



# Analysis of Students Difficulties in Solving Math Words Problems

Sartono Sartono<sup>1</sup>, Syafri Ahmad<sup>1</sup>, Masniladevi Masniladevi<sup>1</sup>, Melva Zainil<sup>1</sup>, Yullys Helsa<sup>1</sup>

<sup>1</sup> Padang State University, Padang, Indonesia  
sartono@fip.unp.ac.id

**Abstract.** In the education of Indonesia, one of the subjects that students learned from elementary school to senior high school was mathematics. One of the assumptions about this subject was that it was scary. This assumption was inseparable from students' difficulty in solving the math problems they encounter. A form of a question considered difficult by students was a word problem. This question was formed from a series of sentences containing instructions and instructions where students were required to solve the problem based on the instructions and instructions in the question. Mathematicians said if students can solve every word problem they encounter, their mathematical ability would increase significantly. This study aimed to reveal students' difficulties in solving math word problems. The research design used in this research was a qualitative research design with the type of case study research. This research was conducted in the even semester at one of the elementary schools in the city of Bandung, i.e. Elementary School 195 of Isola in the 2021/2022 academic year. Students who became respondents to this study were 32 students. Based on the results of the study, the researchers found that students had difficulty changing the language of the questions into mathematical language, understanding mathematical concepts in word problems, and representing story questions in mathematical representations.

**Keywords:** Education, Case Study, Mathematic, Words Problem.

## 1 Introduction

Education is one of the main parts of a country as one of the important sectors of the country. One of the factors for the progress of a country is advanced education. Japan is a country that can be used as an example of the country's progress thanks to its advanced education. When Japan surrendered to the Allies in the second world war, Emperor Hirohito asked about the number of teachers who survived with the assumption that a teacher can create a general but a general cannot create a teacher. Twenty years later, Japan was transformed into a developed country and was nicknamed the tiger of Asia. This is an indication that a country will progress if education is given a high place in the country.

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Education seeks to improve human quality in various ways, one of which is through the learning process. Through the learning process, humans can change their thinking patterns and attitude patterns in a better direction [1–3]. Furthermore, Paul & Quiggin (2020) said that education would make people more mature, so in the end, they will be able to solve the problems they face. The learning process is a structured activity that aims to change behavior patterns [5, 6], and students' mindsets and increase student knowledge and understanding [7, 8]. Through the learning process, students are expected to be able to change their mindset and behavior patterns in a better direction and they are also expected to be able to improve their knowledge and skills.

The learning process carried out in schools must be carried out carefully. This is because the learning process is one of the processes that determine changes in student behavior patterns and patterns of thinking [9, 10]. Mathematics is one of a subject that will always be studied by students from elementary school to high school [11, 12]. Mathematics not only learns about how to count but also learns about logic. In line with this statement, [13, 14] also revealed that logic is one of the important materials studied in mathematics. Furthermore, Mammarella et al. (2018) said that studying mathematics is tantamount to learning and practicing various skills such as problem-solving skills, critical thinking, communicating, and working together. These skills are skills that students need in the era of the industrial revolution 4.0 [16].

Mathematics is a very important subject to be learned and understood by every student. Learning mathematics is the same as studying life sciences [17]. This is because mathematics has a very close relationship with human life, from waking up from sleep to going back to sleep [18, 19]. Furthermore, Li et al. (2020) said that mathematics contains various kinds of material related to numbers and logic. In addition, this subject leads students to understand and hone various skills they need in everyday life [15]. In line with this statement, Brandt et al. (2016) said that the skills honed by students when studying mathematics are skills needed in the era of the industrial revolution 4.0. Thus, it can be said that mathematics will hone various skills for students and is very important for every student to understand.

As a subject that is considered difficult by students, there are various difficulties experienced by students in solving math problems. According to Lehmann (2022) generally, the difficulties that students often encounter to solving problems in mathematics are problems that are also difficult for students at the next level. These difficulties include difficulties in understanding mathematical symbols, cognition, and geometry. Furthermore, Verschaffel et al. (2020) said that students also experienced difficulties in understanding the concept of numbers and solving math word problems. Word problems were considered difficult by students because students had to represent the word problems [22]. Furthermore, word problems are difficult for students because of the language used in word problems [23, 24]. Therefore, it can be said that word problems are one of the serious difficulties faced by students.

Basically, word problems have become one of the studies conducted by experts in various countries around the world [25, 26]. This is an indication that word problems are a very important form of a problem to be studied in Indonesia. Word problems are a form of problem in mathematics that can only be solved with maximum effort. In

line with this statement, L. Fuchs et al. (2020) said that students needed a lot of effort to solve math word problems. Furthermore, Vondrová (2022) said that in order to solve math word problems, a student needs a high level of understanding. Therefore, students need more effort than usual to solve word problems. This study aims to reveal the difficulties of students in solving math word problems.

## 2 Methodology

This study uses a qualitative research design that emphasizes the views of the researchers themselves. This research design is a vital tool that can assist researchers in answering every big question in research [29]. In addition, this research design allows researchers to use research documents realistically and holistically.

The type of research used in this study is a case study. Case study research is carried out to study, know, and understand various phenomena that occur in human life [30]. In this study, researchers seek to learn, know, and understand students' difficulties in solving math word problems for further research to express in the form of a description.

This research was carried out in one of the schools in the city of Bandung, namely SD Negeri 195 Isola. Respondents in this study were 32 students. The sample selection technique in this study was purposive sampling. Researchers use math word problems as a means of gathering information about students' difficulties. The word problems that the researcher uses are word problems that contain the topic of cubes, blocks, and fractions. Word problems number 1, 2, 4, 6, 7, and 8 contain the topic of cubes, and the other questions are questions about blocks. Meanwhile, word problems number 4 and 10 contain the topic of geometric shapes and fractions. Each respondent will be given a question that has a different level of difficulty. Word problems number 1, 2, 6, and 7 are word problems with a low difficulty level. Question number 3, 5, 8, and 9 have a medium difficulty level. Meanwhile, the other two questions are word problems with a high level of difficulty. In addition, researchers will interview respondents to find out how they learn and how teachers teach. Respondents' answers will be analyzed to find out their difficulties in solving math word problems and the causes of these difficulties.

## 3 Result

This research was conducted to find out the difficulties of students in solving math word problems. Students are given math story questions consisting of easy questions and difficult questions. After the students answered the story questions given, the researcher then checked the results of the students' work to find out the difficulties they experienced by the students in solving math word problems. After the researcher finished examining student work, the next researcher conducted interviews with students. Interviews were conducted to find out the factors causing students' difficulties in solving math word problems. The students interviewed were students who got high points and got low points. After the researcher finished conducting the

interviews, the researcher then analyzed the results of the student's work and the results of the interviews. The following are the results of the researcher's analysis regarding the difficulties of students in solving math word problems.

### **3.1 Changing the Language of Story Problems to the Language of Mathematics**

Math word problems consist of a series of sentences that contain certain meanings which in turn must be answered by students based on the instructions contained in the math word problems. The language contained in math word problems is a language that needs to be translated into mathematical language. Translating or converting math word problems is the process of converting a series of sentences into mathematical statements. The difficulty of changing the language of word problems into the language of mathematics is part of an epistemological obstacle. This is because they cannot use the initial abilities of students to translate the language of math story problems.

Based on the test results, the researcher found that there were always students who were wrong in every word problem that the researcher gave. For question with a low level of difficulty, 16 students had difficulty answering them. 31 students had difficulty solving word problems with medium difficulty levels. Meanwhile, 31 students experienced difficulties in solving word problems with a high level of difficulty.

Based on the results of the interviews between the researcher and the students, the researcher found that their difficulty in solving word problems was due, in part, to their lack of ability to translate word problems into mathematical language or mathematical formulas. Most of the students interviewed said that their lack of understanding in translating math word problems into mathematical language was due to a lack of practice solving math word problems. In addition, the researcher found that students were very fluent when reading the story problems given. However, when they were asked about the meaning or purpose of the question, they said that they did not know. This shows that the students have difficulties changing the language in word problems into the language of mathematics.

### **3.2 Understanding Mathematical Concepts**

Math word problems are long series of sentences that contain information and instructions related to mathematics which requires students to understand mathematical concepts well. The concept of mathematics is one of the most important things in mathematics. This is because the concept of mathematics is the basis of mathematics subjects. If students do not understand the basic concepts of mathematics well, it can be said that they will experience difficulties in solving each math problem. Based on the test results, the researcher found that the students did not understand the concept of geometry well, especially in cubic and cuboid shapes. In addition, they also have difficulty understanding the concept of fractions. For example, in word problems number four and number ten. In word problem number four, students are



asked to calculate the volume of a water tank that is not filled with water. The water tank is in the form of a cube with a side length of 4 m. In this story problem, students are given information that  $\frac{1}{2}$  of the water tank is filled with water. While in story number ten, students were asked to calculate the volume of a cupboard in the form of a block. In this word problem, students are given information that the length of the wardrobe is 2 meters, 1 meter wide, and 2.5 meters high.

In word problems with the topic of cubes, 35 students experienced difficulties in solving the story problems. For more details, see the table below.

**Table 1.** Students' Difficulties in Cube

No	Question number	Number of Students with Difficulty
1	One	2
2	Two	6
3	Four	11
4	Six	4
5	Seven	4
6	Eight	8

In word problems with the topic of blocks, 43 students experienced difficulties in solving the story problems. For more details, we can see the table below.

**Table 2.** Students' Difficulties in Block

No	Question number	Number of Students with Difficulty
1	Three	7
2	Five	8
3	Nine	8
4	Ten	20

In word problems containing the topic of cubes and ordinary fractions, 11 students experienced difficulty in solving these word problems. Meanwhile, 20 students experienced difficulties in solving word problems containing the topic of geometrical blocks and decimal fractions.

Based on the results of interviews with students, the researchers found that in carrying out the learning process, the teacher taught the topic of cubes, blocks, and fractions without using adequate media. Based on the confessions of the students interviewed, it can be said that the student's difficulties in understanding mathematical concepts are included in the didactical obstacle. However, students' difficulties in understanding mathematical concepts can also be included in the epistemological obstacle category.

### 3.3 Understanding Mathematical Concepts

Changing the representation of word problems into mathematical representations is changing the math word problems which are still in the form of text into other forms.

Changing math word problems into other forms is intended, so students can easily understand the word problems. In addition, changing the representation of the word problem into another form will help students solve the math word problem. Students experience difficulties in representing math word problems that are still in the form of text in a better form such as pictures, tables, or others. For example, in word problem number four, namely "A cube-shaped tub with a side length of 4 meters. If  $\frac{1}{2}$  the tub is filled with water, then calculate the volume of the tub that is not filled with water!".

If students understand deeply and represent the word problem in another form, then they will be able to solve the math word problem. Students can change the problem into an image form, namely a cube image, and shade half of the cube as a representation of the water in the tub of water. If they change the representation of the math problem into a picture, they will find that the length and width of the water in the bathtub is 4 meters while the height is 2 meters. In the end, students will be able to solve the word problems.

Based on the test results, students who both correctly or incorrectly immediately answered the question without first representing it in another form. This representation will help students who have difficulty solving the problem. From the interview results, the researcher found that the teacher only taught how to solve word problems in the usual way, namely using formulas directly. This makes it difficult for students to solve math word problems.

## 4 Discussion

Mathematics is one of the subjects that every student in elementary school will definitely encounter. This subject is a science that should be understood and mastered by every student in elementary school. This is because mathematics will always be encountered by students in their lives [31, 32]. Furthermore, Deringöl (2022) said that this subject should be taught to every child from an early age. This is because mathematics will help every student in solving various problems in their lives. In line with this statement, Van der Beek et al. (2017) said that mathematics will help students develop their skills in solving problems. In addition, it will be easier for students to learn and develop science and technology by mastering mathematics [35, 36]. Thus, it can be concluded that studying and exploring mathematics is one of the important things that students need to do.

Mathematics is a very important subject for students in their daily lives. However, various obstacles or challenges must be considered by every teacher of this subject. The obstacle or challenge that researchers mean is the difficulty of students in solving math word problems. One of the difficulties experienced by students is that students have difficulty changing the language of the questions into the language of mathematics. According to Purpura et al. (2017), this difficulty is one of the difficulties that students often experience when solving math word problems. The language of mathematics is in the form of symbols that are different from the language in general, so they need to understand the language of mathematics [38, 39]. Furthermore, Layn & Kahar (2017) said that students' linguistic abilities also

influenced their ability to solve math word problems. As a result, students are not able to know the purpose of the word problem.

As a form of problem in mathematics, students need to understand and master various things in mathematics to make it easier for them to solve math word problems. One of the things in question is understanding and mastering the basic concepts of mathematics. The basic concept of mathematics is one of the fundamental requirements for studying mathematics at a higher level. According to Lin & Williams (2017), mastering the basic concepts of mathematics is an absolute requirement for students to study mathematics at the next level. Understanding and mastering the basic concepts of mathematics has a major impact on students' mathematical abilities. In line with this statement, Pasnak et al. (2016) said that a lack of understanding of the basic concepts of mathematics would be a major obstacle for students to understand and master mathematics.

Based on the explanation above, research found that students had difficulty solving math word problems because they had difficulty understanding the basic concepts of cubic shapes, cube shapes, and the basic concepts of fractions. The fractions used in this study are ordinary fractions and decimal fractions as described above. According to, Strohmaier et al. (2019) understanding, the basic concepts of mathematics is a must for students to solve any problems related to mathematics. Furthermore, Zhang et al. (2021) said that students' lack of understanding of the basic concepts of mathematics would make it difficult for them to solve math problems. This is because students often encounter mathematical concepts in their lives [45, 46].

Mastering the basic concepts of mathematics is one of the difficulties of students in solving math word problems. In addition, students also had difficulty representing math word problems in other forms. Representing math word problems in other forms will help students solve a math problem in a non-formal way. In line with this statement, Li et al. (2021) also said that representing math word problems in other forms would help students solve the math word problems they encountered. Therefore, it is very important for students to change a math word problem in another form, so it makes it easier for them to solve the word problem.

## 5 Conclusion

Based on the results and discussion above, the researcher concluded that there were three difficulties for students in solving math word problems, namely (1) students had difficulty changing the language of the questions into mathematical language; (2) students have difficulty understanding the mathematical concepts contained in math word problems; (3) students experience difficulties in representing math word problems in other forms.

### 5.1 Suggestion

Based on the research conclusions above, the suggestions from researchers are (1) provide students with a good understanding of mathematical concepts; (2) understand

each participant about spoken language and mathematical language; (3) familiarize students with math word problems; (4) familiarize students with problem-solving steps; (5) using the right model to teach students during the teaching and learning process takes place. The results of this study can be a reference for every teacher in teaching math word problems to students.

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