

The Effect of the Realistic Mathematics Education (RME) Approach on Fifth-Grade Students' Mathematical Conceptual Understanding in a Public Elementary School in Bandung

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Abstract. Understanding mathematical concepts is an important skill in developing numeracy literacy in elementary school students. However, initial observations at SDN Bandung 1 in Serang District show that some fifth-grade students still have difficulty understanding basic mathematical concepts, especially in the subject of fraction calculations. This occurs because learning is still teacher-centered and does not sufficiently relate mathematical concepts to real-life contexts. This study aims to determine the effect of the Realistic Mathematics Education (RME) approach on students' understanding of mathematical concepts. The method used is quantitative with a quasi-experimental design of the nonequivalent control group type. The research sample consisted of 41 students, namely 21 students in the experimental class and 20 students in the control class. The results of the analysis using the t-test showed a t-value of $3.52 > t\text{-table} = 2.02$ at a significance level of 0.05. The average posttest score of the experimental class was 82.90, which was higher than that of the control class, which was 73.45. These results indicate that the RME approach has a significant effect on improving students' mathematical concept understanding and helps them understand abstract concepts through more contextual and meaningful situations.

Keywords: RME, conceptual understanding, mathematics, elementary school students.

INTRODUCTION

Mathematics is a very important subject for elementary school students because it plays a role in developing logical, systematic, and analytical thinking skills. Conceptual understanding of mathematics, namely the ability to understand the meaning of basic ideas behind procedures and formulas, is an important foundation for the formation of students' numeracy literacy (Sayekti and Sukestiyarno, 2021). This understanding enables students to not only memorize the steps to solve problems, but also to explain the reasoning behind a procedure and apply it in new contexts.

In Indonesia, Numerous studies demonstrate that traditional teacher-centered approaches continue to dominate mathematics instruction in primary schools. Student learning activities are often limited to practicing problems without a deep understanding of the concepts being studied (Holmes and Tuomi, 2022). This condition has an impact on students' low conceptual understanding, especially on abstract topics such as fractions. Students are able to solve routine problems, but they struggle when faced with contextual problems that require logical reasoning and deep understanding (Vebrian et al., 2021).

This phenomenon of low conceptual understanding among students is also evident in national and international assessment results. According to the 2022 PISA assessment, Indonesian students' mathematical literacy abilities remain below the OECD average, particularly when it comes to conceptual comprehension and practical application (OECD, 2023). In addition, data from the 2023 According to the Ministry of Education, Culture, Research, and Technology's National Assessment, over 60% of primary school pupils still lack the necessary literacy and numeracy skills (Kemendikbudristek, 2023). This fact reinforces the need for innovation in mathematics learning approaches so that students are not only able to calculate, but also understand the meaning behind the concepts they learn.

The Realistic Mathematics Education (RME) approach has emerged as an alternative learning method oriented towards real-world contexts. This method is predicated on the idea that mathematics is a human endeavor that has to be developed using real-world scenarios and experiences that are relevant to students' daily lives (Üredi and Doğanay, 2023). Through real-world contexts, students can discover mathematical concepts through the processes of guided reinvention and mathematization, enabling them to understand the relationship between mathematical ideas and the real world (Inci et al., 2023). Recent research confirms that the application of RME in elementary schools not only improves learning outcomes but also encourages motivation, active participation, and critical thinking skills in students (Khasanah and Siswono, 2025).

Initial observations at SDN Bandung 1 Serang show that some fifth-grade students still have difficulty understanding basic mathematical concepts, especially fractions. Learning tends to be oriented towards problem solving and teacher explanations, with little connection to the real-life contexts of students. As a result, students are unable to relate mathematical concepts to everyday situations. Therefore, a learning approach is needed that can help students build conceptual understanding through contextual experiences.

Furthermore, the use of the RME approach in fifth grade is expected to shift the learning paradigm from “teacher-centered” to “student-centered.” Through exploratory, manipulative, and reflective activities, students actively participate in discovering mathematical concepts, rather than simply receiving information. This approach is in line with the government's efforts to strengthen the Pancasila Student Profile and improve numeracy literacy as part of the independent curriculum transformation (Nurwahid, Ashar, & Awantagusnik, 2025).

In addition, developments in the national curriculum in recent years have also emphasized the importance of active, collaborative, and learner-centered approaches to learning (Dewi, 2019).

This paradigm shift requires teachers to design learning activities that are not only procedural in nature, but also capable of stimulating higher-order thinking skills. In the context of mathematics learning, the ability to understand concepts is key for students to be able to interpret problems, connect information, and develop independent problem-solving strategies (Saputra, 2024). Thus, the problem of weak conceptual understanding cannot be viewed solely as a pedagogical issue, but also as a curricular challenge that must be addressed with a more relevant and contextual approach.

The RME method provides chances to close the gap between students' practical experiences and abstract mathematical ideas (Asmaarobiyah et al., 2025). Through context-based problem solving, mathematization, and guided discussion, students not only gain conceptual understanding, but also metacognitive skills in planning, monitoring, and evaluating their solution strategies (Chairani, 2016). Based on this reasoning, it is crucial to present actual data about the efficacy of RME in enhancing primary school pupils' comprehension of mathematical concepts, particularly in fractions, which they frequently view as challenging. Thus, the purpose of this study is to examine how the Realistic Mathematics Education approach affects fifth-grade students at SDN Bandung 1 Serang's mathematics conceptual knowledge.

METHODOLOGY

This study employed a nonequivalent control group design type quasi-experimental method with a quantitative approach (Krishnan, 2025). This design was chosen because the researcher could not completely randomize the subjects, but it still allowed for a comparison of the results between two groups that received different treatments. The study's goal was to determine how primary school students' conceptual understanding of mathematics was impacted by the Realistic Mathematics Education (RME) approach.

Table 1. Research Design Structure (Nonequivalent Control Group Design)

Group	Pretest	Treatment	Posttest
Experimental (Class VA)	O ₁	X (RME Method)	O ₂
Control (Class VB)	O ₃	– (Traditional Method)	O ₄

Notes: O₁, O₃ = Pretest results before treatment; O₂, O₄ = Posttest results after treatment; X = RME-based learning treatment.

Population and Sample

The research population consisted of all fifth-grade students at SDN Bandung 1 Serang for the 2024/2025 academic year, comprising two parallel classes. Sampling was conducted using a purposive technique based on academic ability equivalence. Class VA was identified as the experimental class, receiving training using the RME methodology, whereas class VB was allocated as the control class, receiving instruction using conventional methods. There were 41 students in the sample, 20 in the experimental group and 20 in the control group.

In addition to considerations of academic ability equality, sample selection also took into account aspects of classroom stability, teacher readiness, and learning schedule suitability. This was done to minimize non-pedagogical biases that could affect the effectiveness of the treatment, especially since experimental research in elementary school environments is greatly influenced by diverse classroom conditions. Thus, this research design seeks to ensure that any differences in learning outcomes that arise are due to the learning treatment provided, rather than other external factors that are difficult to control.

Table 2. Research Population and Sample Distribution

Class	Treatment Type	Number of Students
Class VA	Experimental (RME Method)	20
Class VB	Control (Traditional Method)	21
Total		41

Research Instrument

The research instrument was a multiple-choice test of mathematical conceptual understanding based on indicators from Kurniawan (2022) which include: (1) the capacity to restate concepts; (2) the capacity to categorize objects according to their attributes; (3) the capacity to give examples and non-examples of concepts; (4) the capacity to represent concepts in a variety of formats; (5) the capacity to apply concepts in problem-solving scenarios; and (6) the capacity to link one concept to another.

Content validity was tested by three mathematics education experts, however, dependability was determined using the Cronbach's Alpha formula, yielding a high degree of reliability with a value of 0.82 (Arikunto, 2010).

Table 3. Instrument Validity and Reliability

Test Aspect	Method Used	Result
Content Validity	Expert Judgment (3 experts)	Valid
Reliability	Cronbach's Alpha	0.82 (High Reliability)

In addition to validity and reliability tests, the instruments were analyzed by examining the level of difficulty and discriminating power of the items. This analysis was conducted to ensure that the items were able to measure students' abilities proportionally, without being too easy or too difficult. The results of the analysis showed that most of the items were in the moderate category with good discriminating power, making them suitable for accurately measuring conceptual understanding. This step was also taken to ensure the integrity of the research results, especially since quantitative research is highly dependent on the quality of the measurement instruments.

Table 4. Summary of Item Analysis Results

Analysis Aspect	Category
Difficulty Level	Moderate
Discriminating Power	Good
Suitability for Measurement	Appropriate

Research Procedure

The research procedure included pretest, treatment, and posttest stages. The experimental class received RME-based learning for four meetings with problem contexts close to the students' lives, while the control class followed conventional learning. An independent t-test was then used to examine the pretest and posttest data in order to see how the two groups' learning results differed. As a precondition for statistical analysis, the data were first examined for homogeneity and normality before the t-test was performed (Usmadi, 2020).

Table 5. Research Procedure Steps

Stage	Description
Pretest	Measuring students' initial conceptual understanding
Treatment	Conducting RME-based learning (Experimental) and traditional learning (Control)
Posttest	Administering the same test to measure improvement
Data Analysis	Normality and Homogeneity Tests, followed by Independent t-Test

Data Analysis Technique

Descriptive and inferential statistics were used to assess the data in order to ascertain the impact of the RME approach. Pretest and posttest data were described using descriptive statistics (mean, standard deviation), and significant differences between the experimental and control groups were identified using inferential statistics (independent t-test). To make sure parametric assumptions were satisfied, the data were examined for homogeneity and normality before to the t-test.

Table 6. Data Analysis Techniques

Type of Analysis	Purpose
Descriptive Statistics	To describe pretest and posttest results
Normality Test	To check data distribution
Homogeneity Test	To ensure equality of variance
Independent t-Test	To determine significance of difference between groups

RESULTS AND DISCUSSION

The purpose of this study is to ascertain how the Realistic Mathematics Education (RME) method affects fifth-grade students at SDN Bandung 1 Serang's conceptual grasp of mathematics. Prior to applying the RME technique, a pretest was administered to both groups the experimental class and the control class to ascertain their preliminary conceptual grasp of mathematics. The beginning skills of both groups were comparatively balanced, according to the descriptive analysis results, suggesting that it was possible to compare the students' initial conditions in both classes objectively.

After four lessons, a posttest was conducted to measure the improvement in mathematical conceptual understanding. Table 1 below displays the findings of the descriptive analysis of the pretest and posttest scores.

Table 7. Descriptive Results of Pretest and Posttest Scores

Class (Treatment)	Number of Students	Mean Pretest	Mean Posttest	Standard Deviation
Experimental (RME)	21	67.48.00	82.90	0,25833333
Control (Conventional)	20	66.90	73.45.00	06.15

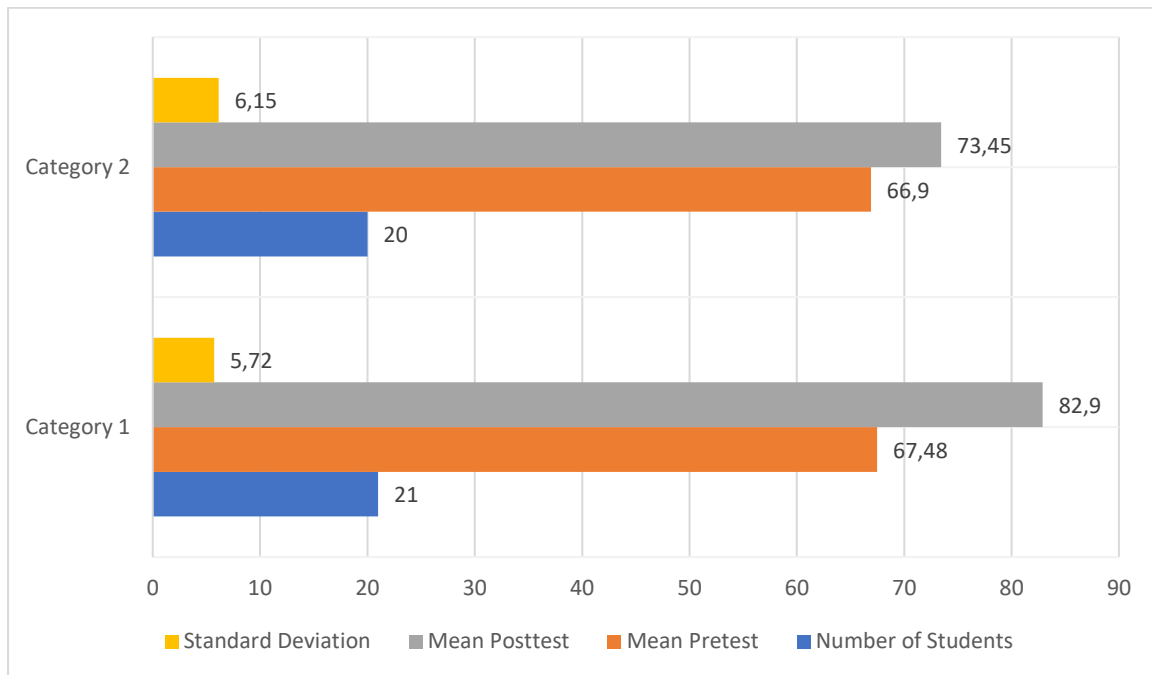


Figure 1. Descriptive Results of Pretest and Posttest Scores

The experimental class's average posttest scores were greater than the control class's, as Table 1 demonstrates. The experimental class's average score rose by 15.42 points, compared to just 6.55 points for the control group. This suggests that using the RME technique improved students' comprehension of mathematical ideas in a more significant way.

A preparatory analysis, which included homogeneity and normality tests, was carried out prior to testing the hypothesis. The Kolmogorov–Smirnov normality test showed that the data were normally distributed, with significance values of 0.134 for the experimental class and 0.092 for the control class ($p > 0.05$). The homogeneity test using the Levene Test also showed that the variances of the two groups were homogeneous, with a significance value of 0.276 ($p > 0.05$).

Table 8. Results of Assumption Testing

Type of Test (Analysis)	Class	Sig. Value	Criteria	Description
Normality (Kolmogorov–Smirnov)	Experimental	0,09305556	$p > 0.05$	Normal

Normality (Kolmogorov– Smirnov)	Control	0.092	$p > 0.05$	Normal
Homogeneity (Levene Test)	Both Classes	0,19166667	$p > 0.05$	Homogeneous

An independent t-test was used to compare the average posttest scores of the experimental and control groups after the necessary tests were completed. Table 3 below displays the results of the t-test.

Table 9. Independent t-test Results

Variable		t- count	t-table ($\alpha = 0.05$; df = 39)	Sig. (2- tailed)	Description
Mathematical Understanding	Conceptual	3.52	2.02	0.001	Significant

The estimated t-value of 3.52 is higher than the table t-value of 2.02 at a significance level of 0.05 with a degree of freedom (df) = 39, according to the t-test findings. The mathematics learning results of pupils taught using the RME methodology and those taught using traditional methods differ significantly, as indicated by the significance value of $0.001 < 0.05$. Therefore, it is believed that the RME technique affects students' comprehension of mathematical topics.

To ascertain the extent of the RME approach's impact on students' comprehension of mathematical ideas, an effect size calculation was carried out in addition to the significance test. Cohen's d formula was used to calculate the effect size, and the following outcomes were obtained:

Table 10. Effect Size Test Results

Group	Standard Deviation	Effect Size	Criteria
Experimental	5.72	1.59	Very High
Control	6.15	-	-

Cohen's d value of 1.59 falls into the category of very large effect, based on Cohen's classification (1988) which states that 0.2 = small, 0.5 = moderate, and 0.8 = large. These results indicate that learning with the RME approach not only provides statistically significant differences, but also has a large practical impact on improving students' understanding of mathematical concepts.

Overall, the study's results show that using the RME technique effectively aids students in comprehending abstract mathematical ideas, like fractions, through real-world settings. Students are encouraged to solve issues more rationally, actively, and imaginatively through this reality-based learning, which makes the concepts they learn more significant and enduring in their minds.

The study's findings show that fifth-grade students at SDN Bandung 1 Serang significantly improve their arithmetic conceptual knowledge when the Realistic Mathematics Education (RME) approach is applied. Students who learnt using the RME technique had an average score of 82.90, which was higher than the control class's score of 73.45. This conclusion is illustrated by the difference in the average posttest scores between the experimental and control classes. According to the t -test findings, there is a significant difference between the two groups since the computed t -value of 3.52 is higher than the table t -value of 2.02 at a significance level of 0.05. Furthermore, the RME technique has a significant practical influence on enhancing students' comprehension of mathematical ideas, as indicated by the effect size value of 1.59, which falls into the very high category.

These results corroborate those of a study conducted in 2023 by Apriyanti et al., which demonstrated the efficacy of the RME learning paradigm in enhancing primary school pupils' comprehension of mathematical ideas. Students who engaged in RME-based learning significantly outperformed those who received traditional instruction in that research. Similar findings were made in this study, where students in the experimental group outperformed the control group in terms of activity, enthusiasm, and reasoning abilities when it came to solving contextual mathematics problems.

The RME approach places students' real experiences as the starting point for learning. Thus, students do not only receive knowledge passively but construct mathematical concepts through a process of guided reinvention (Rangkuti, 2019). In the context of this study, teachers used problems that were close to everyday life, such as food distribution, measurement, and

contextual games to help students understand the concept of fractions. Through these activities, students were able to relate mathematical symbols to concrete experiences, thereby strengthening and lasting their conceptual understanding.

RME-based learning also facilitates students' active involvement in exploratory and reflective activities. Students discuss, argue, and compare problem-solving strategies with their peers, thereby forming a social understanding of mathematical concepts (Firdaus, 2025). This is in line with the findings of Ndiung et al., (2021), who asserts that the steps of RME learning, starting from understanding the context, solving problems, comparing strategies, to drawing conclusions, encourage students to think critically and creatively in understanding the meaning of mathematics.

The use of RME seems to be able to boost student motivation and involvement in the learning process in addition to boosting conceptual comprehension. Students in the experimental group shown greater excitement and curiosity throughout learning activities, according to observers. They were more likely to ask questions, voice their ideas, and take part in group discussions. This condition is in line with the results of research by Harefa (2023), which explains that student activity in the learning process is positively correlated with interest and motivation in mathematics.

Pedagogically, these findings reinforce the argument that the RME approach can be used as an alternative effective learning strategy to strengthen the numeracy literacy of elementary school students. Real-world context-based learning provides meaningful experiences that encourage students to think at a higher level (HOTS) and connect mathematical concepts with everyday life (Abd Rahman et al., 2024). Thus, the application of RME is in line with the spirit of the Merdeka Curriculum, which emphasizes contextual, collaborative, and student-centered learning.

Overall, the study's findings support the RME approach's instructional significance and statistical efficacy. Students are able to develop a deeper and more useful comprehension of mathematical ideas via active involvement and real-world learning experiences. Teachers are therefore encouraged to include RME concepts into primary school mathematics instruction so that pupils may learn in an enjoyable, relevant, and meaningful way.

In addition to showing significant differences in scores, the findings of this study indicate that the characteristics of RME learning provide greater scope for students to build conceptual understanding independently. The horizontal and vertical mathematization processes that are

at the core of RME enable students to elaborate on the relationships between concepts while applying those concepts to a variety of situations. This contrasts with conventional learning, where students' thinking processes tend to be limited to procedural problem solving without exploring broader meanings.

Active student involvement during learning is also evident from the improved quality of interactions among students in completing context-based tasks. Well-facilitated group discussions encourage students to express their reasons, compare strategies, and clarify their understanding. These activities are in line with the social constructivism framework, which emphasizes that effective learning occurs through interaction and negotiation of meaning. Thus, the success of RME in improving conceptual understanding is not only influenced by the use of context, but also by the collaborative dynamics created during the learning process.

From a pedagogical perspective, these findings reinforce the urgency for teachers to shift their role from being the primary source of information to being facilitators who guide students in discovering concepts through an exploratory process. RME provides a theoretical and practical foundation for this shift in roles. By utilizing authentic contexts and models of representation, teachers can help students gradually generalize concepts, resulting in more stable understanding that can be transferred to other situations. These findings enrich the empirical evidence supporting the effectiveness of context-based learning approaches as a strategy for fostering conceptual thinking skills in elementary schools.

CONCLUSION

The results of the study indicate that using the Realistic Mathematics Education (RME) approach greatly enhances fifth-grade students' understanding of mathematical topics at SDN Bandung 1 Serang. The t-test results show that, at a significance level of 0.05, the calculated t-value of 3.52 is greater than the tabulated t-value of 2.02, with an average posttest score of 82.90 for the experimental class and 73.45 for the control class. Additionally, the impact size calculation result of 1.59 falls into the very high category, indicating that the RME approach greatly improves students' mathematical conceptual understanding.

The RME approach helps students understand abstract concepts, such as fractions, through problem contexts that are close to everyday life. Students become more active, creative, and able to connect real experiences with the mathematical concepts they learn. Thus, RME-based learning not only significantly improves learning outcomes but also fosters students'

logical thinking and numeracy skills. Therefore, the RME approach is recommended to be implemented continuously in mathematics learning in elementary schools to create meaningful, contextual, and student-centered learning.

The findings of this study also have important practical implications for the development of mathematics learning in elementary schools. Teachers need to more frequently integrate real-world contexts and visual representation models into learning activities so that students have a concrete foundation for understanding abstract concepts. In addition, the results of this study can be used as a reference for schools to encourage the use of learning approaches that emphasize the process of knowledge construction, rather than simply conveying information. The continuous implementation of RME is expected to produce students who are not only able to calculate, but also have a deep, flexible mathematical understanding that can be applied in various everyday situations.

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