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THE EFFECT OF REALISTIC MATHEMATICS EDUCATION ON ELEMENTARY SCHOOL STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITIES

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ABSTRACT

This study aims to examine the influence and the degree of effectiveness of Realistic Mathematics Education (RME) on the mathematical problem-solving abilities of elementary school students. Employing a quantitative approach, the research utilized an experimental method with a one-group pretest–posttest design. The participants consisted of fourth-grade students at State Elementary School Telaga Tujuh Langsa. Data were collected through problem-solving tests and analyzed using paired sample t-tests and the eta-squared effect size formula. The findings indicated a significant influence of RME on students' problem-solving abilities, as evidenced by a $t_{count} > t_{table}$, which was 15.961 >1.753. Furthermore, the eta-squared coefficient was calculated at 0.944, suggesting a very high level of influence. These results demonstrate that RME is highly effective in enhancing the mathematical problem-solving skills of elementary school students

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1. INTRODUCTION

The Indonesian government underscores the importance of orienting mathematics education toward the development of students' problem-solving abilities. As articulated in the Content Standards of the 2006 Curriculum, a problem-solving approach serves as a central focus in mathematics instruction, encompassing closed problems with a single solution, open-ended problems with multiple solutions, and problems that allow for various solution strategies (Depdiknas, 2006).

Hudojo (2001) also emphasized the vital role of mathematics education in preparing future experts in science, technology, and urban planning. This assertion highlights the significance of mathematics instruction across all educational levels as a foundational tool for equipping students to meet the demands of a rapidly evolving world. Given that elementary school represents the initial stage of formal education, special attention must be paid to mathematics instruction at this level to prevent the emergence of foundational learning gaps that could hinder students' academic progression.

In the perspective of education, especially in mathematics education, the paradigm that brings up problem-solving skills through appropriate strategies must be maintained. However, in Indonesia, this paradigm has not attracted much attention from teachers in managing the mathematics education process. In addition, learning in elementary schools tends to be text-book oriented, and is less connected to students' daily lives. In learning, students' activities are more focused on listening to teacher explanations and taking notes, studying mathematics directly from its symbols. The teaching and learning process still tends to be teacher-centered and not many have implemented student-centered. Meanwhile, most teachers still pay less attention to students' thinking skills and the teaching methods used are less varied.

The statement shows that although problem-solving skills are the focus of the government in mathematics education, in reality students' problem-solving skills are rarely considered by teachers. Teachers often only teach using the old paradigm, namely teacher-centered mathematics education that does not facilitate diversity of opinions and opportunities for students to solve a problem.

Empirical evidence from the fourth-grade class at State Elementary School Telaga Tujuh Langsa similarly indicates that students' mathematical problem-solving abilities remain critically low. In a class comprising 20 students, a diagnostic test was administered to assess their problem-solving skills. The results revealed that 16 students were categorized as "unable," four students as "less able," and none were classified as "able." Furthermore, the data suggest that the instructional approach predominantly employs a teacher-centered model. The learning process has not been oriented toward real-life contexts relevant to students' daily experiences, nor has it adequately addressed or fostered the development of students' problem-solving competencies.

Lady et al. (2018) stated that Realistic Mathematics Education (RME) is a mathematics education model based on reality and the environment around students. Teachers try to present learning by utilizing real examples that can be seen or experienced by students. Lauren et al. (2018) and Fauzan et al. (2017) stated that the principles of RME learning are as follows: (1) activity-based, teachers must be able to encourage students to be physically and mentally active; (2) reality-based, lessons begin by raising real problems around the student's learning environment; (3) problem-solving in stages, students are directed to carry out certain stages to solve problems; (4) connectedness, showing the relationship between one mathematical concept and another, not separately; and (5) social interaction, mathematics education activities to be able to create social relationships between teachers and students so that learning takes place interactively, actively, and enjoyably.

Based on the description above, it is necessary to conduct research on optimizing the ability of elementary school students in solving mathematical problems through a learning paradigm that orients students to solve problems that are close to student experience through realistic learning. One thing that can be done is to examine the effect of realistic mathematics education on elementary school students' mathematical problem-solving abilities.

Papadakis (2021) stated that the RME learning model is related to mathematical concepts, critical thinking skills, creative thinking, and problem-solving. Warsito et al. (2018) also argued that the RME learning model provides the widest possible opportunity for students to build their own knowledge through the process of solving the problems given. Furthermore, Ndiung et al. (2021) said that RME has advantages and disadvantages. The advantages of the RME model include: (1) students are more active and independent in finding concepts and theories in learning, so that they are able to connect these concepts with

everyday life; (2) RME is also able to increase seriousness in learning because learning is activity-based, so that all students are actively involved in learning. On the other hand, there are several disadvantages of RME, namely: (1) teachers are reluctant to prepare a better teaching concept to teach more creatively; (2) teachers have difficulty enriching learning media based on real objects that are in accordance with the concepts to be studied.

According to Polya (1973), problem-solving is an effort to find a way out of a difficulty to achieve a goal that cannot be achieved immediately. In line with this opinion, Hudojo (2001) added that a question will be a problem only if students do not have certain rules or laws that can be used immediately to find the answer to the question. Mathematics is concerned with abstract ideas or concepts that are arranged hierarchically and the reasoning used is deductive (Hudojo, 1988)

Thus, in the context of students solving math problems, it can be seen that the ability to solve math problems is the ability of students to find solutions to math problems that cannot be solved immediately or whose solutions are not yet clear. Solving math problems has an abstract nature and is arranged hierarchically. Polya (1973) stated that there are four steps that must be taken in problem-solving, namely (1) understanding the problem, (2) planning a solution, (3) implementing the solution plan, and (4) checking the solution again. The explanation is as follows:

1) Understanding the problem
   Ask students to repeat the question and students should be able to state the question fluently, and explain the most important parts of the question which include: what is being asked? what data is known? and what are the requirements?
2) Planning a solution
   To answer the problem asked, students must make a plan to solve the problem, collect information or existing data and connect it with several related facts that have been studied before.
3) Solving the problem
   Students solve the problem according to the solution plan; students must be sure that each step is correct.
4) Rechecking the results obtained
   By rechecking the obtained results, they can strengthen their knowledge and develop their ability to solve problems, students must have the right reasons and be sure that the answer is correct, and mistakes are very likely to occur so that rechecking needs to be done.

2. RESEARCH METHODOLOGY

This study uses a quantitative approach with an experimental research type and uses a pre-experimental design because in addition to realistic mathematics education as an independent variable, there are still external variables that affect the ability to solve mathematical problems as dependent variables. The form of pre-experimental designs used is one-group pretest-posttest designs (Sugiono, 2013).

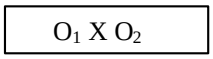

Figure 1 Research Design Caption

O_1 = Pretest score (before realistic mathematics education is implemented)

X = Treatment (implementation of realistic mathematics education)
O_2 = Posttest score (after realistic mathematics education is implemented)

Population is all subjects in the study (Arikunto, 2006), the population of this study is all fourth-grade students of State Elementary School Telaga Tujuh Langsa in the 2024/2025 academic year totaling 20 students. Meanwhile, the sample is part of the subjects or representatives of the population being studied (Arikunto, 2006). This study is a population study because all students are used as research subjects (Arikunto, 2006). Thus, the population members and samples of this study are the same. According to Sugiono (2013), if all members of the population are used as samples, then the sampling technique used is saturated sampling. The researcher uses this technique because the researcher wants to make generalizations with very small errors.

The data collection technique for this research uses tests, according to Arikunto (2006) to measure the presence or absence and extent of the ability of the object being studied, tests are used. In this research, the test is intended to obtain data. Regarding students' mathematical problem-solving abilities before and after being given treatment in the form of realistic mathematics education. The test was given to students through a mathematical problem-solving instrument that the researcher created based on Polya's problem-solving steps, namely understanding the problem, planning a solution, implementing the plan, and rechecking the answers. To measure students' problem-solving abilities, the writer used a scoring rule developed by Upu based on Polya's problem-solving steps. Furthermore, to interpret mathematical problem-solving abilities, the writer converted the students' total scores into a value interval of 0-100 with a value interval of 0-100, the writer can group the level of students' problem-solving abilities based on the total score obtained in solving the problems in Table 1.

Table 1. Math Problem-solving Ability Level

Interval Score	Level Ability
$69 < L \leq 100$	Competent Quite
$31 < L \leq 69$	Competent Not
$0 \leq L \leq 31$	Competent

Information:
L = Problem-solving Ability Level

The instrument for measuring students' mathematical problem-solving abilities is in the form of a test. The Problem-Solving Ability Test instrument must have valid and reliable criteria before being used in order to obtain valid and reliable data on students' mathematical problem-solving abilities. To test the validity and reliability, the researcher tested it in a higher class at State Elementary School Telaga Tujuh, which is in sixth-grade students. The validity test used was construct validity with factor analysis which was first carried out by expert judges (expert consultation), while the reliability test used the Cronbach Alpha technique with a significance level of 5%. The construct validity test of the problem-solving ability test with 4 factors and 10 essay questions, and a sample size of 20, obtained a correlation coefficient of 4 factors and 16 questions of more than 0.30. The factors in question are indicators of problem-solving ability, namely understanding the problem (factor 1), planning a solution (factor 2), implementing the solution (factor 3), and re-checking the

solution (factor 4). While the reliability test obtained an Alpha value> r table at a significance level of 5%, namely 0.964> 0.444. So, this test has a valid and reliable construction and questions to measure mathematical problem-solving ability.

Before conducting data analysis through hypothesis testing to determine whether or not there is an effect after being given treatment in the form of realistic mathematics education on problem-solving ability, the researcher conducted a prerequisite test, namely a data normality test to determine whether the population from which the problem-solving ability data was taken was normally distributed. With a normality test using the chi-square formula, the criteria used were if the value $X^2 > X^2$ table then the population is not normally distributed. Conversely, if the value of $X^2 < X^2$ table then the population is normally distributed (Arikunto, 2006).

From the normality test, it was found that $X^2_{count} < X^2_{table}$ namely 9,900 < 11,070. with degrees of freedom 6-1=5 and a significance level of 5%, so that the data used is normally distributed data. The research hypothesis test conducted by the researcher used the Arikunto (2006) t-test formula. Realistic mathematics education is said to have an effect on the ability to solve mathematical problems if t count > t table at a significant level of 5%, conversely if t count ≤ t table at a significant level of 5% then realistic mathematics education is said to have no effect on the ability to solve mathematical problems. To determine the level of influence of realistic mathematics education on problem-solving abilities, calculation steps were carried out according to Pallant (2011).

3. RESULTS AND DISCUSSION

The results of data analysis to determine the effect of realistic mathematics education on mathematical problem-solving ability can be seen in Table 1.4. In the Table, the average pretest value of students was 25.00, meaning that before being given treatment in the form of realistic mathematics education, the average mathematical problem-solving ability of students was at the unable level. While the posttest value of students was 75.25, meaning that after being given treatment in the form of realistic mathematics education, the average mathematical problem-solving ability of students was at the able level. This interprets that there was an increase in students' mathematical problem-solving ability after being given treatment in the form of realistic mathematics education.

The results of the t-test formula calculation obtained a t count of 15.961, while the t table value at a significance level of 5% was 1.753, so it can be concluded that t count > t table, which means that realistic mathematics education has an effect on students' mathematical problem-solving abilities. From the calculation results using the eta squared formula, the eta squared value is 0.944. The value of 0.944 is at a high level of influence. This showed that realistic mathematics education has a large influence on students' mathematical problem-solving abilities.

Table 2. Realistic Mathematics education on Mathematical Problem-solving Ability

Information	Pretest	Postest	Gain (d)	Md	x^2d	n	t_{hitung}	t_{tabel}
Total Value	368	1156	788	49,25	37,75	20	15,961	1,753
Mean	25,00	75,25						
Level	Not Competent	Competent						

Information:	d	: difference between posttest and pretest scores
	Md	: mean of deviation (d) between post-test dan pre-test
	x^2d	: sum of the squares between the differences of the deviations and the mean
	n	: many subjects

Through realistic mathematics learning, students are able to independently use their knowledge to solve new and previously unseen problems, and have more responsibility for their learning along with the increase in students' experience and knowledge. In mathematics subject, there is a problem-solving process. So the first thing students must do is understand the questions asked and then students must think of a strategy to answer the question using their own logic. Problem-solving skills are important for students to have because in everyday life students will always encounter what is called a problem (Ertikanto, 2016). This shows that if realistic mathematics learning is applied by teachers to facilitate students periodically and continuously, it can increase students' problem-solving skills, especially in mathematics subjects. The results of this study are in line with (Rosyada et.al, 2019) From the results obtained, it can be concluded that the realistic mathematical education (RME) learning model has a better influence on the problem-solving abilities of fifth grade elementary school students.

Conclusions

Based on data analysis and discussion, it can be concluded as follows: there is an influence of realistic mathematics education on the problem-solving abilities of elementary school students. Meanwhile, realistic mathematics education has a high level of influence on the problem-solving abilities of elementary school students.

Acknowledgements

It is expected that this research can provide input for educators, especially for educators who will teach mathematics. Because it actually covers mathematics education is on students' problem-solving abilities. Furthermore, many students are not interested in mathematics, so students should be facilitated with realistic mathematics education so that students' problem-solving abilities can be developed and students are motivated by the existence of problem-solving through activities experienced by themselves and close to their lives.

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