

# The Influence of Realistic Mathematics Education (RME) Approach on Students' Mathematical Problem Solving Ability

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**Abstract**—In this research, the researchers compared mathematical problem solving ability between the students who were taught using Realistic Mathematics Education (RME) and those who were taught using conventional approach, according to their self-regulated learning. This is quasy-experimental research. The population of the research was the students at fourth grade SDN Gugus 1st Batang Gasan. Samples were taken by simple random sampling technique with fourth grade SDN 13 Batang Gasan as control class and fourth grade SDN 17 Batang Gasan as experiment class. The data were collected through questionnaires and test. The results showed that: 1) the students' mathematical problem solving ability was higher when they were taught using RME than when the students were taught using conventional approach, irrespective of their self-regulated learning, 2) there is no interaction between RME and students' self-regulated learning on problem solving ability. In the end, it can be concluded that the RME approach contributed to the improvement of students' mathematical problem solving ability.

**Keywords**—RME, problem solving, self-regulated learning

## I. INTRODUCTION

Problem solving ability is an important skill that is mastered by students in learning mathematics. "The heart of mathematics is problem solving." Through problem-solving students are encouraged to explore, to take risks (with the assumptions and strategies chosen), share success stories and failures (in obtaining solutions), and question each other's strategies and results other [1]. This is supported by NCTM [2] which makes problem solving a standard for school math learning process.

Problem solving as an attempt to find a way out of a difficulty to achieve a goal that is not so soon can be achieved [3]. So it takes a professional educator and has expertise in handling mathematical problem solving, to help students become better problem solvers. Lester [4] puts it: He also suggests several proficiencies of the problem solving instruction. Learning about mathematics and mathematical problem solving is a process that is strongly influenced by beliefs about mathematics. This belief determines how a student chooses a problem approach, as well as the techniques and strategies to be used [5]. Problem solving becomes an integral component of mathematical problems for prospective teachers of mathematics education [6].

Recognizing the importance of mathematical problem solving ability, hence exploring and developing problem

solving ability of students must become teacher commitment as part of main task to educate nation life. Students should have plenty of opportunities to use their abilities, practice, formulate concepts, engage in solving complex problems that demand the enormous efforts of students and then students are encouraged to reflect on their thinking in drawing accurate conclusions.

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Indonesia ranks 69 out of 76 countries surveyed by Trends International Mathematics and Science Study (TIMSS) where problem solving is an important element of the 2015 TIMSS test [7]. Conventional approaches such as expository and lectures are commonly used for teaching. As a result, students find it difficult to work on problems that demand problem-solving skills. Students leave in the course of work the information is long and tend to be interested in routine questions that are directly related to the formula [8].

One of the problems in education in Indonesia is the weakness of the learning process [9]. The learning problem can not be separated from the ability of low problem solving ability. Sudiarta [10] identifies the main factors causing the low ability of problem solving of students 'mathematics, that is the learning that has been done so far has not been able to develop the students' ability in communicating mathematical ideas appropriately, understanding mathematical concepts, and solving math problems.

One way that can be done to improve problem solving skills is to use the Realistic Mathematics Education (RME) approach. The RME approach is in stark contrast to the conventional approach commonly used by teachers today. The RME approach builds an understanding of students' math concepts through their informal knowledge. If the conventional approach begins with the algorithm, the RME approach places the algorithm as the ultimate goal [11].

The conventional approach is traditional learning characterized by lectures or chalk and talk methods. Learning begins with an explanation of the teacher and the student taking notes. then accompanied by the assignment and

training. Conventional learning emphasizes more on the function of the teacher as the informant, while the students are positioned as listeners. As a result, learning becomes teacher-centered [12, 13, 14, 15, 16]

RME is an approach with the paradigm that mathematics is a human activity (human activities), and learning mathematics means working with math (doing mathematics)[17]. With the RME approach, students can not be viewed as passive recipients of mathematics. Instead students are seen as human being who has a set of knowledge and experience gained through interaction with his environment. Furthermore, students also have the potential to develop such knowledge for themselves. The RME approach leads students to reinvent mathematics in their own way.

In the classroom, RME approach starting from contextual problems and giving freedom to students to describe, interpret and solve contextual problems in its own way in accordance with the initial knowledge possessed. The process of developing ideas and concepts of mathematics beginning with the real world is called "conceptual mathematization". At first students will solve problems informally or use their own language (horizontal mathematization). Once familiar with similar processes of solving (via simplification and formalization), they will use a more formal language, and at the end of the process students will find an algorithm. The process students go through until they find an algorithm called vertical matematization [18]. This situation was described at Fig. 1.

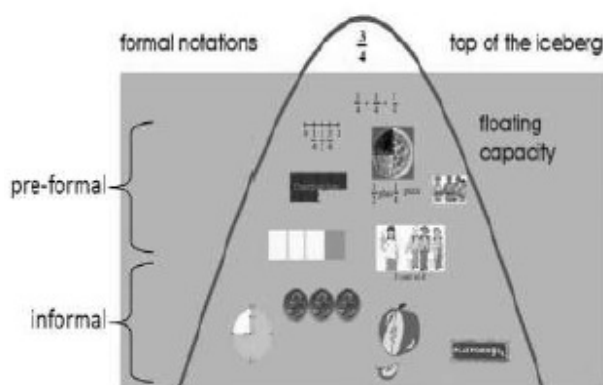


Fig. 1. Building conceptual understanding

Learning with RME is more interesting. Kuiper and Knuver mentioned that learning using RME approach can: (1) Make mathematics more interesting, relevant, meaningful, less formal, and less abstract, (2) Consider student's level of ability, (3) Emphasize learning math on learning by doing, (4) Facilitate solving mathematical problems without using standard (algorithmic) solutions, and (5) Using context as the starting point of mathematics learning [19].

In the RME approach, students are encouraged to exchange ideas, criticize other students' ideas, and learn from other students' ideas that are considered appropriate. This situation will train students' independence in learning. So in other words, the RME approach requires the involvement of students' learning independence [11].

The development of technology and global currents implies that the future life will further compel us towards a more competitive life, so that individuals are required to have learning independence in order to compete. self-regulated learning (SRL) as a learning process that occurs because of the influence of thoughts, feelings, strategies, and attitudes oriented self-achievement goals. Learning is no longer just to gain knowledge, but rather to fulfill the need to solve problems. [20].

The word independence comes from the basic word of self that gets the prefix to and the suffix which then forms a word of state or noun. Independence is an internal strength of individuals acquired through the process of individuation. The process of individuation is the process toward perfection. The self is the essence of personality and is the central point that aligns and coordinates all aspects of personality [21].

The need for the development of SRL in individuals learning mathematics is also supported by several studies. These findings include: Individuals with high SRL tend to learn better, be able to monitor, evaluate, and manage their learning effectively; save time in completing the task; organize learning and time efficiently, and gain high scores in science [22].

The research findings confirm that student independence plays an important role in learning. Students with high independence have characteristics, among others; has a passion to compete to advance, be able to take decisions and initiatives over problems faced, have confidence in doing tasks and responsible for what he does.

The questions in this study are stated as follows: (1) is the student's mathematical problem solving abilities that follow the learning with RME approach better than those using the conventional approach? (2) does the mathematical problem solving ability of students who have high, medium, and low learning independence who follow the learning with RME approach better than those using conventional approach? and (3) Is there an interaction between the RME approach and the independence of learning in affecting mathematical problem-solving skills?

## II. METHOD

This research is a quasy experiment that aims to compare the effect of RME approach with conventional approach on students' mathematical problem solving abilities. The variables involved in this research are problem solving ability as independent variable, RME approach as dependent variable, and learning independence as a moderator variable.

The research was conducted on the fourth grade students of SDN Gugus I of Batang Gasan District which had the same curriculum, KKM, and accreditation. From each school, two classes of six classes were randomly selected as research samples. 20 students of grade IV SDN 17 Batang Gasan as experimental class will follow the learning by RME and 20 grade 4 students of SDN 13 Batang Gasan as the control class will follow the learning using conventional approach. The design of learning with RME used in this study used characteristics by Treffers namely (1) contextual use, (2) modeling, (3) utilization of construction results, (4) interactivity, and (5) linkage [16].

The data were collected using questionnaires and tests. Questionnaires are used to identify students' learning independence, while tests are used to measure students' mathematical problem solving abilities. Questionnaires and tests validated by experts, then tested for emmenuhi validity and re-obligation criteria. The indicators of mathematical problem solving skills used in the tests are (1) identifying known elements and adequacy of the required elements, (2) formulating problems or composing mathematical models, (3) implementing strategies for solving problems, and (4) explaining or interpret the results of the problem solving. The students' mathematical problem-solving scores were determined using the rating rubric made [23]. The data were then analyzed using two-way t-test and ANOVA after performing a series of normality and homogeneity tests.

### III. RESULTS AND DISCUSSION

Based on data analysis, the students' mathematical problem solving abilities were classified according to their self-regulated learning, as can be seen on Table I.

TABLE I. THE AVERAGE SCORE OF SYTUDENTS' MATHEMATICAL PROBLEM SOLVING ABILITY ACCORDING TO THEIR SELF-REGULATED LEARNING

| Class      | Self-Regulated Learning | N  | Problem Solving |
|------------|-------------------------|----|-----------------|
| Experiment | High                    | 5  | 95              |
|            | Middle                  | 10 | 91,5            |
|            | Low                     | 5  | 86              |
| Control    | High                    | 5  | 75              |
|            | Middle                  | 9  | 81,11           |
|            | Low                     | 6  | 68,33           |

Table I shows that the average scores of students who followed the learning using the RME approach were higher than those who followed the learning using the conventional approach. Based on self-regulated learning, the average grade of the experimental class is higher than in the control class.

After conducting a series of normality and homogeneity tests, it was concluded that the t-test was used for four hypothesis testing and a two-way ANAVA was used for testing the interaction between the RME approach and learning independence in influencing mathematical problem-solving abilities. A summary of hypothesis testing, with the help of Microsoft Excel, is presented in the following table II.

TABLE II. THE RERSULT OF HYPOTHESIS TESTING

| Self-Regulated Learning | Result   |       |       |              |
|-------------------------|----------|-------|-------|--------------|
|                         | $\alpha$ | $t_t$ | $t_h$ | Information  |
| Total                   | 0,05     | 2,025 | 4,349 | Accept $H_1$ |
| High                    | 0,05     | 2,306 | 4,472 | Accept $H_1$ |
| Middle                  | 0,05     | 2,110 | 2,267 | Accept $H_1$ |
| Low                     | 0,05     | 2,262 | 3,088 | Accept $H_1$ |

The result of hypothesis testing in Table II shows that all hypotheses are accepted. That means that the students'

mathematical problem-solving skills that follow the learning with the RME approach are higher than those that follow the lessons with the conventional approach. This finding also applies to students with high, medium, and low self-regulated learning. This is because the learning of mathematics with the RME approach begins with the giving of contextual questions. Then students are given the opportunity to use their informal knowledge-solving strategies and strategies. Such conditions in addition to fostering students' self-confidence in problem solving, but also improve their ability to identify the adequacy of the necessary elements, understand problems, find varied strategies in solving problems and interpret problem-solving outcomes [11].

The next hypothesis testing uses a two-way ANOVA used to determine the interaction between RME and Self-Regulated Learning approaches in influencing students' mathematical problem solving abilities.  $f_{3,28}$  with  $\alpha = 0.05$  greater than  $f_h$  0.104 so receive  $H_0$ . That is, there is no interaction between RME approach and Self-Regulated Learning in influencing students' mathematical problem solving abilities.

In general the experimental class students have reached the problem solving indicator. This can be seen from the answers given by students in solving the problem of mathematical problem solving. One of the students' answers to the problem of mathematical problem solving in identifying known elements can be seen in Fig. 2.

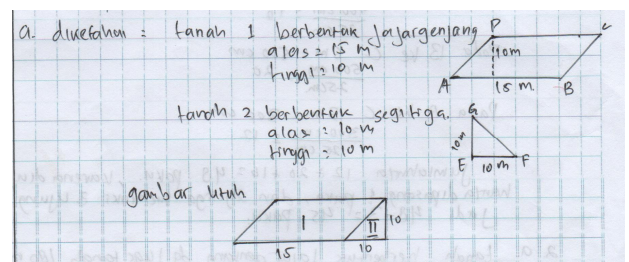


Fig. 2. Answers on Mathematical Problem Solving for Experiment Class Students

From Fig. 2 it can be seen that the student has been able to identify the known elements and the adequacy of the necessary elements. Students also describe problems to be easily understood. Similar to the control class student's answer, students identify known elements of the problem clearly. However, students have not yet seen to reinforce the identification of elements with images or explanations that cause some students to err in the selection of problem-solving strategies. Results of student control class answers can be seen in Fig. 3.

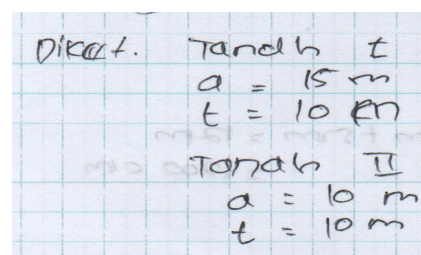


Fig. 3. Answers to Mathematical Problem Solving Students in the Control class



The experimental class student has formulated the problem exactly as shown in Fig. 4

b. ditanya : a. luas tanah  
b. harga tanah Rp. 50.000/m<sup>2</sup>

Fig. 4. Mathematical Problem Solving Problem Student in Experiment class

Likewise with students of control classes. Students have been able to formulate the problem appropriately. Here are the results of students' control class answers can be seen in Fig. 5.

ditanya : luas tanah ?  
harga tanah jika Rp. 50.000 / m<sup>2</sup> ?

Fig. 5. Mathematical Problem Solving Problem Student in Control class

In answering the question, the students of the experimental class are very detailed in the translation. Students have been able to choose the right strategy target according to the problems that have been formulated. As in Fig. 6.

c. jawab : a. luas tanah  $= a \times l$   
 $= 15 \text{ m} \times 10 \text{ m}$   
 $= 150 \text{ m}^2$   
luas tanah II  $= \frac{a \times l}{2}$   
 $= \frac{10 \times 10 \text{ m}}{2}$   
 $= \frac{100 \text{ m}^2}{2}$   
 $= 50 \text{ m}^2$   
luas tanah  $= 150 \text{ m}^2 + 50 \text{ m}^2 = 200 \text{ m}^2$   
b. harga tanah  $= 200 \text{ m}^2 \times \text{Rp. } 50.000$   
 $= \text{Rp. } 10.000.000$

Fig. 6. Answers on Mathematical Problem Solving Students in the Experiment class

Another case with control class students. The selection strategy used by the average of all students is counting one by one. It can be seen in Fig. 7.

a. Tanah I  $= a \times l$   
 $= 15 \text{ m} \times 10 \text{ m}$   
 $= 150 \text{ m}^2$   
Harga  $= 50.000 \times 150 \text{ m}^2$   
 $= \text{Rp. } 7.500.000$   
b. Tanah II  $= a \times l$   
 $= \frac{10^2 \text{ m} \times 10 \text{ m}}{2}$   
 $= \frac{100 \text{ m}^2}{2}$   
 $= 50 \text{ m}^2$   
Harga II  $= 50.000 \times 50 \text{ m}^2$   
 $= \text{Rp. } 2.500.000$

Fig. 7. Answers on Mathematical Problem Solving Students in the Control class

In the indicators explain or interpret the results according to the problem of origin, the students of the experimental class only reinforce the answer according to the problems that have been formulated. The work of the students can be seen in Fig. 8.

Jadi luas tanah adalah  $200 \text{ m}^2$  dengan harga Rp. 10.000.000.

Fig. 8. Answers on Mathematical Problem Solving Students in the Experiment class

While the control class is still doing calculations at this stage. The work of students can be seen in Fig. 9.

Harga tanah seluruhnya  $= 7.500.000$   
 $+ 2.500.000 = \text{Rp. } 10.000.000$   
dan luas keseluruhan  $= 150 \text{ m}^2 + 50 \text{ m}^2$   
 $= 200 \text{ m}^2$

Fig. 9. Answers on Mathematical Problem Solving Students in the Control class

RME is an approach that trains students more actively and creatively in constructing and expressing their ideas because what students learn is what students experience. In the RME, the problem raised comes from the real world. Problem solving is done in its own way instead of applying the existing way, where the problem is solved by the students themselves. By identifying issues that are close to the student's daily life or that are within the student's mind, the student will understand the problem better, so that the student will more easily solve the problem. RME makes students more responsible in answering questions by giving reasons[17].

In conventional learning also begins with problems. But activities on learning have not constructed the students' knowledge to solve the problems themselves. Where the material described by the teacher makes the students with low recall ability less able to construct the mathematical idea it possesses. Control class students tend to be able to solve the same problems that teachers have modeled while the ability of students to solve the problem of problem solving is mostly still lacking. From the above explanation it can be said that it is these things that lead to problem solving skills of students who are taught with a higher RME approach than students taught by conventional approaches.

This finding is similar to that of Ahmad Fauzan and Yerizon. The result of the study explains that students' problem solving abilities taught by RME are better than conventionally taught students. Thus, it can be interpreted that RME learning has an effect on improving students' problem solving skills, especially in grade 4 elementary school students.

In the results of the above research appears important. First, the students' mathematical problem-solving abilities that follow the learning with the RME approach are better than those that follow conventional learning. Second, students' mathematical problem solving skills with high, medium, and low learning independence that follow the learning with RME approach is better than those that follow conventional learning. Third, there is no interaction between

the RME approach and the learning independence in influencing students' mathematical problem-solving abilities.

#### IV. CONCLUSIONS

Based on the results of research and discussion it can be concluded that the RME approach gives a better influence than the conventional approach in improving students' mathematical problem solving abilities. This conclusion also applies to students with high, medium, and low self-regulated learning. There is no interaction between learning approaches and learning independence in influencing students' mathematical problem solving abilities.

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