An analysis of students problem solving skills using a realistic mathematics approach on integers materials

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Abstract. This study aims to describe the problem-solving skills of seventh-grade students of junior high school by using a realistic mathematics approach on integers materials. This study was conducted qualitative descriptive research. The subjects of this study were class VII-B students of Junior High School of Nusantara Lubuk Pakam in the Academic Year of 2018/2019. They were 36 students. The instrument of data collection in this study was conducted by problem-solving skills test which included four indicators consisting of comprehending the problem, making plans, implementing the plan, and re-checking the results obtained. The integers test material consists of (1) The recognizing and comparing integers; (2) the addition and subtraction of integers; and (3) the multiplication and division of integers. The results of the study state that the average overall problem-solving skills of students in integer material increases. This can be seen from the percentage of the average score of the overall problem-solving abilities of students from 3 subtopics on integers material. In subtopic 1 were 72.31 %, subtopic 2 were 78.61 %, and subtopic 3 were 81.41 %

1. Introduction
Mathematics is one of the subjects that requires the skill to think specifically in solving problems. Mathematics as a tool in solving problems both small and big problems [1]. Therefore, mathematics is one of the important subjects to learn. Another reason is important because mathematics is related to everyday life. Problems in everyday life can be connected with mathematics. Problems that connect mathematics with real life and allow students to study it are contextual problems [2]. Because mathematics is an important lesson in school, surely every mathematics teacher hopes that the mathematics scores of his students will be good. However, some students did not get good grades, even they were not interested in learning mathematics [3].

Problems in mathematics need to be solved. Adams interpreted problems in mathematics as problems presented in the form of stories or related to real life [4]. The problem-solving process is explained as a complex process that requires a lot of skills in applying it. Principally, types of problem-solving in mathematics consist of two namely routine and non-routine problems. In mathematics, a routine problem is a type of problem where the solution is technical in order to get good basic abilities, especially arithmetic abilities involving four basic operations in mathematics, namely addition, subtraction, multiplication, and division. Direct applications also use mathematical formulas, laws, theorems and equations. The problem-solving process that does not require a high level of reasoning in completing it is classified as a routine problem [5]. While non-routine problems are unique ones that need the application of skills, concepts or principles to solve them. The results of non-routine problems cannot be predicted and cannot be solved by known methods or formulas [6].
Through studies that have been conducted and international evaluations such as the International Student Assessment Program (PISA), the level of problem solving skills of Indonesian students is still weak in solving non-routine or high-level problems [7]. In relation to students’ abilities in mathematics, the data on the position of Indonesia for 15 years is presented in PISA in the mathematics subjects presented in the table below:

| Years | Points | Rating of Indonesia | Participating Countries | Total of Students |
|-------|--------|---------------------|-------------------------|------------------|
| 2000  | 367    | 39                  | 41                      | 265,000          |
| 2003  | 360    | 38                  | 40                      | 275,000          |
| 2006  | 391    | 50                  | 57                      | 400,000          |
| 2009  | 371    | 61                  | 68                      | 470,000          |
| 2012  | 375    | 64                  | 65                      | 510,000          |
| 2015  | 386    | 62                  | 70                      | 540,000          |

Table 1 shows that Indonesia’s ranking in a number of years in mathematics has shown an increase but has not yet reached a good rating. This is in line with reality. Considering the implementation of the 2013 curriculum, where students are demanded to be active, students need the ability specifically to solve problems. Related to the implementation of the 2013 curriculum, where students are required to be active and able to solve problems it is necessary to apply a learning model. One model that is suitable for developing students' mathematical problem-solving abilities is the Polya model. Polya (1956) stated four steps in problem solving. The four steps are understanding the problem, planning the problem, solve or find alternative solutions to problems, implement plans or calculations, and check or test the correct calculation or problem solving [8].

The low level of mathematical problem-solving abilities of students is related to the learning approach applied by the teacher so far. Many teachers still teach applying traditional approaches, namely introducing mathematics in a symbolic or abstract way, and forcing students to memorize. Such an approach is contrary to the development of students' cognitive abilities and is considered to be less useful for students. Each learning approach is different from each other. This is distinguished according to the characteristics, functions, and objectives of each approach. The implementation of the learning process requires a good learning approach, which is related to students’ mathematical concepts and in accordance with the objectives of the learning curriculum oriented to contextual problems as a means of problem-solving[9]. Therefore, one of the learning approaches oriented to contextual problems especially in the field of mathematics is a realistic mathematical approach or realistic mathematics education (RME).

The goal of RME is to change mathematics learning to be more fun and meaningful for students through contextual problems. The RME step begins with taking a problem that is relevant to students' experience and knowledge. Then the teacher facilitates students in helping to solve contextual problems[10]. There are several steps to learning with realistic mathematical approaches, namely (1) presenting contextual problems; (2) resolve contextual problems; (3) discuss the completion of contextual problems; and (4) concluding learning material[11].

Realistic Mathematics Education (RME) students are increasingly aware that mathematics is very important because it deals with problems that occur in everyday life so it is said that the truth is realistic relating to the real world and its realism refers to the real problems that arise in the minds of students[12]. But in each application of learning, it is necessary to analyze the learning outcomes obtained.

Learning outcomes are related to students' skills. Seeing the facts in the field, quite a number of teachers only assess and accumulate the results of their students' abilities as a whole, but not analyzed. The analysis is very necessary to find out what problems or difficulties experienced by students through the process of solving the problems that students make. The teacher is expected to be able to
analyze students' abilities to find out the problems faced by students. Therefore we need a study of the analysis of students' problem-solving abilities related to the application of learning with realistic mathematical approaches.

The formulation of the problem in this study is how to analyze the achievement of students' mathematical problem-solving abilities by applying learning realistic mathematical approaches. Problem-solving skills will be analyzed based on 4 indicators of problem-solving steps, namely (1) comprehend the problem; (2) make plans; (3) implement plans; and (4) recheck the results.

2. Research Methods
This type of study was qualitative descriptive research. This study used descriptive methods because through this research, students described the skills to solve problems based on four indicators of problem-solving skills, namely (1) comprehend the problem; (2) make plans; (3) implement the plans; and (4) re-check the results. The sample of this study was class VII-B of students of Junior High School Nusantara Lubuk Pakan at Academic Year 2018/2019. For the test instruments used previously, has been validation by based content and format by the validator, namely the teacher and lecturer. Giving the test is done three times. There are three integers sub-topics given to students along with the number of test items presented in the table 2:

| No. | Sub Topics                         | Number of Item Questions |
|-----|------------------------------------|--------------------------|
| 1.  | Recognize and compare integers     | 3                        |
| 2.  | Addition and subtraction of integers | 4                      |
| 3.  | Multiplication and division of integers | 4                    |

Table 2 explains that integers material has several questions in each subtopic, namely three questions recognize and compare integers, four questions of addition and subtraction of integers, and four questions of multiplication and division integers.

3. Results and Discussions
Before the analysis of students' problem-solving skills is carried out, all instruments are validated and tested. The validated and tested instruments are problem-solving skill test instruments. Then proceed with applying to learn with realistic mathematical approaches to the topic of integers. In integer material, there are 3 subtopics. After completing the learning process for each subtopic, students are given a problem-solving skill test. Test results were analyzed based on 4 indicators of problem-solving skills. The analysis is presented as follows:

3.1 Comprehending Problems
The indicators assessed from the skills to comprehend the problem were: score 0 if there is no answer at all; score 1 if incorrectly written data is known; score 2 if only write a little data that is known correctly; score 3 if writing part of the data correctly known; score 4 if writing data that is known correctly but not complete; score 5 if writing data is known correctly and completely.

Based on the test results obtained data that more students are skill to understand the problem in the material recognize and compare integers than the other two subtopics. This can be seen in the following figure 1:
Figure 1 shows that the average percentage of students' ability to comprehend the problems on the subtopics of recognizing and compare integers were 83.15; addition and subtraction of integers were 80.83, and multiplication and division of integers were 80.83. Based on these data, it can be concluded that the ability to comprehend the problems on the subtopics of recognizing and compare of integers was better than the other two subtopics.

3.2 Make a Plans

The indicators assessed from the skills to make plans are: score 0 if there is no answer at all; score 1 if writing a wrong settlement strategy; score 2 if only writing a few settlement strategies correctly; score 3 if writing part of the resolution strategy correctly; score 4 if writing a settlement strategy correctly but not complete; score 5 if writing a settlement strategy correctly and completely. Based on the test results obtained data that more students are skill to plan for multiplication and integer division compared to the other two subtopics. This can be seen in the following figure 2:

Figure 2 shows that the average percentage of students' ability to make plans on subtopics of recognizing and compares integers were 65.19; addition and subtraction of integers were 76.04, and multiplication and division of integers were 79.40. Based on these data, it can be concluded that the ability of students to make plans on the subtopics of multiplication and division of integers was better than the other two subtopics.

3.3 The Implement Plans

The indicators assessed from the skills to implement solutions are: score 0 if there is no completion at all; score 1 if the settlement is not in accordance with the planning and wrong results; score 2 if the completion is slightly in accordance with the plan but the result is wrong; score 3 if the completion is
slightly in accordance with the plan but the result is correct; score 4 if the settlement is in accordance with the plan but the results are correct; score 5 if the settlement is in accordance with the plan and the results are correct. Based on the test results obtained data that more students are skill to carry out planning on multiplication material and integer division compared to the other two subtopics. This can be seen in the following figure 3:

![Implement The Plans](image)

**Figure 3.** Percentage of average skills of students based on implement the plans

Figure 3 shows that the average percentage of students' ability to implement planning on the subtopic of recognize and compare integers were 69.82; addition and subtraction of integers were 80.83, and multiplication and division of integers were 85.28. Based on these data, it can be concluded that the ability of students to carry out planning on the subtopic of multiplication and division of integers was better than the other two subtopics.

3.4 Re-check the Results

The indicators assessed from the skills to re-check are: a score of 0 if there is no information; score 1 if doing a wrong check; score 2 if checking is as correct as possible; score 3 if the examination is close to true; score 4 if doing a correct check but not complete; and a score of 5 if doing a correct and complete examination. Based on the test results obtained data that more students are skill to re-examine multiplication and integer division compared to the other two subtopics. This can be seen in the following figure 4:

![Re-check The Results](image)

**Figure 4.** Percentage of averages kills of students based on re-check the results

Figure 4 shows that the average percentage of students' ability to recheck the result on the subtopic of recognizing and compare integers were 70.37; addition and subtraction of integers were 77.22, and multiplication and division of integers were 80.60. Based on these data, it is concluded that the ability of students to re-check the result on the subtopic of multiplication and the division of integers was better than the other two subtopics.

Overall, the percentage of average problem-solving skills students based on four indicators of
integers materials is presented in table 3:

| No. | Sub Topics                              | Comprehending the Problems | Making Planning | Implementing Plans | Recheck Results | Average Overall Scores |
|-----|----------------------------------------|----------------------------|-----------------|-------------------|----------------|------------------------|
| 1.  | Recognize and compare integers         | 83.15                      | 65.19           | 69.82             | 70.37          | 72.31                  |
| 2.  | Addition and subtraction of integers   | 80.83                      | 76.04           | 80.83             | 77.22          | 78.61                  |
| 3.  | Multiplication and division of integers| 80.83                      | 79.40           | 85.28             | 80.60          | 81.42                  |

Table 3 shows that aspects of problem-solving skills in subtopics 1, the percentage of students understanding the problem is better than the other three aspects. Whereas in subtopic 2, the aspect of understanding the problem has the same percentage as the plan implementation and is higher than the other two aspects. In subtopic 3, the percentage of plan implementation is better than the other three aspects. Of the three subtopics, the average score of problem-solving ability in subtopic 3 is better than the other 2 subtopics.

4. Conclusion

Through this study, it was concluded that the average overall problem-solving skills of students in integers material have increased. This can be seen from the percentage of the average score of the overall problem-solving abilities of students from 3 subtopics on integers material. In subtopic 1 were 72.31 %, subtopic 2 were 78.61 %, and subtopic 3 were 81.41 %. However, if viewed from each indicator of problem-solving skills for each subtopic, it can be concluded that in subtopic 1 skills of students were more increasing on indicators comprehending the problems, but weak on indicators making plans. Students who able to comprehend the problem in the subtopic 1 were 83.15%, students were able to make plans by 65.19%, students were able to carry out the plans by 69.81%, and students were able to recheck the results by 70.37%. In subtopic 2 the conclusion was that the skills of students were more increasing on indicators comprehending the problems and applying plans, but weak on the indicator of checking the results. There were 80.83% of students able to comprehend the problem, 76.04% of students able to make plans, 80.83% of students able to carry out the plan, and 77.22% of students were able to recheck the result. In subtopic 3, it can be concluded that the skills of students were more increasing on the indicators implementing the plans, but were weak in making the plans indicators. There were 80.83% of students who could comprehend the problem, 79.40% were able to make plans, 85.28% were able to carry out the plan, and 80.60% were able to recheck the results. Therefore it is expected that through this research the teacher is able to analyze students' problem-solving skills by applying to learn with realistic mathematical approaches. The researcher suggested that the teacher analyze the problem-solving skills in each learning especially learning with realistic mathematical approaches. Analysis of students' problem-solving skills can be done on learning the material and other subtopics.

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