

The Influence of the Realistic Mathematics Approach (RME) on Fifth Grade Students' Mathematics Learning Outcomes and Critical Thinking Abilities

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ABSTRACT

The importance of implementing innovative learning models, such as the realistic mathematics approach (RME), is a solution to improve student interaction and mathematics learning outcomes. This research aims to evaluate the effect of the Realistic Mathematics (RME) approach on Mathematics learning outcomes and critical thinking abilities of students in classes VA and VB at SDN 02 Percontohan Bukittingi. The research method used was a quasi-experimental research design (Quasi Experiment) with an experimental group of 25 students at VA SDN 02 Percontohan Bukittingi (class with the PMR approach) and a control group of 24 students at VB SDN 02 Percontohan Bukittingi (class with conventional learning). The research instrument involved critical thinking ability tests and Mathematics learning outcomes tests (Pre-test and Post-test). The results of data analysis show that the application of the Realistic Mathematics Approach has a significant influence in improving Mathematics learning outcomes and students' critical thinking abilities (Sig. 0.00 < 0.05). The experimental group showed a higher increase in average scores. (83.68) compared to the control group (61.54). The Realistic Mathematics Approach Model can be used as an effective alternative for teachers to improve student's critical thinking skills and understanding of mathematical concepts.

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INTRODUCTION

Mathematics is a basic science that is a tool for studying other sciences. Mathematics is a subject that is the basis for studying other subjects. Mathematics has practical uses so that the use of mathematics cannot be separated from everyday life (Claudia et al., 2020). Mathematics emphasizes activities that involve reasoning, not just the results of observations or experimental

results that are formed from the human mind related to ideas, processes, and reasoning (Chairunisa et al., 2022).

Learning mathematics in elementary schools shows that mathematics is not only limited to mastering mathematical facts and procedures and understanding concepts but also takes the form of more complete mathematical skills (Puspita et al., 2020). Mathematics skills can be divided into two, namely high-level skills and low-level skills. Therefore, students in elementary schools are not only required to be able to have low-level skills but are also expected to be able to have high-level skills, such as students being able to have critical thinking skills in solving a problem. So teachers are required to be able to facilitate students to be able to have critical thinking skills (Ayuningtyas & Prastowo, 2022; Saputri et al., 2020).

Critical thinking ability is one of the high-level thinking abilities in solving problems. Critical thinking is a skill in reasoning regularly, meaning thinking systematically in assessing, solving problems, making decisions, and expressing beliefs with clear evidence (Dewi & Wardani, 2021). Critical thinking skills include thinking abilities that are essential and function for all aspects of life (Prameswari et al., 2018). Critical thinking skills are important to develop in learning, where students are required to be active in learning and the teacher only acts as a facilitator (Safitri & Mediatati, 2021).

With critical thinking skills, students will have the ability to identify central issues or main problems, compare similarities and differences, create and formulate questions appropriately, find the causes of problems, be able to assess impacts or consequences, be able to predict further consequences of the impact of the event, being able to explain problems and making simple conclusions, being able to design a simple solution, and being able to reflect on the values or attitudes of the event. So students will be skilled in dealing with problems, both personal and social problems, because in essence students live in a society that is full of potential seeds for problems to emerge (Dadri et al., 2019). However, in reality, there are still many students whose critical thinking skills have not been honed, which has an impact on student learning outcomes that are less than optimal.

Based on the results of observations of the learning process carried out at SDN 02 Percontohan Bukittingi, especially mathematics learning and students' critical thinking skills in class V, in reality, the field of mathematics learning is still far from expectations, this is because teachers have not been able to apply various varied models, especially teachers are still implementing learning pattern by providing material through lectures, practice questions, then giving assignments. This situation still creates learning interactions that are less effective and thus less meaningful. This can be seen from the students' average Odd Semester Final Test scores which are less than the predetermined KKM of the total students, around 56% of students have mathematics learning outcomes below the KKM.

The same thing was also found (Nugraha, 2017) Students' critical thinking abilities have not been facilitated and have never been measured, this was proven when the teacher demonstrated the LKPD and test questions used to evaluate low order thinking oriented learning outcomes, namely at the remembering (C1) and understanding (C2) levels. To hone students' critical thinking skills, an innovative model, method, strategy, and learning approach is needed so that students are interested and motivated to participate in learning. Teachers who have implemented a model, method, strategy, or learning approach that can hone students' critical thinking skills will certainly find it easier to achieve optimal learning goals. Learning that is interesting and motivating for students will certainly last a long time in students' memories until adulthood (Kristiyanto, 2020).

Teachers can make an effort to improve student's critical thinking skills by using a learning approach. This is because critical thinking skills are an important factor in increasing student learning achievement, especially in the field of mathematics. High critical thinking skills will have an impact on increasing the progress of student learning achievement (Binasdevi, 2021; Mahanal et al., 2019; Muhammadiyah et al., 2020). Researchers recommend the use of a realistic mathematical approach (RME) as a learning approach to overcome this issue. According to (Pangestu & Santi, 2016) The realistic mathematics approach (RME) is an application of mathematics learning in elementary schools that places students' reality and experiences as the starting point and reference in lessons. The realistic mathematics approach (RME) requires students to be active in problem-solving. Problem-solving is also related to reality/real life based on students' learning experiences that are everyday life so that it can make it easier for students to understand a subject matter (Chairunisa et al., 2022).

According to (Khotimah et al., 2020) This realistic mathematics approach is by students' concrete operational thinking stage because teachers can present learning that is close to students' daily lives or students' experiences, and teachers can present concrete and real objects according to students' experiences. With concepts that are concrete, real, and in line with students' daily experiences, it will certainly make it easier for students to learn and not just memorize and do assignments from books. A study (Sumianto, 2018) explained that the realistic mathematics approach (RME) is more helpful for students in dealing with mathematics learning because in this approach the implementation of learning is more student-oriented rather than teacher-centered. The learning carried out is an activity that is connected to everyday life. Teaching and learning activities are more meaningful because students' learning experiences will feel more real.

The realistic mathematics approach (RME) is an instructional method that teaches students to solve contextual problems, engage in discussion, and reflect on the learning process to enhance critical thinking skills. The learning approach to realistic mathematics education has appropriate steps to train students' critical thinking skills and students can learn actively in acquiring knowledge. Teachers can use a realistic mathematics learning approach in a variety of learning approaches to increase student motivation and cognitive learning outcomes. Students are expected to further improve their learning outcomes (Puspitasari & Airlanda, 2021). In previous research (Herlina, 2020) The Indonesian Realistic Mathematics Education Approach has a significant influence on student mathematics learning outcomes in students learning the volume of blocks and cubes. Research conducted by (Narayani, 2019) A Realistic Mathematics Approach Based on Problem-Solving Assisted by Concrete Media has a significant influence on Mathematics Learning Outcomes.

Based on the background of the problem which explains that students' critical thinking abilities and mathematics learning outcomes are still low in solving mathematics problems, the researcher intends to research "The Influence of the Realistic Mathematics Approach (RME) on Mathematics Learning Outcomes and Students' Critical Thinking Abilities in Elementary Schools".

METHOD

This research method is quantitative research with an experimental design. Experimental research aims to provide certain treatments to investigate an event/condition and its consequences. This research was carried out by SDN 02 Percontohan Bukittingi. This research was conducted in the odd semester of 2023/2024. The population used in this research was all students in classes VA and VB at SDN 02 Percontohan Bukittingi. Researchers used two classes, namely the experimental group which was given treatment, namely being given a realistic mathematics approach (RME)

while the control group was only given conventional learning. The conventional approach to this research involves teacher lecture as the primary method, with students listening passively. Textbooks are used as source material, interaction between teachers and students is limited, and assessment tends to be through written tests.

The research sample that will be used is 25 students in the VA class of SDN 02 Percontohan Bukittingi as the experimental class and 24 students in the VB class of SDN 02 Percontohan Bukittingi as the control class. So, the number of samples used in this research was 49 students. The independent variable in this research is the Realistic Mathematics Education (RME) learning approach. The dependent variable in this research is students' critical thinking abilities.

The instrument used in this research was a test in the form of a pretest and posttest from the mathematics learning results of class V students at SDN 02 Percontohan Bukittingi. The test in this study aims to determine the critical thinking abilities of students in classes VA and VB, the test was carried out twice, namely, the test was carried out before giving (pretest) to determine the abilities of students before implementing the Realistic Mathematics Education (RME) approach and the test was carried out after giving treatment (posttest) to determine students' critical thinking abilities after implementing the Realistic Mathematics Education (RME) approach. The test form in this study used 10 essay questions. Before the questions are tested, a validity test, reliability test, difficulty test, and differentiability test of the questions are carried out first.

a. Validity of Critical Thinking Skills Test Questions

The validity test is determined by determining the product-moment coefficient which is calculated using the formula:

$$r_{xy} = \frac{N \sum X_1 Y - (\sum X_1)(\sum Y)}{\sqrt{\{N \sum X_1^2 - (N \sum X_1)^2\} \{N \sum Y^2 - (\sum Y)^2\}}}$$

Information :

rx : Correlation coefficient of item scores with total scores

N : Number of participants

$\sum X$: Total item score

$\sum Y$: Total score

$\sum XY$: The number of times the item score is multiplied by the total score

$\sum x^2$: Sum of item square scores

$\sum y^2$: Total squared score(Widoyoko, 2010)

Based on the calculation results above, they are then interpreted in the table as follows:

Table 1. Question Validation Test Criteria

r value	Interpretation
$0.81 < r \leq 1.00$	Very high
$0.61 < r \leq 0.80$	High
$0.41 < r \leq 0.60$	Enough
$0.21 < r \leq 0.40$	Low
$0.00 < r \leq 0.20$	Very low

b. Reliability of Critical Thinking Skills Tests

The reliability test was carried out using the Cronbach Alpha coefficient formula because the scores of the items to be tested were in the form of continuum (description) questions. Cronbach's Alpha formula is:

$$r_{11} = (n/(n-1)) (1 - (\sum \sigma_i^2)/\sigma^2)$$

Information:

r_{11} : the reliability sought

$\sum \sigma_i^2$: the amount of variance in the scores for each item

σ^2 : total variance

Based on the results of the reliability test calculations, the results are then interpreted according to the reliability test criteria

Table 2. Question Reliability Test Criteria

r value	Interpretation
$0.91 < r \leq 1.00$	Very high
$0.71 < r \leq 0.90$	High
$0.41 < r \leq 0.70$	Enough
$0.21 < r \leq 0.40$	Low
$0.00 < r \leq 0.20$	Very low

c. Critical Thinking Skills Test Difficulty Test

To find out the difficulty level of the questions, the questions are tested for their difficulty level. The formula used as a difficulty level test is:

$$P = \frac{B}{Js}$$

Information :

P: Difficulty index

B: The number of students who answered the question correctly

Js: The total number of students taking the test

The results of calculating the level of difficulty of the questions are then analyzed based on the criteria

Table 3. Criteria for Difficulty Levels of Question Items

Mark	Interpretation
0.00 – 0.30	Difficult problem
0.31 – 0.70	Medium problem
0.71 – 1.00	Easy question

d. Differential Power Test Critical thinking skills test

To determine the differentiating power of a question, all test takers are grouped into two groups, namely group A with the highest score and group B with the lowest score. After being divided into two groups, you can see the number of students in the upper group and JB the number of students in the lower group. Meanwhile, BA shows the number of students in the upper group who answered correctly and BB shows the number of students in the lower group who answered the question correctly. If these four values are known, the P value can be determined for each group in each question item using the following formula:

$$P.A = \frac{BA}{JA} \text{ and } P.B = \frac{BB}{JB}$$

$$D = PA - PB$$

Information:

PA : Difficulty Index in group A

PB : Difficulty Index in group B

BA : The number of group A students who answered correctly

BB : The number of group B students who answered correctly

JA : Number of students taking the test in group A

JB : Number of students taking the test in group B

Table 4. Criteria for Differentiating Power of Questions

Mark	Interpretation
0.00 – 0.20	Bad
0.20 – 0.40	Enough
0.40 – 0.70	Good
0.70 – 1.00	Very well

(Arikunto, 2010)

The data obtained in the research came from the final test of critical thinking skills and mathematics learning outcomes using a realistic mathematics approach and a conventional approach. Data analysis aims to test whether the proposed hypothesis is accepted or rejected. To test or find the effect of a realistic mathematical approach on learning outcomes and students' critical thinking abilities, the t-test was used. Before carrying out the t-test, prerequisite tests are first carried out, namely the data normality test and homogeneity test. Hypothesis testing in this research uses the independent sample t test (Sakinah & Ibrahim, 2023).

RESULTS

Validity, Reliability, Discriminating Power, and Difficulty Index

The critical thinking ability test instrument is in the form of questions consisting of 10 essay questions with material on the area of flat built areas. These questions are given before learning (Pre-test) and after learning (Post-test), both trial elementary schools and implementation elementary schools. Based on the test instrument test, the following data was obtained:

Table 5. Recapitulation of Data Analysis of Critical Thinking Ability Test Evaluation Results.

No	Test Questions	1	2	Question 3	4	5	6	7	8	9	10
1	Validity	0.85	0.83	0.77	0.75	0.76	0.81	0.75	0.77	0.82	0.80
	Category	Tall	Tall	Tall	Tall	Tall	Tall	Tall	Tall	Tall	Tall
2	Criteria	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
	Reliability										0.87
3	Category										Tall
	Differentiating power	0.433	0.476	0.475	0.444	0.447	0.553	0.489	0.551	0.493	0.463
4	Category	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
	Difficulty index	0.50	0.49	0.54	0.49	0.45	0.52	0.56	0.43	0.53	0.41
	Category	Currently	Currently	Currently	Currently	Currently	Currently	Currently	Currently	Currently	Currently

Based on the table above, it can be seen that the validity of questions for numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 meets the high category with valid criteria. Meanwhile, reliability is in the high category. The distinguishing power of numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 is in the good category. The difficulty index for numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 is in the medium category.

Based on the results of the critical thinking ability test, it can be concluded that the critical thinking ability test instrument is suitable or can be used in research.

Mathematics Learning Outcomes

The data used in this research are the evaluation scores of the experimental group and the control group. Data from research on the realistic mathematics approach (RME) on mathematics learning outcomes and critical thinking abilities of students at V SDN 02 Percontohan Bukittingi can be seen in the following table:

Table 6. Mathematics Learning Results

Group	N	Mean	Std. Deviation	Maximum	Minimum
Experiment	25	83.68	6.87	95	70
Control	24	61.54	7.14	74	50

The data above shows that the average score for mathematics learning outcomes in the experimental class is 83.68 ± 6.87 and the control class is 61.54 ± 7.14 . The maximum in the experimental class is 95 and in the control class 74. The minimum in the experimental class is 70, while the control class is 50. Data from the two classes were then tested for normality using the Shapiro-Wilk test. The results of the normality test data analysis can be seen in the following table:

Table 7. Normality Calculation Results

Class	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Experiment	0.072	25	0.200	0.978	25	0.854
Control	0.073	24	0.200	0.965	24	0.542

The normality test applied in this analysis is the Shapiro-Wilk test. This type of test was chosen based on the sample size of less than 50 sample data for each VA and VB class. Based on the table above, it can be seen that the significance value of normality for the control class is 0.542 and the experimental class is 0.854. The significance value in both classes meets the Sig value. > 0.05 , therefore it can be accepted that the mathematics learning outcomes data for students in the control class and experimental class for class V at SDN 02 Percontohan Bukittingi are normally distributed. Next, a homogeneity test was carried out. The data that has been analyzed produces the results as below:

Table 8. Homogeneity Test Calculation Results

Test of Homogeneity of Variances				
	Levene Statistics	df1	df2	Sig.
Based on mean	0.113	1	47	0.738
Based on median	0.120	1	47	0.730
Based on median adjusted df	0.120	1	46.96	0.730
Based on trimmed mean	0.116	1	47	0.735

Based on the homogeneity test results, it is known that the Sig results for the control and experimental classes show that the Sig. > 0.05 . So it can be concluded that the mathematics learning outcomes data for the experimental class and control class are homogeneous and the posttest score

data for the experimental class and control class are also homogeneous. After carrying out the two tests above, the hypothesis test is then carried out. The following are the results of the calculation of the independent sample t-test as a hypothesis test:

Table 9. Hypothesis Test Calculation Results

	F	Sig.	t	Df	Sig. (2-tailed)
Equal variances assumed	0.113	0.738	11,061	47	0,000
Equal variances not assumed			11,052	46,691	0,000

The t-test calculation can be seen in the table above showing that Sig. equal to $0.000 < 0.05$, then H_0 is rejected and H_1 is accepted, meaning that the hypothesis states that there is an influence of the realistic mathematics approach (RME) on the mathematics learning outcomes and critical thinking abilities of class V students at SDN 02 Percontohan Bukittingi.

DISCUSSION

The results of the research show that there is a positive influence from applying a realistic mathematical approach to the learning outcomes and critical thinking abilities of class V students at SDN 02 Percontohan Bukittingi. In a test-based evaluation of mathematics learning outcomes to measure critical thinking abilities, the average score in the experimental group was significantly higher (83.68) compared to the control group (61.54). This shows that a realistic mathematics approach can improve students' critical thinking skills, especially in mathematics subjects. These results are in line with research (Ilma, 2023) that the application of the realistic mathematics approach (PMR) shows differences in students' thinking abilities before and after being given treatment. This can be seen in the increase in pretest to posttest learning outcomes which previously obtained an average score of 51.75 to 82.50 after implementing the realistic mathematics approach. Study (Trivonia Bau et al., 2023) the achievement and improvement of students' critical thinking skills in mathematics who learn through a realistic mathematics education approach is better than students who learn with a conventional approach and learning with a realistic mathematics education approach can facilitate students' critical thinking abilities. In other research (Puspitasari & Airlanda, 2021). The application of realistic mathematics learning (RME) can improve students' problem-solving abilities compared to using conventional learning. Research conducted by (Juniarini et al., 2014) learning outcomes using a realistic mathematics education approach is higher than learning using conventional methods. Research conducted by (Whenty et al., 2017) that learning outcomes in the material for determining KPK and FPB by applying expository strategies are lower than learning outcomes that apply a realistic mathematics education approach

The application of this realistic mathematical approach helps elementary school students to be able to think more critically because this model provides an effective and efficient experience for students and is appropriate to the student's learning environment. According to (Anggi et al., 2023) The realistic mathematics approach provides students with the opportunity to be immediately involved in learning by posing real problems for students at the beginning of learning. These problems are directed according to learning objectives and enable students to develop informal symbolic models of the problems posed. This approach makes students feel valued and open because every answer has value. With this approach, students will be trained to work together and have the courage to express opinions. It can be seen from observations made by researchers that when learning uses a realistic mathematics approach, class VA students are more active in asking questions and completing assignments given by the teacher. Students are also more courageous in

conveying ideas and answers to problems raised during the learning process. In contrast to the results of observations in VB classes which are taught using conventional methods, many students tend to still depend on the teacher, are not enthusiastic about learning activities are lazy to ask questions, and are passive in learning, even though the teacher provides a lot of stimulus, so that students are active in the learning process. This is in line with research (Ilma, 2023) the application of the RME approach also influences students to participate in learning well and actively. The realistic mathematics learning approach (RME) attracts interest in learning, involves students in learning activities, and students to think critically so that it makes it easier for students to understand, the material explained by the teacher during the learning process is related to the student's specific daily life environment (realistic) (Fajriati et al., 2023; Lestari et al., 2019; Iranti, 2023). According to research (Trivonia Bau et al., 2023) the realistic mathematical approach enables students to solve problems because the learning process from the start confronts students with their experiences. When students are given problems that fit the context, it can be seen that students are very enthusiastic about reading the problems and trying to answer the problems given.

In the context of curriculum development, a realistic mathematics approach can be used as an effective alternative to enrich students' learning experiences by improving critical thinking skills, providing real-world context, and increasing understanding of mathematical concepts. The practical implication of this research is the need to apply a realistic mathematical approach at various levels of education to improve the quality of learning, critical thinking skills, and student mathematics learning outcomes. Learning mathematics with a realistic mathematics approach makes students able to think critically through the application of mathematical concepts in real-life situations, triggering questions that require analytical, evaluative thinking and creative solutions to problems. However, other factors such as student motivation, quality of learning implementation, and other variables can also influence results. Further research with tighter control of these variables could provide a deeper understanding of the impact of applying realistic mathematics.

CONCLUSION

The application of the Realistic Mathematics (RME) approach in Mathematics learning at SDN 02 Percontohan Bukittinggi has had a positive impact on student learning outcomes and critical thinking abilities. Classes that implemented RME showed significant increases in test scores on learning outcomes and critical thinking abilities compared to classes that used conventional methods. The results of this research provide practical implications for the development of the Mathematics curriculum at the elementary level. Application of the realistic mathematics approach allows students to learn mathematical concepts through real situations, which makes learning more relevant and meaningful. In addition, the realistic mathematics approach trains students to work together in groups to solve mathematical problems, allowing them to share ideas and strategies. In particular, in this research, the realistic mathematics approach helps develop students' critical thinking skills through contextual problem-solving and reflection. Thus, a realistic mathematical approach can be an effective alternative for improving the quality of learning, enriching students' learning experiences, and developing critical thinking skills. The RME approach can be an effective alternative for improving the quality of learning, enriching students' learning experiences, and developing critical thinking skills. However, it should be noted that other factors such as student motivation and the quality of learning implementation also influence the results, so further research needs to be carried out with tighter control of these variables.

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