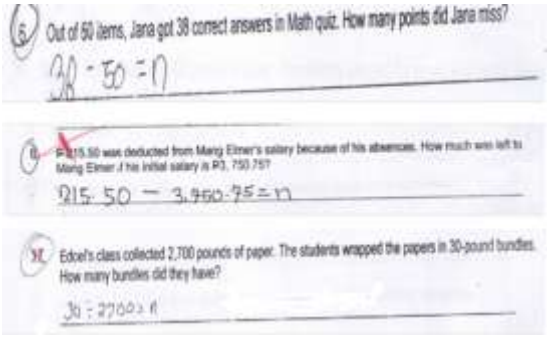


Fig. 6. Answers showing interchanging values of the given problems.

Interchanging values mostly occur in items involving subtraction and division in which students

interchange the value for minuend in subtrahend, and vice versa. The same goes for division in which the divisor is incorrectly placed as the dividend and vice versa. This incorrect translation into mathematical symbols will eventually lead to incorrectly solving the problem as unlike addition and multiplication, subtraction and division are not commutative operations.

In Fig. 6, the minuend 50 was written as a subtrahend and vice versa in item number 6. Another student similarly answered item number 8, where 3750.75 became the subtrahend and 215.50 was the minuend. Seventy (70) out of 117 students interchanged these values in item number 8.

On the other hand, in item number 17 where about 12 out of 135 interchanged the values 30 and 2,700 as divisors and dividends, respectively. These were the same answers given by students who tend to write the values in accordance to the position of the value stated in the problem which lead them to translate worded problems into mathematical symbols incorrectly. It is also considered as one of the difficulties encountered in translating worded problems into mathematical symbols.

6. Unfamiliar words

Fig. 7. Incorrect and incomplete answers.

Fig. 7 shows incorrect and incomplete answers due to unfamiliarity of the words used in the problem. It appears that the answers in question numbers 15, 16 and 20 reflect students had difficulty in completing the translation process because they thought that there was incomplete information in the problems.

It was found out that out of 124 students who got item number 15 incorrectly, 47 were unfamiliar with the terms used in the problem. On the other hand, 85 out of 168 students were unfamiliar with the words used in item number 16.

45 out of 160 students cannot answer the question posed in item number 20 with the same reason with item numbers 15 and 16 as the student cannot determine the value that goes with 382. Students' answers also indicate that they have difficulties in determining the numerical value for words such as "a week" and "a quarter".

Results in the analysis reveal that students have difficulties in translating worded problems into mathematical symbols and these can be classified into 6 categories. Some difficulties were the same as those found in the study of Yeo: misinterpretation of the problem and lack of comprehension of the problem posed. Aside from these, they also exhibit other difficulties such as incorrect use of operation, carelessness, interchanging values, and unfamiliar words.

4. CONCLUSIONS

In the light of the above findings, it was concluded that the students' ability in solving worded problems depends on how they translate phrases into mathematical symbols according to Bardillion Jr. (2004). Problem solving is a difficult task as it involves a lot of steps. Students have to hurdle the challenges in going from one step to another although the steps may not necessarily have to be taken in sequential manner. Some of the processes in solving word problems involve reading comprehension and how students make a plan. This is where the study focused on because it includes the ability of the students in translating worded problems into mathematical sentence.

The regular learning target of at least 85% of Grade five students must be able to translate worded problems into mathematical sentences was not met as there are only less than 60% Grade 5 students were in and above the satisfactory level of performance.

Of the four operations, students had division as the most difficult to perform. This may be because division is the operation less prioritized in every discussion involving whole number or decimals this is the last operation taken up in their classes. Teachers may have made the least focus on this topic.

According to Krulik & Rudnick (1996), many students encountered difficulties in problem solving because they misinterpret some words that have multiple meanings and overlook its context. This difficulty usually happened when problems are presented in written form.

For further study, the research recommends to study about the difficulties encountered by students in performing necessary operations in

problem solving. This is the third step of Polya's four steps in problem solving. Determining students' difficulties in translating worded problems is just one of the many research avenues, students' difficulties in other steps in problem solving such as carrying out a plan and looking back are also worth exploring.

The researcher also recommends for further study determining the difficulties of students in translating worded problems into mathematical symbols involving two or more operations.

It is hoped that through this study, teachers realize that students may have the skill to perform operations such as addition, subtraction and the like, but may not be able to use this when asked to solve a worded problem mainly because they cannot translate this into mathematical symbols. Having this difficulty in the initial step of problem solving, deter students in proceeding to the next steps which lend to unsuccessful problem solving.

5. ACKNOWLEDGMENTS

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