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The Effectiveness of the Problem Based Learning Model with a Realistic Mathematics Education Approach to Problem Solving Ability

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ABSTRACT

Based on a preliminary study at SDN Karangsono 1 that students had difficulty to solve problem-solving questions or questions presented in the form of stories, especially geometric material. The purpose of this study was to determine the ability to solve mathematical problems with the PBL model with the RME approach better than the PBL learning model. This study used a quantitative design with an experimental class and a control class. Data collection techniques used are tests and non-tes. The data analysis technique in this research is prerequisite test and hypothesis test. The results of this study were that the average mathematical solving ability of students using the PBL model with the RME approach is better than using the PBL model alone. This can be proved from the experimental class, the average indicator 1 during the pretest is 70 and when the posttest becomes 77, in indicator 2 during the pretest the average is 60 and becomes 73 during the posttest, in indicator 3 during the pretest the average is 50 and becomes 80 during the posttest, on the other hand in indicator 4 during the pretest the average is 53 and becomes 73 during the posttest. Meanwhile, in the control class in indicator 1 the average pretest was 50 and it became 65 during the posttest, in indicator 2 the average during the pretest was 60 and it became 70 during the posttest, in indicator 3 the average was 50 and it became 60 when posttest, and on indicator 4 the average is 55 to 60 during the posttest. This shows that students' mathematical problem-solving skills in the experimental class are better than those in the control class.

Keywords: *Mathematical Problem-Solving Ability, Model PBL, RME Approach*

INTRODUCTION

Education becomes an important role in preparing human resources for life in the future. Education is able to provide the student's skill and expertise which can support the future careers for the students through the concept of learning in schools. Mathematics is one of the subjects which students must learn through some efforts and activities in learning. So that students can develop their mindset, and can solve their problems in everyday life. Learning mathematics is an attempt to help students construct knowledge through a process. This is linked with what was stated by Bruner (Dahar, 2011) who considered that discovery learning is in accordance with the active search for knowledge by humans and by itself provides the best results. Trying alone to find solutions to problems and the knowledge that accompanies them, produces knowledge that is truly meaningful. Bruner suggested that students should learn through active participation with concepts and principles so that they are encouraged to gain experience and carry out experiments that allow them to discover the

principles themselves. For that students are given the opportunity to construct their own knowledge that must be owned, because by giving opportunities to students is a strategy for students to interact in study groups.

Based on a preliminary study at SDN Karangsono 1 that students had difficulty to solve problem-solving questions or questions presented in the form of stories, especially geometric material. The teacher conveyed to the researcher that students in working on problem solving questions still felt confused and could not understand the questions correctly so they could not find a strategy to use in solving the problems. In working on questions, students are often lazy to read questions and find it difficult to understand the initial concept of solving geometric shapes, especially in story problems.

The low ability of students in solving problems in learning mathematics, it might be caused because in learning students are not confident in what they have done. The ability of students in learning mathematics is not only influenced by factors of mathematical intelligence. However, learning activity factors and self factors also influence students' mathematical abilities. 5 influence factor of self (self) on students' mathematical abilities was revealed by Ma & Kishor as cited by Kadijevich (2008) that there is a positive interaction between mathematics attitude and mathematics achievement. There is also a positive relationship between self-concept about mathematics and achievement in mathematics. This means that there is a positive relationship between self-concept about mathematics and mathematics achievement. The intended self-concept about mathematics is self-confidence in learning mathematics, liking mathematics, and believing in the usefulness of mathematics. Therefore, we need a mathematics learning that can involve students actively and can stimulate the growth of students' self-confidence so that students can gain optimal results of learning mathematics.

In the 2013 curriculum requires students to play an active role in the learning process. Based on Permendikbud Number 103 of 2014 and Permendikbud Number 22 of 2016 the 2013 curriculum learning model highlights activity and creativity, inspiring, fun and initiative, student-centered, authentic, contextual, and meaningful for students' everyday lives. Learning models in the 2013 curriculum include: Discovery Learning, Inquiry Learning, Problem Based Learning, Project Based Learning and other cooperative learning models.

In this research, the model used is Problem Based Learning (PBL). PBL presents authentic problems to be formulated and solved together in groups. PBL is a learning model which uses real problems as a context for students to learn critical thinking skill, problem solving skill, and the essential knowledge or concepts from learning materials. According to Arends (2007), PBL is learning that has the essence of presenting various authentic and meaningful problem situations to students. Matthew (2012) stated that problem-based learning is a student-centered method of teaching that involves learning through original problem solving.

PBL can focus students on the learning process and activate students to solve problems through applications. PBL can also support a fun and student-centered mathematics learning process. Students are given the opportunity to find problems around them that can be used as problems in the learning process. Students are given the opportunity to think about solving the problem through discussion with their classmates, thereby training students to think critically. As the opinion of Abanikannda (2016) that with PBL, students become more experienced in collecting, organizing, and storing information that can be used for the future, facing and solving complex and realistic problems. This is supported by research from Gunantara (2014) which revealed that the application of the Problem Based Learning (PBL) learning model can improve problem

solving abilities, namely from cycle I to cycle II of 16.42% of the criteria being high. The results of the study show that the Problem Based Learning (PBL) learning model can improve problem solving abilities in Mathematics.

Research on PBL conducted by Padmavaty (2013) shown that problem-based learning has the effect of increasing student understanding and the ability to use concepts in students' real lives, Sahyar (2017) shown that the problem-solving abilities of students who use problem-based learning models are more better than conventional and self-regulated learning students in problem-based learning is better than conventional learning, and Suarjana (2014) shows that the PBL learning model can improve problem-solving abilities in mathematics.

The application of the PBL learning model can train students to be more confident in solving problems. Research on PBL conducted by Masitoh (2018) concluded that PBL can increase students' self-confidence, while Lintang (2017) showed that the indicators of self-confidence of experimental class students increased which belonged to the medium criteria.

In connection with the approach used in learning mathematics, it is necessary to use an approach that is oriented to real events in society, so that students are able to communicate material well. The approach that is considered appropriate for the existing problems is PMRI or an approach adapted from RME. Realistic mathematics education is the mathematics subject which is learned in schools, by placing the reality and experiences of students as the starting point of learning. The problems used as learning resources are problems that can encourage problem solving activities, finding problems, and organizing the subject matter. Realistic mathematics basically makes use of reality or concrete things that students can observe or understand by imagining. The students can imagine the environment or everyday life which means the environment where students are, whether in the family, school or community environment which can be understood by students.

Realistic mathematics learning is the starting point in learning that is contextual in the environment of the students, so that they are able to solve problems in accordance with experiences in their lives. The RME approach used is expected to be able to make students communicate material easily because the problems presented are closely related to their daily lives.

Based on that thing, the purpose of this research is to determine the ability to solve mathematical problems with the PBL model with the RME approach is better than the PBL learning model.

MATERIALS & METHODS

This study used a quantitative design with an experimental class and a control class. The population in this study were fifth grade students at SDN Karangsono 1 for the 2021/2022 academic year. The population consisted of 87 fifth grade students at SDN Karangsono 1. Then the sample was selected using a purposive sampling technique, with the consideration that the class has the same or balanced number of students. Classes VA and VB were selected, each of which consisted of 30 students. Then randomly determined class VA as the experimental class and VB as the control class. Data collection techniques used were tests and non-tes, the methods used were observation, interviews, with observation sheet instruments, interview sheets, while the test technique used problem solving instruments. The data analysis technique in this research was prerequisite test and hypothesis test. The hypothesis test used consists of an effectiveness test.

RESULT

The difference in treatment in the experimental class and the control class was in the learning that is carried out. In the experimental class, students were taught using the PBL model with the RME approach while in the control class, students

were taught using the PBL model only. Indicators of students' mathematical problem-solving abilities used were; (1) understand the problem; (2) develop a solution plan; (3) do solution plan; and (4) examine the solution plan.

These following were the students' mathematical problem-solving abilities in the experimental class presented in Table 1.

Table 1. Students' Mathematical Problem-Solving Ability for Each Indicator

No	Indicators of Students' Mathematical Solving Ability	Pretest Average Score	Posttest Average Score
1	understand the problem	70	77
2	Develop a solution plan	60	73
3	Do solution plan	50	80
4	Examine the solution plan	53	73

For more details, it can be seen in Figure 1 related to the experimental class of the students' mathematical problem solving abilities.

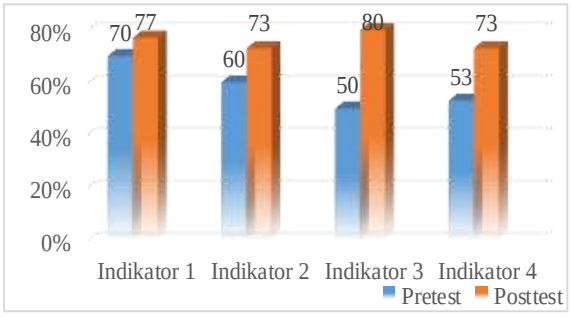

Figure 1. Experiment Class of Students' Mathematical Problem-Solving Ability

Based on the data in Figure 1, the first indicator of students' mathematical problem-solving ability can be achieved by 70% of students on the pretest results and increases to 77% of students who were able to answer questions according to indicator 1 on the posttest results. Indicators of students' mathematical problem-solving ability 2 can be achieved by 60% of students on the pretest results and increased to 73% of students who are able to answer correctly on the posttest results. Indicators of students' mathematical problem-solving ability 3 can be answered correctly by 50% of students during the pretest and increased to 80% of students who answered correctly during the posttest. Indicators of students' mathematical problem-solving ability 4 can be answered correctly by 53% of students during the pretest and increased to 73% who are able to answer correctly during the posttest.

Furthermore, following are the mathematical problem-solving abilities of students in the control class presented in Table 2.

Table 2. Students' Mathematical Problem-Solving Ability for Each Indicator

No	Indicators of Students' Mathematical Solving Ability	Pretest Average Score (%)	Posttest Average Score (%)
1	Understanding problem	50	65
2	Develop a solution plan	60	70
3	Do solution plan	50	60
4	Checking solution plan	55	60

For more details, it can be seen in Figure 2 related to the control class of the students' mathematical problem solving abilities.

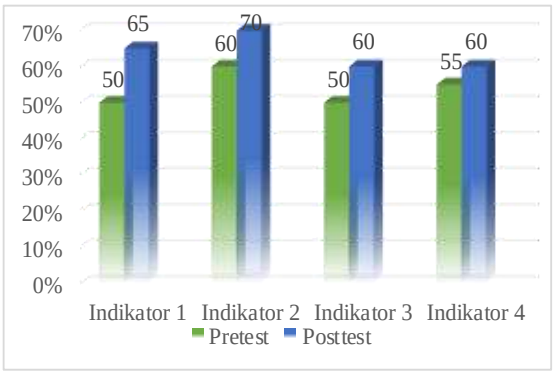

Figure 2 Experiment Class of Students' Mathematical Problem-Solving Ability

Based on the data in Figure 2, the first indicator of students' mathematical problem-solving abilities can be achieved by 50% of students on the pretest results and 65% of students are able to answer the questions according to indicator 1 on the posttest results. Indicators of students' mathematical problem-solving ability 2 can be achieved by 60% of students on the pretest results and 70% of students who were able to answer correctly on the posttest results. Indicators of students' mathematical problem-solving ability 3 can be answered correctly by 50% of students during the pretest and 60% of students who answered correctly during the

posttest. Indicators of students' mathematical problem-solving abilities 4 can be answered correctly by 55% of students during the pretest and increased to 60% who were able to answer correctly during the posttest.

Based on the results of students' mathematical problem-solving abilities for each indicator in the experimental class and control class it can be seen that the experimental class or class taught using the PBL model with the RME approach has better mathematical problem solving abilities compared to the control class which is taught using the PBL model only.

Next, a hypothesis test is carried out, namely;

a) Test Sample t-Test

This test is used to determine the average difference of the experimental class and the control class related to the ability of the students'mathematical problem solving.

The criteria used to reject or not reject H0 based on the P-value are as follows.

1) If P-value > α, then H0 is accepted.

2) If the P-value ≤ α, then H0 is rejected.

The result of the sample t-test of students' mathematical problem solving abilities can be seen in Table 3.

Table 3 Test Sample t-Test

Sig 2 tailed	α	Mean		Description
		Experi-ment	Con-trol	
0,00	0,05	81.76	70.02	There is difference in the average of problem solving ability

Based on the data obtained in Table 3, it can be seen that the Sig. shows a result of 0.00 <0.05 which means H0 is rejected. There is a difference in the average of students' mathematical problem solving abilities in the experimental and control classes. The mean result also shows that the students' average mathematical problem solving ability in the experimental class is higher than the control class.

b) N-Gain Test

The N-Gain test is used to determine the difference of the students' mathematical problem solving ability from pretest to posttest. The results of the N-Gain test can be seen in Table 4.

Control Class	Experiment Class
Average N-Gain	
0.24	0.43
Category	
Sufficient	Moderate

Based on the data in Table 4, it can be seen that the N-Gain average of the students' mathematical problem solving ability in the control class is 0.24 in the sufficient category and 0.43 in the experimental class in the medium category. Based on the result, it can be seen that the proportion of the completeness of the students' mathematical problem-solving ability in the experimental class who were taught using the PBL model with the RME approach was better than the control class which was taught only using the PBL model.

Problem solving is a process to overcome various difficulties in achieving a goal. Students in learning mathematics must have problem solving skills (Sumartini, 2018). Based on the results of the study, students' mathematical problem-solving skills in the experimental class were better than those in the control class. This is because the experimental class is given learning using the PBL model with the RME approach.

The indicators used to measure students' mathematical problem-solving abilities were; (1) understand the problem; (2) develop a solution plan; (3) do solution plan; and (4) examine the solution plan. In the experimental class, the average indicator 1 during the pretest was 70 and when the posttest became 77, in indicator 2 during the pretest the average was 60 and became 73 during the posttest, in indicator 3 during the pretest the average was 50 and became 80 during the posttest, on the other hand in indicator 4 during the pretest the average was 53 and becomes 73 during the posttest. Meanwhile, in the control class in indicator 1 the average pretest was 50 and it became

65 during the posttest, in indicator 2 the average during the pretest was 60 and it became 70 during the posttest, in indicator 3 the average was 50 and it became 60 when posttest, and on indicator 4 the average was 55 to 60 during the posttest. This shown that students' mathematical problem solving skills in the experimental class are better than those in the control class.

Learning with the Problem Based Learning (PBL) learning model with the RME approach has been carried out in 3 meetings with increasing progress at each meeting. At the 1st meeting the teacher was not able to get students actively involved in the learning process. All students worked on the problems given by the teacher but from the results of seeing their friends' answers, only a few people found their own solutions. At the 2nd meeting, the teacher was also not fully able to make students active in problem solving. But students who found solutions to solve the problem had increased from the previous meeting. At the 3rd meeting, here the teacher saw that there had been interaction between groups to solve problems and students were enthusiastic in the learning process.

In the control class, it appeared that in learning the students were less enthusiastic, students are confused when faced with a problem that will find a solution. Students were also passive when participating in learning because interaction between friends is still not related to learning. In learning that was only given the PBL model without using an approach that was relevant to the mathematics material, it turned out that students were confused about following it. This is the reason why students' mathematical problem-solving abilities in the experimental class are better than those in the control class, plus the experimental class with the RME approach is given learning media that was concrete and easily understood by students.

The results of this study are in line with the results of research conducted by Saprizal (2018) & Mulyati (2017) in their research stating that abstract mathematical concepts are more easily digested by students based on learning media in their surroundings.

DISCUSSION

This research was also conducted by Fadhilah et. al. (2018) and Akbar et.al. (2015) there is a relationship between the implementation of family functions and the teacher providing guidance and direction for learning to have a vital role in guiding, directing, and educating students in the learning process or in the daily scope of the family. Dewi. (2020) stated that the impact of COVID-19 on the implementation of online learning in elementary schools can be carried out well. So that learning is now learning at home by using various applications such as the teacher's room, class room, zoom, google doc, google from, or through the WhatsApp group.

The results of research conducted by Badawi (2019) Good character education is education by integrating subjects with akhlakul karimah which are based on religious teachings and are carried out with compassion, patience, exemplary, wise advice and allow it to be implemented in daily life.

Several studies from Khofifah (2017), Setyowati (2009); Nurul et.al. (2015), Surya et.al. (2018) with the aimed of research to find out the urgency and influence of manners and courtesy for students. The results of the study have the character of honesty, the value of harmony, the value of courtesy, the value of discipline and the value of cooperation that has been carried out properly.

CONCLUSION

The conclusion of this study was that the average mathematical solving ability of students using the PBL model with the RME approach was better than using the PBL model alone. This appeared from the experimental class, the average indicator 1 during the pretest was 70 and when the posttest becomes 77, in indicator 2 during the pretest the average was 60 and becomes 73 during the posttest, in indicator 3 during

the pretest the average was 50 and becomes 80 during the posttest, whereas in indicator 4 during the pretest the average was 53 and becomes 73 during the posttest. Meanwhile, in the control class in indicator 1 the average pretest was 50 and it became 65 during the posttest, in indicator 2 the average during the pretest was 60 and it became 70 during the posttest, in indicator 3 the average was 50 and it became 60 when posttest, and on indicator 4 the average was 55 to 60 during the posttest. This shown that students' mathematical problem-solving skills in the experimental class were better than the control class.

Declaration by Authors
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Conflict of Interest: The authors declare no conflict of interest.

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