Identification of elementary school students’ difficulties in mathematical problem-solving

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Abstract: One of the goals of learning mathematics is that students can solve mathematical problems in particular that can then solve problems in everyday life. In the process of solving problems, the skills that students must also possess are the ability to understand the problem, the ability to compose mathematical models of a problem and interpret the solution. In practice, however, students will encounter difficulties in resolving unavoidable problems. The purpose of this study is: 1) to explain the difficulties of students in resolving problem-solving problems; 2) to know the cause of students' difficulties in resolving problem-solving. The research studies used are qualitative descriptive. The participants of this study are 27 students of class III B in one of the elementary schools in Sleman Regency, Yogyakarta. Method of collecting data through problem-solving test. Data analysis techniques through the statistical description and content analysis. The results of this study show that 1) students are not used to face problem-solving problems, so that the results of solving problems are very low, (2) students have difficulty in finding keywords from problems in questions, because they don’t know the information or keyword of the problem and tend to guess the solution without going through the completion process (3) Students have difficulty to model the problem into mathematical form (4) Students have difficulty deciding how to resolution of the problem, and (5) students have difficulty in counting operations, so that students interpret conclusions that are not appropriate to the problem. Therefore, this results of the research will lead to inform the teachers, in order to improve students' mathematical problem solving skills.

1. Introduction

1.1. Math skills
Mathematics is one of the subjects studied by students to acquire logical, deductive, analytical, systematic, problem-solving skills, etc. As mentioned in the National Council of Teacher of Mathematics that one of the basic mathematical abilities that become standardized in the learning process is problem-solving ability (problem-solving) [1]. Suherman [2] mentioning problem solving is very important, because, in the process of learning and completion, students are possible to gain experience using the knowledge and skills already possessed to applied to solve the problems-solving that is not routine. It is strengthened by the opinion of Holmes [3] which mentions the background or the reason someone needs to learn mathematical problem-solving is the fact that in the 21st century that people who can solve the problem will be accustomed to solving problems in life. Besides, in the
capability of problem-solving, there are reasoning abilities that participate in academic achievement [4].

Based on the result of TIMSS 2015, Indonesia was in the lower ranks and students’ mathematics skills were still in the ‘knowing’ and ‘applying’ domain. In the ‘reasoning’ domain, students skill still was very low [5]. Similarly, the survey result of Program International Student Assessment (PISA) (Program for International Student Assessment) in 2015, the mathematical skills of Indonesian students in the ranks of 63 from 72 countries with a score of 386 (from average 490) [6]. The result inform that the mathematics skills of Indonesian students are still low and need to act from it.

The evaluation in learning is very important. According to Gronlund, further explains that the evaluation has a function to assist teachers in the placement of students in specific groups, improvement of teaching methods, knowing the readiness of learners (attitude, mental, material), provide guidance and selection to determine the course type as well as increase levels [7]. The educational assessment has multiple advantages, then one of these advantages namely students’ evaluations (summative and formative) [8]. So one effort to improve the quality of mathematics learning is through the enhancement of students’ math problem-solving skills in completing the test. The mathematical problem can be defined as a word problem, a story problem, or a verbal problem that requires finding a way to solve with a quantitative or numerical answer [9].

To understand the ability of students to solve mathematical problems can be diagnosed with students' difficulties in solving problems. Nitko & Brookhart [10] state that there are six approaches of diagnostic assessment in relation to the learning problems namely: (a) the approach of strengths and weaknesses on the capacity of a subject; (b) the approach of identifying the prerequisite knowledge weaknesses; (c) the approach of identifying the learning objectives that have not been mastered; (d) the approach of identifying the students’ mistakes; (e) the approach of identifying the students’ knowledge structure; and (f) the approach of identifying the competencies for completing the narrative test items. In this case, students’ difficulties can be identified by analyzing students’ errors in solving mathematics test items [11].

Based on the above, the teacher conducts tests that test the student problem-solving skills. The test is prepared with the students’ material competence regarding the things that students find difficult. From the results of the tests, the teacher will get accurate information about the concept of mistakes that students have [12] and performed analysis for improvement in the subsequent learning process.

1.2. Mathematical problems and difficulty in learning mathematics

In mathematics education, mathematical problems are usually in the form of mathematics that must be done by students [13]. A math problem can be a mathematical issue if the student has no idea to resolve the problem, but the student wishes to solve the math problem. One type of mathematical problem is the problem to prove. This type of math problem is a problem to determine whether a statement is correct or incorrect. The problem of proving consists of hypotheses and conclusions. The proof is done by creating or processing a logical statement of hypotheses to inferred, while to prove a statement that is not properly given a contradiction sample so that the statement is not true [14]. So, in this study, the mathematical problems given is a non-routine problem, which is an unusual problem and there is no definite standard to solve it. Non-routine issues are complex issues that require students to use a heuristic strategy to find problems, understand and find the solution [15].

Ruseffendi suggests that an issue is a problem for a person if the matter is not known, and the person has a desire to solve it, regardless of whether it ends up or not to the answer to the problem [16]. So, every student cannot avoid the difficulties in their learning. It should be realized that students are generally experiencing varying levels of difficulty in learning mathematics. The difficulties in solving mathematics problem can lead students to do some errors [17]. From that difficulty can lead to students’ success in achieving less optimal learning outcomes. Learning difficulties tend to have difficulties in solving problems both in the classroom and in their life issues or in the receiving the lessons at school. [15]
Important to know the types of difficulties experienced by students. Wood describes some characteristics of learning difficulties experienced by students when learning Mathematics 1) difficulty differentiating numbers, symbols, and building space, 2) can not remember the mathematical evidence, 3) write numbers in size Small, 4) do not understand the mathematical symbols, 5) weak ability of abstract thinking, 6) weakness of the ability of metacognition ability to identify and utilize algorithms in solving math problems [18].

1.3. Problem-solving skills

Problem solving is the main goal of all mathematics learning and is an integral part of all mathematical activities. According to Schroeder & Lester [1] problem solving is also important because it can serve as a vehicle for learning new mathematical ideas and skills. Problems solving is not a new topic, it is a process that needs to be absorbed in all programs and provides context in which concepts, principles and skills are learned [19]. When learning focuses on the problem solving process, so it will develop problem-solving skills for students.

Problem solving skills in mathematics learning are significant competence [20]. This is because in the process of learning as well as completion, students can get experience using the knowledge and skills already possessed to be applied solve the problem [15]. From the completion of problems, students are required to be more creative to reveal and use knowledge (understanding) in solving mathematical problems [21].

To measure the problem-solving skills, teachers provide problems in questions that require criteria of problem solving, then provide opportunities for students to solve the problem. That criteria can be measured by the indicators. These indicators are used as a reference to assessing the student's ability in problem-solving. One method of problem solving as an alternative to facilitate students in learning is the problem solving invented by Polya [22]. The steps used to refer to the Polya's stages. The problem-solving indicators according to the NCTM Indicators to measure students' mathematical problem-solving skills include: 1) students can identify the known elements, the questions asked, and the adequacy of the elements necessary, 2) students can formulate mathematical problems or formulate mathematical models, 3) students can apply strategies to solve various problems (new types and problems) in or out of mathematics, 4) students can explain the results according to original problems, and 5) students can use mathematics meaningfully [1].

Meanwhile, Polya has several stages in problem solving, namely 1) understand the problem (understanding the problem), 2) designing a plan of settlement (devising a plan), 3) implement the plan for solution (carrying out the plan), and 4) look back at the completion step (looking back) [23]. Understanding the problem can be done by reading the problem through the found keywords. Devise a plan can be done by modelling the problem into mathematical form, formulating questions and formulating concepts that will be used to resolve the problem. Carry out the plan is implementing a plan that has been compiled with mathematical concepts that get solutions to problems. Look back over, confirm the answer/solution to the problem given.

The difficulties they experienced became one of the clues to the extent to which the mastery of students learned to learn mathematics. Therefore, there is knowing the difficulties of students learning mathematics in resolving problem-solving problems that are then identified further in order to do the appropriate efforts to overcome it. Mayer states that "problem-solving as a multiple-step process where the problem solver must find relationships between past experiences (schema) and the problem at hand and then act upon a solution" [24]. Therefore, problem-solving is a set of processes involving the relationship between knowledge to obtain a solution. One of the models that can be used in learning is mathematical problem-solving. It identifies the basic sequence of three cognitive activities in problem-solving [25]: (1) declare a problem, including recalling the knowledge previously obtained. Next, identify the destination and start the finish by using the prerequisite material (as appropriate) to resolve the issue, (2) devise a plan to solve the problem, (3) implement plans that have been compiled to get settlement results.
Based on the explanation above, researchers formulated the aspects and indicators to resolve the problem in the following Table 1.

| The aspect on problem-solving | Indicators                                                                                           |
|------------------------------|------------------------------------------------------------------------------------------------------|
| Understanding the problem    | Students are able to identify problems by understanding and explaining what is known and asked in the problem. Students are able to predict what knowledge will be used to solve the problem. |
| Devising a plan               | Students plan a problem solving by involving the knowledge gained earlier in resolving the problem.   |
| Carrying out the plan         | Students can supervise their work whether they are known and asked questions or not. At the time of resolving the problem, students can think in other ways to solve the problem. Students can demonstrate where and how to do changes when there are working steps that do not fit into the problem. |
| Look back                     | Students can test that the results are already in accordance by the intent of the question. Students revise their steps and calculations if they do not match what they are asked to do. Students explain the conclusion of the problem appropriately. Students can solve the problem with other alternatives and in accordance by the request in the problem. |

Already, many researches have been carried out to investigate students’ difficulties in solving mathematics test items. Hadi, Retnuwati, Munadi, Apino, & Wulandari [26] had analyzed about the high school students’ difficulties in problem-solving HOTS showing that around 8.33% of the students had difficulties in comprehension, 15.59% in transformation, 32.53% in process skills, and 1.34 % in encoding. In addition, Jupri and Drijvers had investigated students’ difficulties in solving algebra word (story) problems and the result showed that the student encountered difficulties in formulating the mathematical model, indicated by errors in mathematical equations, schematics or diagrams [27]. Phonapichat, Wongwanich, and Sujiva had identified students’ difficulty in solving mathematics problem, namely difficulty in understanding the keywords in problems, finding assumption and information in the problem to solve it, guessing the answer without any thinking process, students are impatient and do not like to read mathematical problems or long word problems. [28]

2. Method
The research method used is a qualitative descriptive approach. What is described in this study is the analysis of students' difficulties in mathematical problem-solving. This research collects data from 27 students’ answer of class III B in one of the elementary schools in Sleman Regency, Yogyakarta. The test instrument contains five problem-solving questions of the addition and subtracts operation about a whole number. The validity of the question is done by three associates and one of grade 3 teacher to
assess the suitability of an item with an indicator. It is then calculated using the coefficient of Aiken with an average of 0.875 values (high category). The test results are quantitatively calculated to determine the student’s success in resolving problem-solving. Then, the data is analyzed in a descriptive order to know the difficulties of the students in resolving problem-solving.

3. Result and Discussion

3.1. Result

The results showed that there were still many students who were wrong in answering problem-solving questions. In general, figure 1 show that the student's distribution in answering mathematical problem solving.

![Figure 1](image)

**Figure 1.** The distribution of students’ answer in mathematical problems solving

From the results of the test, researchers analyzed each item by following the indicator of the problem-solving steps. Then, researchers identified the students’ errors and the cause of students’ errors in question that marked by students’ errors in the identification of “what is asked” and “what is given” from the test items [29]. Then, identify the students’ errors is displayed by aspect of indicators in each of aspects. In general, the indicators in solving the problem in each aspect can be concluded and presented by the following diagram:

![Figure 2](image)

**Figure 2.** The percentage of students’ difficulties

3.1.1. Problem 1

At a stadium, there is a race with participants consisting of 948 people. Also, there are 1,337 people watched the race. How many people are there in the stadium?
From the question, the results were obtained 17 students answered correctly and 10 students answered wrong. Furthermore, analysis of students' difficulties through wrong answers to students. The difficulties that the students experienced in answering question number 1 are:

- Many students (40%) didn’t understand the sentence that is in question, so that students do not understand the desired intent of the question. (the indicator of aspect 1)
- Some students (20%) only counted the numbers contained in the problem without understanding the operation that should be done. (the indicator of aspect 2)
- There was students (20%) who only moved the number from questions into the completion step. (the indicator of aspect 3)
- There were students’ error in operating the sum (20%). (the indicator of aspect 4)

3.1.2. Problem 2
Today the Post Office sells 1,565 sheets of postage stamps. Yesterday sold 3,157 sheets of postage stamps. How many stamps were sold today and yesterday?

From the question, the results were obtained 22 students answered correctly and 5 students answered wrong. The difficulties that the students experienced in answering question number 2 are:

- The inaccuracy of students in calculations on addition operations so that the results obtained do not correspond to the solution of the problem. (aspect of indicator 4)

3.1.3. Problem 3
There are 2,345 patients of the hospital in a month. Among those patients were 852 men. How many female patients in the hospital?

From the question, obtained 5 students answered correctly, while there were 22 students answered wrong. The difficulties found through the answer of the students in answering the number 3 question are:

- Most of students (54.5%) didn’t find keywords as the main problem in the matter so that students didn’t understand the desired intent of the question. (the indicator of aspect 1)
- Many students (44.5%) only counted the numbers contained in the problem without understanding the operation that should be done. (the indicator of aspect 2)

3.1.4. Problem 4
In Pak Deni shop there are 2,256 garments. For one week the outfit sold 1,209 garments. Choose the rest of the clothes in Pak Deni's shop!
From the question, the results of 14 students answered correctly and 13 students who answered wrong. Meanwhile, the difficulties experienced by students in answering question number 4 are:

- Most of students (46%) didn’t understand the sentence that is in question, so that students do not understand the desired intent of the question. (the indicator of aspect 1)
- Students (23%) didn’t understand what surgery to do. (the indicator of aspect 2)
- Some students (16%) only counted the numbers that on the problem. (the aspect indicator 2)
- Students (15%) error in operating the sum. (the indicator of aspect 4)

3.1.5. Problem 5

The supply of glasses in Earthenware stores amounted to 4,563 pieces. Then the store added more glass supplies as much as 1,275 pieces. After walking a month, there were 2,549 glasses sold. Calculate the rest of the glass supplies at Earthenware Shop!

From the question, the results obtained 7 students answered correctly and 20 students answered wrong. The difficulties that the students experienced in answering question number 1 are:

- Multiple students (25%) not understand the sentence that is in question, so that students do not understand the desired intent of the question. (the indicator of aspect 1)
- Some students (25%) only counting the numbers contained in the problem without understanding the operation that should be done. (the indicator of aspect 2)
- Multiple students (30%) To move the number of questions into the completion step. (the indicator of aspect 3)
- Student (20%) In operating the sum. (the indicator of aspect 4)

3.2. Discussion

By observing the above results, questions 3 and 5 are the hardest thing to solve with a percentage below 50%. In Question No. 3 only 18.5%, and 26% for question number 5 of the whole student who answered correctly. This is evidenced by the percentage of students in 5 problems of low problem solving, which is only 18.5% of students who can answer 4 questions from 5 questions and 30% of students who managed to answer 3 questions of 5 mathematical problem-solving. Secondly, there are still many students who have not been able to use basic concepts and prior knowledge to solve mathematical problem-solving. Thirdly, some students can succumb when faced with a non-routine problem so they only guess the solution through the numbers written in the matter.
In the aspect of understanding the problem (Aspect 1) is the most numerous aspects of the students experiencing difficulties. This happens due to students’ inability to find keywords and identify the problems presented in the problem. Then, when students do not understand the problems, they are likely to guess without any mathematical thinking process. It is similar to the research result of Phonapichat, Wongwanich, and Sujiva [25]. In the same way, the result of Lamb [26] and Jiban & Deno [27] that states that the level of reading skill is a significant indicator of mathematics achievement. Also, according to the results of interviews with teachers, students are not used to and are reluctant to do problem-solving questions because it is too long and very complex, hence not motivating students to solve it [28]. In addition, students’ inability to make a mathematical model representing a contextual problem [30].

In the aspect of drafting a plan to complete, some students are still struggling a lot, because difficulties continuing from the aspect of understanding the problem. Students who have difficulty finding the main problem with questions will have an impact on students' ignorance of the plan that will be used to resolve the problem. This is due to the lack of mastery of the student concept of the material. This is the reason why students do mathematical problems wrong is that they lack knowledge about principles, rules, and processes [29]. Besides, comprehension and calculation are also lacked [30]. While in the aspect of implementing the plan, some students do not do the monitoring of the work, so do not know that some mathematical models or steps that do not correspond to what is known in the problem. Because of the lack of calculation, students become less thorough in the process of implementing the plan (calculation operation).

In the aspect of looking back at the procedure and the outcome of the problem, there are still students who do not re-check and immediately make a conclusion after obtaining an answer. Still found some students who do not re-check the answer whether it is correct or not. Of the few students who only have difficulty at this stage, it is possible by the lack of factors of monitoring the job, so that the mistakes of student answers are caused by inaccuracy in the process of calculating.

By observing the above data analysis results, it can be concluded that students did error on reading comprehension, transformation, and process skill [30]. In addition, Radatz [31] mentions that there are various causes of errors, i.e., language difficulties; difficulties in obtaining spatial information; insufficient mastery of prerequisite skills, facts, and concepts; incorrect associations or rigidity of thinking; application of irrelevant rules of strategies.

Furthermore, because the problem solving is a skill that must be owned by each student [32], researchers obtain findings the research such as most students are not familiar with the types of mathematical problem-solving. The solution, they are accustomed to routine problems, so that when given a non-routine problem they simply answer with procedures. Students’ problem solving skills can increase by familiarizing them resolve non-routine problems [22]. Meanwhile, a non-routine problem encourages creativity and originality for a problem solver.

The low ability of students in problems-solving may be caused by the lack of teachers' ability to implement the 2013 curriculum [32] that was announced by the government [33]. The teachers still also have difficulties in designing the learning instruments for the 2013 Curriculum [34], the lack of supporting facilities such as limited learning media [33] and another things. So, to overcome the student’s difficulties in problem-solving can be done by strengthening the student’s mathematical understanding of the mathematical concepts taught by teacher. A good understanding of concepts and materials will determine the attitudes and behaviors of the students in dealing with the problem. Therefore, teachers in the study must prepare students not only to be able to memorize it but also to be competent in the daily problem solving faced by students’ [32]. Like Helmon’s opinion that through developing strategy such as problems based learning focuses on the strengthening of problem solving skills [34]. Moreover, developing instructions in mathematics learning can go through by media. Damayanti et al develop the products Interactive Multimedia Android (MITRA) Learning Model of Problem-Solving [35] to improve the quality of learning by offer the use of Smartphones in learning mathematics. There are learning model and makes MITRA more strategic and innovative when used in the learning of mathematics, which is the problem solving learning model [37]and it makes students
are motivated to be active in the learning, the ability of representation [38], especially problems-solving [39]. These can be applied in mathematics learning in order to increase students’ problems solving skills.

4. Conclusion
Based on the results and discussion of analysis of problem solving, it can be concluded that the students’ difficulties in solving problem-solving problems based on the problem solving most are (1) difficulty facing the mathematical problem-solving, (2) the understanding of the problem, (3) model the problem into mathematics (4) determine how to settle in the matter, and 5) on the calculating operation. The cause of the students to experience these difficulties is as follows: (1) Not yet accustomed to face problems of non-routine (mathematical problem-solving), (2) Students do not understand the language in the sentence so that students do not know the main problem of the question. The students are subsequently misdetermined how to Settle, (3) Students find it difficult to model problem solving into mathematical sentences, (4) Students are not accustomed to solving problem solving problems so that lack of students' mastery over strategies to solve mathematical problem-solving, (5) lack of thoroughness of students in performing counting operations so that the students are still wrong in carrying out the addition and subtraction operations. While the findings that researchers obtain include: (1) in the process of resolving the problem, students do not use systematic steps in solving the correct problem, (2) There are still many students who have not been able to use basic concepts and prior knowledge to solve problem-solving problems, (3) still found some students just guessing the solution through the numbers written in the matter.

By knowing the results of the above research, it can be given the following suggestions. First, the teacher is reflecting on student learning evaluation related to the ability of problem-solving on the addition and subtraction material. Secondly, learning focuses on the learning of the Constructivis, so that the concept of the students can last long. Thirdly, the need for teachers to teach is centered on the student's thinking process so that students can achieve at high order thinking skills level.

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