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The Influence of a Realistic Mathematics Education Approach on Students' Mathematical Problem Solving Ability

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ABSTRACT

Purpose of the study: The purpose of this research is to determine the effect of a realistic mathematics education approach on students' mathematical problem solving abilities.

Methodology: The method used was a quasi-experiment with a post-test only research design. Sampling was carried out using the cluster random sampling technique. The research instrument given was a test with a description type of 5 questions. Data analysis using the t-test from both groups obtained a t value of 4.47 , while t table was at a significance level of 5% with degrees of freedom (dk) = 47.09, namely 1.68, so it can be said that $t_{count} > t_{table}$.

Main Findings: The results of hypothesis testing using the "t test" for heterogeneous samples obtained t = 4.47 and t table = 1.68, with a significance level of α = 5% and degrees of freedom (dk) = 47.09. This data shows that H 0 is rejected and H 1 is accepted or in other words the mathematical problem solving ability of students in the experimental group is higher than the mathematical problem solving ability of students in the control group.

Novelty/Originality of this study: Research on the effect of the Realistic Mathematics Education approach on students' mathematical problem solving abilities shows significant improvements in students' analytical and applied skills, opening new avenues for more effective teaching methods in schools. Apart from that, this approach not only improves mathematical abilities but also enriches students' learning experiences through a more real and relevant context.

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1. INTRODUCTION

Education is a need that must be fulfilled in the life of society, nation and country. The government has declared education as an instrument to build a better Indonesian nation and state . The progress and decline of a nation is determined by the educational creativity of the nation itself and the complexity of life's problems requiring human resources who are reliable and capable of competence [1], [2] . Apart from that, education is a forum for activities that can be seen as producing high quality human resources [3], [4] . Education at school includes many aspects, one of which is the subjects presented or determined.

One of these subjects is mathematics. Mathematics is a part of science that has an important role in shaping the quality of human resources [5], [6] . The quality of mathematics education must continue to be

improved as an effort to form high quality human resources, namely people who are able to think critically, logically, systematically, creatively, innovatively, and take the initiative in responding to problems that occur [7]–[9] . However, the fact that needs to be faced is that mathematics is difficult for students to understand and there are many problems they face.

These problems are of course not all mathematical problems, but mathematics has a very central role in answering everyday problems. This means that mathematics is needed by everyone in everyday life to help solve problems [10], [11] . In students' minds and imaginations before studying mathematics are formulas, calculations and various mathematical operations, students are required to understand all these aspects in order to graduate from school [12], [13] . TIMSS data shows that the emphasis in mathematics learning in Indonesia is more on mastering basic skills, but there is little or no emphasis on applying mathematics in the context of everyday life.

The best possible solution needs to be designed and paid attention to by the educational unit, so that educational goals are achieved well and in line with targets. Teachers are required to be able to process classes better and selectively choose the right approach for students in mathematics subjects [14], [15] . The Realistic Mathematics Approach is a mathematics learning method that emphasizes the application of mathematical concepts in the context of everyday life or real situations [16], [17] . This approach aims to provide a better understanding of mathematical concepts by connecting them with real-world experiences.

With a more concrete approach, it can encourage students to improve their problem solving abilities. Problem solving ability is a person's ability to identify, analyze and solve problems in an effective and efficient way [18], [19] . It involves several cognitive aspects, analytical skills, and contextual understanding. Someone who is good at problem solving can face various challenges with confidence and is able to produce effective solutions [10] . This ability is also closely related to the development of critical and analytical thinking skills.

GAP analysis by Rosidah [20] aimed to analyze students' problem solving abilities in physics subjects. Meanwhile, this research was renewed with the aim of measuring the effect of a realistic mathematical approach on students' problem solving abilities in mathematics subjects. The variables used are also more updated and were carried out on different research samples. The limitation of this research is that it only focuses on research measuring influence without providing feedback to improve these abilities. So, recommendations can be given for further research to carry out research designs aimed at improving students' abilities in mathematics subjects.

The novelty of this research is that this research reveals that the Realistic Mathematics Education (RME) approach significantly improves students' abilities in solving mathematical problems, showing great potential to revolutionize mathematics teaching methods in the classroom. By applying a Realistic Mathematics Education approach, this research found marked improvements in students' mathematical problem-solving abilities, highlighting the effectiveness of RME as an innovative and practical teaching strategy.

This research is important to conduct in order to understand how a realistic mathematics education approach can improve students' abilities in solving mathematical problems, so that it can help in designing a more effective and relevant curriculum. By conducting this research, we can obtain empirical data that can be used as a basis for developing more contextual and applicable learning methods, which not only improve students' mathematical skills but also prepare them to face real world challenges. The purpose of this research is to determine the effect of a realistic mathematics education approach on students' mathematical problem solving abilities.

2. RESEARCH METHOD

2.1. Research Type

The research method used is a quasi-experimental research method. This method has a control group, but cannot fully function to control external variables that influence the implementation of the experiment. Quasi-experimental research is research that approaches a real experiment where it is impossible to control/manipulate all relevant variables, there must be a compromise in determining internal and external validity in accordance with existing limitations [21], [22]

This research uses a posttest only research design. In this design there are two groups, each selected randomly (R). The first group was given treatment (X) and the other group was not. The group that is treated is called the experimental group and the other group is called the control group . The effect of treatment is ($O1 : O2$) . In simple terms, the research design can be shown in the table below:

Table 1. Research Design

Group	Treatment	Posttest
(R)	X	O_1
(R)	-	O_2

Information:
R = Random selection of subjects

E = Experimental class
K = Control class
X = Researcher's treatment using a realistic mathematical approach
$O_1 : O_2$ = Final test

2.2. Population and Sample

Population is a generalized area consisting of objects/subjects that have certain qualities and characteristics determined by the researcher to be studied and then conclusions drawn [23]–[25]. The target population in the research was all students of public junior high school 160, while the target population was class VII students. The sample is part of the number and characteristics of the population. The sampling technique uses cluster random sampling. After sampling the five existing classes, the samples were class VII-A as the experimental class and class VII-B as the control class.

2.3. Research Instrument

To find out the extent of students' mathematical problem solving abilities, the instrument used in this research is a test with a description type and consists of 5 questions. This test was carried out after the treatment was given to the experimental class and control class with the aim of obtaining the latest data.

Table 2 . Guidelines for scoring problem solving abilities

Score	Understand the problem	Plan a settlement strategy	Implement resolution strategies	Check the results again
0	Wrong interpretation/completely wrong	No plans, making irrelevant plans	Didn't do the calculations	There is no examination or no other skills
1	Misinterpreting some questions/ignoring the conditions of the questions	Create a solution plan that cannot be implemented	Carrying out the correct procedure, may result in the correct answer, but miscalculation	There was an examination but it was not complete
2	Understand the problem in full	Make that plan Correct, but wrong in result/no result.	Perform the correct procedures and get the correct results	Inspections are carried out to see the correctness of the process
3	-	Make a proper plan, however not complete.	-	-
4	-	Make plans according to procedures and leads to the correct solution	-	-

2.4. Data Analysis Technique

The data analysis carried out was a normality test using the chi square test to determine whether the data obtained was normal or not. Then a homogeneity test was carried out whether the two sample groups came from the same population or not. After carrying out the 2 prerequisite tests, hypothesis testing was carried out using the t-test formula.

3. RESULTS AND DISCUSSION

In this research, the normality test used was the chi square *test* . The normality test is used to determine whether the data comes from a normally distributed population or not, provided that the data comes from a normally distributed population if it meets the criteria $\chi^2_{counts} \leq \chi^2_{tables}$ are measured at a certain level of significance and level of confidence.

3.1 Normality test

3.1.1 Group Normality Test k Experiment

From the results of the normality test calculations, it is obtained that $\chi^2_{counts} = 2.87$. With a sample size of 30, significance level $\alpha = 5\%$ and degrees of freedom (dk) = 2, we obtain $^2_{tables} = 5.99$, thus $\chi^2_{count} \leq \chi^2_{tables}$ ($2.87 \leq 5.99$), this means that the experimental group's mathematical problem solving ability values are normally distributed.

3.1.2 Control Group Normality Test

From the results of the normality test calculations, it is obtained that $^{2}_{counts} = 2.38$. With a sample size of 30, significance level α = 5% and degrees of freedom (dk) = 2, we obtain $\chi^{2}_{tables} = 5.99$, thus $\chi^{2}_{counts} \leq \chi^{2}_{tables}$ ($2.38 \leq 5.99$), this means that the control group's mathematical problem solving ability scores are normally distributed. For more details, the results of the normality test calculation between the experimental group and the control group can be seen in the following table:

Table 7 . Formality Test Calculation Results

Group	*n*	χ^2 count	χ^2 table (α = 5%)	Conclusion
Experiment	30	2.87	5.99	Data comes from a normally distributed population
Control	30	2.38	5.99	

3.2 Homogeneity Test

The two variance homogeneity test is used to determine whether the two sample groups come from the same (homogeneous) or different (heterogeneous) populations. In this study, the homogeneity test used was Fisher's test. The test criteria used are that the two groups are said to be homogeneous if $F_{count} \leq F_{table}$ is measured at a certain level of significance and level of confidence. The calculation results for the experimental group obtained variance = 147.10 and for the control group obtained variance = 51.52, resulting in a calculated F value = 2.86. From the F distribution table with a significance level of α = 5% and dk in the numerator = dk in the denominator = 29, we obtain $_{table\ F} = 2.10$. Because $F_{calculated} > F_{table}$ (2.86 > 2.10), then H_0 is rejected and H_1 is accepted or in other words the variance of the two populations is not the same or heterogeneous.

For more details, the results of the homogeneity test calculation can be seen in the following table:

Table 8 . Homogeneity Test Calculation Results

Group	*n*	F_{count}	F_{table}	Conclusion
Experiment	30	2.86	2.10	The second population variant does not the same or heterogeneous
Control	30			

3.3 Hypothesis test

From the results of prerequisite test calculations, it shows that the data on the mathematical problem solving abilities of students in the experimental group and control group are normally distributed and heterogeneous. To test the difference between the two means between the experimental group and the control group, a one-tailed t test, namely the right-hand test, was used. The hypothesis tested is as follows:

H_0 : $\mu_1 = \mu_2$

H_1 : $\mu_1 > \mu_2$

Information:

μ 1 : average mathematical problem solving ability of students in the experimental class

μ 2 : average mathematical problem solving ability of students in the control class

The test criteria are, if t is calculated < t_{table} then H_0 is accepted. Meanwhile, if $t_{count} \geq t_{table}$ then H_0 is rejected and H_1 is accepted. From the results of the t test calculation, t_{count} is obtained = 4.47 and t_{table} = 1.68, with a significance level of α = 5% and degrees of freedom (dk) = 47.09. Because a *tcount* ≥ *ttable* (4.47 1.68), then H_0 is rejected and H_1 is accepted or in other words On the other hand, the average mathematical problem solving ability of students in the experimental class is higher than the average mathematical problem solving ability of students in the control class. Complete calculations can be seen in attachment 15 **.** For more conciseness, it can be seen in the following table:

Table 9 . Difference Test Results with t Test Statistics

t_{count}	t_{table}	Conclusion
4.47	1.68	Reject H_0 and Accept H_1

3.4 Discussion

Based on the results of hypothesis testing with the "t test" for heterogeneous samples, *a* t_{count} was obtained = 4.47 and t_{table} = 1.68, with a significant level α = 5% and degrees of freedom (dk) = 47.09. Because $t_{count} \geq t_{table}$ (4.47 ≥ 1.68), then H_0 is rejected and H_1 is accepted or in other words the average mathematical

problem solving ability of students in the experimental group is higher than the average mathematical problem solving ability of students in the control group.

Based on observations when researching the experimental class, namely class VII-A, this process can be seen that students are required to be able to solve contextual problems from students' daily lives. In this process students try to solve problems from everyday life in their own way according to their cognitive level because by solving/finding it themselves the results will be better understood and remembered longer by students. [21], [22] . Apart from that, students are also required to use their own language or symbols armed with the knowledge they already have because this will enable students to discuss and collaborate with other students, ask and respond to questions, as well as evaluate other students' work so that interaction between teachers and students as well as students and students can go well. After that , the teacher provides formal conclusions from the results of the students' work. Learning with the PMR approach makes students understand Mathematics without having to memorize so that students are better able to solve Mathematics problems, especially those related to everyday life [11], [23] . In realistic mathematical approach learning, students not only act as listeners but are also active in conveying ideas and providing responses to these ideas.

In the control class, namely class VII-B, learning is carried out using conventional learning. The methods used are lectures, questions and answers, and giving assignments. In conventional learning, the teacher explains the material sequentially, then students are given the opportunity to take notes. Next, the teacher gives several examples of practice questions. Then the teacher gives practice questions to work on in the exercise book. After finishing working on the questions, several students were asked to work on the questions on the blackboard. The teacher provides the opportunity to ask students about things they do not understand [24], [25] . Learning with a conventional approach makes students just sit quietly listening to the teacher's explanation so that students become inactive.

From the research results, it was found that the average mathematical problem solving ability of students taught using the realistic mathematical approach approach was higher than the average mathematical problem solving ability of students taught using the conventional approach. In this case, learning using the realistic mathematical approach approach makes students' understanding more developed because in the learning process the teacher does not provide an explanation of the material first, but learning starts from real problems for students, emphasizing the skills of *'process of doing mathematics '*, discussing and arguing with classmates so that students can find their own ways to solve problems, thereby making the learning process more meaningful for students.

Research on the Effect of a Realistic Mathematics Education Approach on Students' Mathematical Problem Solving Ability has had a significant impact in the educational context. This research can provide empirical evidence that supports the effectiveness of certain educational methods in improving students' abilities in solving mathematical problems. The limitation of this research is that this study may be limited in geographic and demographic coverage of respondents, so the generalization of the results may be limited. In addition, external factors such as previous experience in mathematics or the conditions of each student's learning environment can influence the results of the study.

4. CONCLUSION

Based on the results of data processing and analysis obtained from research conducted at SMP Negeri 160 Jakarta by applying a realistic mathematical approach, it can be concluded that the results of hypothesis testing using the "t test" for heterogeneous samples obtained $t_{=} 4.47$ and $t_{table} = 1.68$, with a significance level of $\alpha = 5\%$ and degrees of freedom (dk) = 47.09. This data shows that H_0 is rejected and H_1 is accepted or in other words the mathematical problem solving ability of students in the experimental group is higher than the mathematical problem solving ability of students in the control group. Future research is recommended to explore the long-term effects of the Realistic Mathematics approach on students' mathematical problem-solving abilities at various levels of education, in order to understand the sustainability and consistency of its impact on mathematics learning.

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