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The Effect of Realistic Mathematics Education on the Mathematical Problem-Solving Ability of Fifth-Grade Students at SD 21 Banda Aceh

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Abstrak. Penelitian ini bertujuan untuk mengetahui pengaruh penerapan model *Realistic Mathematics Education* (RME) terhadap kemampuan pemecahan masalah matematis siswa. Penelitian ini menggunakan pendekatan kuantitatif dengan jenis quasi eksperimen dan desain *control group pretest-posttest*. Teknik sampling yang digunakan *random sampling*. Populasi penelitian ini siswa kelas V, sedangkan sampel dari dua kelompok, yaitu kelas eksperimen yang berjumlah 17 siswa menggunakan model RME dan kelas kontrol berjumlah 17 siswa yang menggunakan pembelajaran konvensional. Teknik pengumpulan data yang digunakan berupa tes kemampuan pemecahan masalah (TKPM). Teknik analisis data menggunakan uji *independent sample t-test*, data dianalisis menggunakan SPSS 26 *for window*. Hasil penelitian menunjukkan bahwa terdapat perbedaan yaitu kelas yang diberi perlakukan pembelajaran RME dan pembelajaran konvensional, dengan nilai signifikansi sebesar 0,003 < 0,05. Hal ini menunjukkan bahwa penerapan model RME berpengaruh terhadap peningkatan kemampuan pemecahan masalah matematis siswa. Dengan demikian, model RME dapat menjadi alternatif pembelajaran yang efektif dalam meningkatkan kemampuan pemecahan masalah siswa sekolah dasar.

Kata kunci: *Realistic Mathematics Education*, Pemecahan Masalah, Pembelajaran Matematika.

Abstract. This research to examine the effect of implementing the Realistic Mathematics Education (RME) model on students' mathematical problem-solving abilities. This research employs a quantitative approach with a quasi-experimental design, specifically a control group pretest–posttest design. The sampling technique used is random sampling. The population of this study consisted of fifth-grade students, while the sample consisted of two groups: an experimental group consisting of 17 students taught using the RME model, and a control group consisting of 17 students taught using conventional instruction. Data were collected using a mathematical problem-solving ability test. Data analysis was conducted using an independent sample t-test with the assistance of SPSS version 26 for Windows. The results indicate a significant difference between the group that received the RME treatment and the group that received conventional instruction, with a significance value of 0.003 < 0.05. This finding demonstrates that the implementation of the RME model has a significant effect on improving students' mathematical problem-solving abilities. Therefore, the RME model can serve as an effective alternative instructional approach to enhance problem-solving skills among elementary school students.

Keywords: Realistic Mathematics Education, problem-solving ability, mathematics learning

INTRODUCTION

Mathematics is a discipline that plays a crucial role in developing students logical, critical, systematic, creative, and reflective thinking skills. Ideally, mathematics learning in elementary school should not only focus on mastering concepts, formulas, and procedures, but also equip students with the ability to apply these concepts to solve various problems they face in everyday life. Therefore, the mathematics learning process needs to be designed to provide meaningful learning experiences, enabling students to construct their own knowledge through exploration, discussion, reasoning, and reflection on real-world situations. Such learning will help students understand the meaning of mathematics while continuously developing higher-order thinking skills (Astiana et al., 2021; Maulidina, 2024).

One of the key competencies that must be developed through mathematics learning is mathematical problem-solving skills. This ability is an important goal of mathematics learning, as stated by the National Council of Teachers of Mathematics (NCTM), namely, enabling students to understand problems, construct mathematical models, solve these models, and interpret the obtained solutions accurately. Problem-solving skills not only demonstrate mastery of mathematical concepts but also reflect students' abilities to think critically, make decisions, develop strategies, generalize, and communicate ideas systematically. Shoimin explains that mathematical problem-solving skills include the ability to recognize problems, formulate problems, select and develop solution strategies, and then evaluate the results of the solutions through a process of reflection and drawing conclusions (Astiana et al., 2021; Lestari & Saadati, 2021; Nasriwandi et al., 2022).

However, empirical evidence indicates that Indonesian students' mathematical problem-solving abilities still fall short of expectations. The 2022 Program for International Student Assessment (PISA) results showed that Indonesia's mathematics scores declined from 379 in 2018 to 366 in 2022. These results indicate that most students still experience difficulty applying mathematical knowledge to solve contextual problems that require high-level reasoning. This low achievement indicates that mathematics learning tends to be oriented towards procedures and routine exercises, thus failing to optimally develop problem-solving abilities (Wulandari et al., 2024).

These findings align with previous research that report that elementary school students' mathematical problem-solving abilities remain low (Astiana et al., 2021; Lestari & Saadati, 2021). A similar situation was also found at SD 21 Banda Aceh. Initial analysis showed that of 22 fifth-grade students, only around 30% had high problem-solving abilities, while none reached the very high category. Approximately 25% of students fell into the very low, low, or moderate categories. These data indicate that most students still experience difficulties in understanding problems, designing solution strategies, and evaluating answers. Therefore, learning innovations that can develop problem-solving abilities more effectively are needed.

One learning approach considered capable of addressing these issues is Realistic Mathematics Education (RME). This approach places students' real-life experiences as the starting point for learning, enabling mathematical concepts to be developed through exploration of contextual situations relevant to their lives. In RME learning, students are encouraged to understand contextual problems, find solutions independently or collaboratively, discuss various alternative solutions, and then draw conclusions about the mathematical concepts being studied. Thus, learning is no longer teacher-centered but instead provides opportunities for students to construct their own knowledge, making learning more meaningful and encouraging the development of problem-solving skills (Astuti et al., 2024; Hayati et al., 2025; Handun et al., 2020; Prihatinia & Zainil, 2020).

Various previous research have demonstrated the effectiveness of RME in improving the quality of mathematics learning. Astuti et al. (2024) reported that RME helps students rediscover mathematical concepts through contextual problem exploration. Research by Hayati et al. (2025) showed that the implementation of RME provides opportunities for students to construct arguments, explore ideas, and develop active problem-solving strategies. Muncarno and Astuti (2021) also found that RME has a positive effect on students' mathematics learning outcomes because learning is linked to real-life experiences, making concepts easier to understand. Furthermore, Lestari and Saadati (2021) demonstrated that realistic mathematics learning can improve elementary school students' mathematical problem-solving abilities. In general, these research results consistently demonstrate that RME is effective in improving learning activities, conceptual understanding, learning outcomes, and mathematical problem-solving abilities.

However, the results of the review of previous studies indicate that there are still several research gaps, namely that there has not been any experimental research that specifically examines the effect of RME on elementary school students' mathematical problem-solving abilities on spatial geometry material using comprehensive problem-solving ability indicators in the environment of SD 21 Banda Aceh. Therefore, this study has a novelty in the form of empirical testing of the effectiveness of RME in improving the mathematical problem-solving abilities of fifth-grade elementary school students on spatial geometry material by utilizing initial data on student abilities as a basis for compiling learning interventions. This novelty is expected to enrich the empirical evidence regarding the implementation of RME in the context of elementary school mathematics learning in Indonesia.

Based on the description, this study aims to analyze the effect of the Realistic Mathematics Education (RME) model on the mathematical problem-solving abilities of fifth-grade students at SD 21 Banda Aceh on the subject of geometric shapes. The results of the study are expected to provide empirical contributions regarding the effectiveness of RME as an alternative mathematics learning that can improve the mathematical problem-solving abilities of elementary school students while also being a reference for teachers in designing more contextual, active, and meaningful learning.

RESEARCH METHODOLOGY

This research used a quantitative approach with a quasi-experimental method and a pretest-posttest control group design. This design involved two groups: an experimental group that received instruction using the Realistic Mathematics Education (RME) model and a control group that received conventional instruction. Both groups were given a pretest before treatment and a posttest after the instruction to measure changes in students' mathematical problem-solving abilities. This design was selected because it allows researchers to compare the effectiveness of different instructional approaches and determine the impact of the RME model on students' learning outcomes. Furthermore, the use of pretest and posttest scores enables the identification of students' progress and provides a more accurate evaluation of the treatment effects. The research design is as shown in the following table:

Table 1.

Research Design

Group	(Pretest)	Treatment	(Posttest)
Experimental group	O_1	X	O_2
Control group	O_1	-	O_2

Source (Sukardi, 2003)

X : Treatment with *the Realistic Mathematics Education approach*

- : Treatment without *the Realistic Mathematics Education approach*

O_1 : Pretest scores of experimental and control group

O_2 : Posttest scores of experimental and control group (Sugiono, 2015)

The research population was all fifth-grade students of SD 21 Banda Aceh, which consisted of two groupes: group V/A as the control group and group V/B as the experimental group. Because the population was relatively small, the study used saturated sampling (total sampling) so that the entire population was sampled, namely 17 students each in the control group and 17 students in the experimental group.

The research instrument consisted of a mathematical problem-solving ability test in the form of three essay questions, structured based on mathematical problem-solving ability indicators. Students completed questions were then reviewed using the rubric in Table 2.

Table 2.

Problem Solving Ability Assessment Rubric Table

Assessment Indicators	Student responses to questions/problems	Score
Understanding the problem	Understand the problem well (Write down the limitations or information contained in the question)	2

	Just understand the problem (Ignore the problem conditions)	1
	Don't understand the problem (No answer at all)	0
Planning problem solving	Using a strategy or model or formula that is correct and leads to the correct answer	3
	Using a strategy or model or formula that is correct but cannot be continued or the problem solving is only done half way	2
	Using a strategy or model or formula but not leading to the correct answer	1
	There is no plan or no model or strategy for resolution	0
Solve the problem	Using certain correct rules and correct results	2
	Using certain rules that are correct but the answer is wrong or partly wrong due to a calculation error	1
	There is no solution	0
Inspect problem solving results	Can provide explanations according to questions and answers	3
	Can provide an explanation, but the explanation given is not accurate	2
	Can provide an explanation, but the explanation is not correct/wrong	1
	Unable to provide explanation for answer	0
	Total problem solving ability score	18

After being collected, the problem-solving ability data was then analyzed. Data analysis is one of the research activities in the form of a process of compiling and processing data in order to interpret or describe the data that has been obtained so that the data is easier to understand and interpret. In this study, the data was analyzed quantitatively using SPSS version 26. The analysis began with prerequisite tests including normality tests using Shapiro–Wilk and homogeneity tests using Levene's Test. Furthermore, the research hypothesis was tested using the Independent Samples t-test at a significance level of 0.05 to determine the difference in mathematical problem-solving ability between the experimental group and the control group after.

RESULTS AND DISCUSSION

Results

1. Pretest and Posttest Data

The research was conducted at SD 21 Tungkop in 2025/2026 starting on the 5th February to 22 February 2026 in grade I V students. The data obtained were in the form of problem-solving abilities of students in the control group and experimental group before and after the treatment which are presented in tables 3 and 4 below.

Table 3.

Mark Pre-test and Post-test Experiment Group and Control Group

No	Student Code	Pre-test experiment	Post-test experiment	Pre-test Control	Post-test Control
1	NU	45.82	62.09	34.11	29.99
2	NM	41.07	59.52	33.56	35.18
3	MF	38.39	40.16	28.77	28.21
4	BK	33.20	48.57	36.59	36.20
5	NA	25.96	42.16	45.22	54.30
6	SK	39.91	62.09	44.74	44.54
7	KS	33.20	46.09	28.77	30.99
8	RF	20.00	31.78	34.11	39.99
9	M N	20.00	42.42	33.56	36.18
10	AF	22.31	49.27	28.77	28.41
11	N Y	38.50	62.09	36.59	36.50
12	RG	33.20	45.52	45.22	54.20
13	G B	40.20	62.09	34.21	29.99
14	FQ	36.82	55.09	33.46	35.18
15	F R	42.08	62.09	28.47	28.91
16	S M	35.36	54.82	36.49	36.90
17	HA	20.00	35.55	34.31	29.89

Average	33.30	50.67	35.11	36.21

Table 4.

Recap Pre-test and Post-test Experiment Group and Control Group

Statistics	Experimental Group	Control Group
Pretest Average	33.30	35.11
Posttest Average	50.67	36.21
Average Increase	17.37	1.10
Descriptive Conclusion	Height increase	Very low increase

Table 4 shows that the initial mathematical problem-solving abilities of students in the experimental and control groups were relatively similar. The average pre-test score for the experimental group was 33.30, while the average pre-test score for the control group was 35.11. This indicates that before the treatment, both groups had relatively comparable initial abilities, although the average score for the control group was slightly higher.

After the learning process, there was a significant increase in mathematical problem-solving skills in the experimental group. The average post test score of the experimental group increased to 50.67, or an increase of 17.37 points compared to the pre-test score. This improvement was seen in almost all students, with some students even achieving an increase of more than 20 points, such as students AF, MN, SK, and NU. This condition indicates that learning using Realistic Mathematics Education (RME) is able to improve students' abilities in understanding, planning, and solving mathematical problems.

In contrast, in the control group, the improvement in mathematical problem-solving ability was relatively small. The average post test score only increased from 35.11 to 36.21, or an increase of approximately 1.10 points. In fact, several students experienced a decrease in their scores after the learning process, such as NU, MF, SK, GB, and HA. Although some students, such as NA, RG, and RF, did experience improvements, this improvement was not enough to significantly change the group average.

When comparing the two groups, the average difference in the post test was 14.46 points (50.67 in the experimental group and 36.21 in the control group). This difference indicates that students who received learning using the Realistic Mathematics Education (RME) model had better mathematical problem-solving skills than students who received conventional learning.

Descriptively, these results indicate that the implementation of the Realistic Mathematics Education (RME) model has a positive impact on improving students' mathematical problem-solving abilities. However, to ensure that these differences are statistically significant, inferential testing is required after meeting the assumptions of normality and homogeneity.

2. Normality and Homogeneity Test

The normality test was conducted to determine whether the research data from each group were normally distributed or not. The normality test is necessary as a prerequisite for the t-test. In this study, the normality test was performed using the Shapiro–Wilk test with SPSS version 26 for Windows at a significance level of 5%. The results of the normality test for both the experimental and control groups are presented below.

Table 5.

Results of the Shapiro–Wilk Normality Test

Test Of Normality

	Kelas	**Shapiro-Wilk** Statistic	df	Sig.
The Ability solve mathematics problems	pre-test experimental class	.922	17	.058
	post-test experimental class	.928	17	.078
	pre-test Control Class	.873	17	.198
	post-test Control Class	.866	17	.173

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on Table 5, it can be seen that the pre-test and post-test data of students' problem-solving abilities in both the experimental and control groups are normally distributed, as the significance values are greater than 0.05. Therefore, it can be concluded that the data in this study are normally distributed.

The homogeneity test is one of the assumptions that should be examined before conducting an independent samples t-test. The homogeneity test was carried out to determine whether there was an equality of variances between the two groups, namely the control group and the experimental group.

Table. 6

Results of the Pre-test Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
The Ability solve mathematics problems	Based on Mean	.876	1	30	.35
	Based on Median	.751	1	30	.39
	Based on Median and with adjusted df	.751	1	30	.39
	Based on trimmed	.933	1	30	3 .34

Based on table 6, it can be seen that the significant value (Sig) Based on Mean is 0.357. Because 0.357 > 0.05 (0.375 is more than 0.05), it can be concluded that that d a t a *Pre - Test* experiment And control originate from population have variants which the same (homogeneous).

Table 7.

Results of the Post-test Homogeneity Test

Test of Homogeneity of Variance					
		Levene			
The Ability solve problems of students mathematics	Based on Mean	.175	1	30	.679
	Based on Median	.344	1	30	.562
	Based on Median and with adjusted df	.344	1	30	.562
	Based on trimmed	.266	1	30	.610

Based on table 5, the significant value (Sig.) Based on Mean is 0.357. Because 0.357 > 0.05 (0.679 is more than 0.05), it can be concluded that that data *Post-Test* experiment and control originate from population own variants which the same (homogeneous).

3. Hypothesis Testing

Since the data met the assumptions of normality and homogeneity, an independent two-sample t-test was employed to test the hypothesis. This test was used to determine whether there was a significant difference in problem-solving abilities between the experimental and control groups. The results of the test are presented in the following table.

Table 8.

Results of Independent Samples t-Test

Independent Samples Test										
		Levene's Test for Equality of								
						Sig. (2-	Mean	Std. Error	95%	
		F	Sig.	t	df	tailed)	Difference	Differen	Lower	Uppe
The Ability solve mathematics problems	Equal variances assumed	.175	.879	.323	34	.003	12.05	4.03	4.80	21.3
	Equal variances not assumed			.323	34	.003	12.05	4.03	4.80	21.3

Based on the results of the independent samples t-test on the post-test data of the experimental and control groupes, it was found that the Sig. (2-tailed) value was 0.003. Since the significance value of 0.003 is less than 0.05, the null hypothesis (H_0) was rejected. This indicates that there was a significant difference in the problem-solving abilities of students taught using the Realistic Mathematics Education (RME) approach and those taught using conventional methods.

As previously mentioned, the average post-test score of students in the experimental group was higher than that of the control group. Therefore, it can be concluded that the RME approach had a positive effect on students' problem-solving abilities.

Discussion

The results of the research indicate that the application of the Realistic Mathematics Education (RME) model has a significant effect on the mathematical problem-solving abilities of fifth-grade students of SD 21 Banda

Aceh. Descriptively, the average problem-solving ability in the experimental group increased from 33.30 at the pretest to 50.67 at the posttest or an increase of 17.37 points. In contrast, the control group only experienced an increase of 1.10 points, namely from 35.11 to 36.21. The results of the Independent Samples t-test also showed a significance value of $0.003 < 0.05$, so there is a significant difference between the mathematical problem-solving abilities of students who learned using the RME model and students who received conventional learning. These findings indicate that the RME model is more effective in improving students' mathematical problem-solving abilities than teacher-centered learning.

This improvement occurs because the main characteristic of RME learning provides students with the opportunity to construct their own mathematical understanding through contextual problems close to their lives. At each learning stage, students not only receive information from the teacher but are also trained to understand problem situations, formulate solution strategies, discuss various alternative answers, and reflect on the solutions obtained. This process makes students more active in constructing concepts, thereby gradually developing logical thinking and problem-solving skills. According to Ningsih (2014), realistic mathematics learning places real-world experiences as the starting point for learning, allowing students to construct their own mathematical concepts through meaningful activities. This opinion is supported by Handun et al. (2020), who stated that RME develops students' abilities through the stages of understanding contextual problems, solving problems, comparing solution strategies, and drawing conclusions. These stages directly align with the indicators of mathematical problem-solving ability used in this study (Nasriwandi et al., 2022).

The results of this study also showed that students in the experimental group experienced improvements in almost all indicators of problem-solving ability, namely understanding the problem, planning a solution, implementing the solution, and reviewing the results of the solution. In contrast, in the control group, most students still experienced difficulties, especially in determining a solution strategy and evaluating the answers obtained. This condition indicates that conventional learning does not provide sufficient opportunities for students to develop independent thinking strategies. In contrast, through RME, students are encouraged to find various alternative solutions so that the mathematical thinking process becomes more in-depth. This is in accordance with the opinion of Setyawan (2020) that realistic mathematics learning gives students the freedom to develop various solution strategies, so they understand that a mathematical problem does not always have a standard solution procedure.

The findings of this study reinforce previous research demonstrating the effectiveness of the RME model in elementary school mathematics learning. Lestari and Saadati (2021) found that realistic mathematics learning can improve elementary school students' mathematical problem-solving skills through the use of real-world contexts that facilitate students' understanding of mathematical concepts. Research by Muncarno and Astuti (2021) also showed that the implementation of RME has a positive effect on mathematics learning outcomes because the concepts learned are linked to students' real-life experiences. Similarly, Hayati et al. (2025) reported that the use of RME can improve student learning outcomes through exploration, discussion, and independent concept construction. The consistency of these research results indicates that RME is an effective approach to improving the quality of mathematics learning, particularly in the aspect of problem-solving skills.

The findings of this study also support the results of the literature review by Nasriwandi et al. (2022) which concluded that the RME model has great potential in improving elementary school students' mathematical problem-solving abilities. However, this study provides a more specific empirical contribution because it tests the effectiveness of RME through a quasi-experimental design on spatial geometry material in grade V of SD 21 Banda Aceh. Thus, this study not only strengthens the conceptual evidence regarding the effectiveness of RME but also provides empirical evidence that the application of contextual problems to spatial geometry material can improve students' abilities in understanding problems, determining solution strategies, performing calculations, and evaluating the results of the solution systematically.

Practically, the results of this research imply that elementary school teachers need to optimize the use of the RME model in mathematics learning. Learning that starts from a real-world context and allows students to explore various problem-solving strategies can create more meaningful learning than conventional learning. In addition to improving mathematical problem-solving skills, this approach also has the potential to develop critical thinking skills, mathematical communication skills, and students' confidence in solving various mathematical problems. Therefore, RME can be used as an alternative learning model to support the implementation of 21st-century mathematics learning in elementary schools.

CONCLUSION

This research shows that the application of the Realistic Mathematics Education (RME) model has a positive and significant effect on the mathematical problem-solving abilities of fifth-grade students of SD 21 Banda Aceh on the material of geometric shapes. This is indicated by an increase in the average problem-solving ability in the experimental group from 33.30 to 50.67, while the control group only increased from 35.11 to 36.21. The results of the Independent Samples t-test obtained a significance value of 0.003 <0.05, which indicates that there is a significant difference in mathematical problem-solving abilities between students who learn using the RME model and students who learn with conventional learning.

These findings indicate that real-world context-based learning through the RME model can encourage students to understand problems, develop problem-solving strategies, systematically implement solutions, and re-evaluate the results. Therefore, the RME model can be used as an effective alternative mathematics learning method to develop elementary school students' mathematical problem-solving skills.

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