AL JABAR
Jurnal Pendidikan dan Pembelajaran Matematika
E-ISSN: 2828-6731
P-ISSN: 2828-5573
Sekolah Tinggi Agama Islam Muhammadiyah Probolinggo

THE INFLUENCE OF REALISTIC MATHEMATICS EDUCATION (RME) ON STUDENT PROBLEM-SOLVING IN BASIC STATISTICS

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Article History:		
Submitted: 26 Juni 2025	Accepted: 30 Juni 2025	Published: 31 Juli 2025

Abstract

To enhance students' comprehension of mathematical problem solving, particularly when learning Basic Statistics, this project intends to apply the methodology of Realistic Mathematics Education (RME). This research was conducted quantitatively, with data collected through posttest and pre-test-based experiments. The study results stated that students taught using the RME method showed stronger critical thinking abilities than students taught with the conventional method. In particular, students taught using the RME method showed a discernible grade rise. Based on the questionnaire responses, 80% of students stated that learning by linking mathematics to real life makes learning more effective and enjoyable. As a result, the combined posttest and pretest tests demonstrated here demonstrate the RME approach's beneficial effects. This supports the finding that RME enhances students' comprehension and addresses problems by relating math ideas with real scenarios.

Keywords: basic statistics, critical thinking, problem-solving, quantitative approach, realistic mathematics education

INTRODUCTION

The abstract nature of mathematics makes it difficult for many students to understand it. Mathematics relies on signs and annotations that are unfamiliar to many people, making it challenging because it has complex symbols, concepts, and relationships. However, these theoretical signs have real meaning and relationships with the real world around us (Ouellette, 2022). In line with this, Pakhrurrozi (2021) research shows that learning emphasized by the Realistic Mathematics Education (RME) approach to mathematical concepts through real-life contexts can help students understand mathematical concepts with everyday experiences so that the content is easier to understand and tends to be easier to remember. In conclusion, the abstract complexity of mathematics and its symbols can be minimized by applying the RME approach that connects mathematics with everyday experiences, making mathematics more interesting and easier to understand.

To build a deeper understanding, the next section will outline the fundamental theories underlying the influence of the RME approach. RME is a mathematics learning method that connects mathematical ideas with real-world application situations to improve students' understanding in solving problems (Baldwin, 2023). To achieve this goal, this study adopted the theory in the book Realistic Mathematics Education: Theory and Practice by Baldwin (2023), namely Contextual Learning Theory and Mathematization Theory. This contextual learning theory emphasizes learning that uses real problems as a basis for understanding mathematical concepts, where students will be more active in their learning because they feel connected to the problem. After the context, mathematical theory will take place because students will participate in changing real problems into mathematical forms (horizontal mathematization). Students will develop the mathematical form so that it is based on concepts and easier to understand (vertical mathematization). By combining these theories, students will memorize formulas, understand how mathematical concepts are formed, and apply them in everyday life.

Several studies have also highlighted the positive influence of Realistic Mathematics Education (RME) on mathematics skills at various levels of education. First, Fujiarti (2025) conducted a study on fifth grade students of SDN Gunasari using a student learning independence questionnaire and observation sheets. Second, the application of RME to improve elementary school students' abilities in problem-solving skills through certain mathematical topics, such as geometry (circumference and area of kites and trapezoids), proportional fractions, and mixed arithmetic operations, was carried out by Sella et al. (2024). Third, Soleha et al. (2024) showed an increase in their ability to solve problems related to real-life contexts in student learning at SDN 2 Mataram. Furthermore, Hayati et al. (2025) examined how effective it is to combine gamification technology with RME to improve students' proficiency in solving mathematical problems through game elements and local culture. Furthermore, classroom action research conducted by Fitriani & Fauzi (2024) showed that the PBL model combined with RME can effectively improve elementary school students' critical thinking skills when learning mathematics by solving problems.

Furthermore, Miharja et al. (2024) explored the function of RME in developing students' mathematical problem-solving abilities and learning methods through a mixed-method design combining quasi-experimental and case study approaches, where information was collected through tests, observations, and interviews, then examined using SPSS and thematic analysis. Furthermore, Widodo et al. (2023) reviewed the application of RME at various levels of education, from elementary school to university, by analyzing 20 national journal articles selected through purposive sampling. In

addition, Purwadi (2020) examined the improvement of aptitude for solving mathematical problems in a two-variable linear equation system through RME involving 19 eighth-grade junior high school students using observation data and essay tests. Then, Perwira Negara et al. (2021) calculated the effect size (ES) and standard error (SE) values using data from various studies indexed in Google Scholar, SINTA, and the Garuda Portal to assess the overall effect of RME on students' problem-solving abilities. Finally, Wijaya & Irianti (2021) used the Classroom Kemmis and McTaggart Action Research Model (this includes preparation, implementation, observation, and introspection.) to strengthen the critical thinking capacity of Mathematics Education students through RME. Unlike previous studies, the perspective of pure mathematics students in applying RME to Basic Statistics is the main focus of this study. The research in this journal was conducted on 10 2nd semester pure mathematics students of Syarif Hidayatullah State Islamic University Jakarta who were selected through purposive sampling to find out how students' perspectives are in applying RME to Basic Statistics material by relating it to everyday life. This study uses experiments such as pretests and posttests to collect information. This study uses a questionnaire to determine students' responses to the application of RME to Basic Statistics with a four-stage procedure (preparation, implementation, analysis, and reporting). In addition, this study also uses quantitative methods and Google Forms as data collection tools. This study uses a t-test from student responses to compare various answers so that similar and interesting things can be found in learning basic statistics by applying RME.

RME emphasizes the relationship between real life and mathematical concepts. In line with this potential, the RME approach research in mathematics learning can help mathematics students of Syarif Hidayatullah State Islamic University Jakarta to improve their understanding of statistical concepts at the higher education level. This research can also provide flexibility in solving students' mathematical problems, namely by encouraging students to find various strategies based on their understanding of the context of the problem so that they do not always rely on existing examples and train themselves to think critically in finding solutions. In addition, this RME approach also helps students to grow their self-confidence when they succeed in solving problems with their efforts and are braver in facing the basic concepts of mathematical statistics. In short, the influence of the RME approach helps students develop critical thinking and problem-solving by combining mathematics learning with the context of everyday life, which can enable them to find solutions through their thinking.

METHOD

This study uses a quantitative approach with a posttest and pretest experimental design to examine the impact of the Realistic Mathematics Education (RME) learning model on the efficiency of solving mathematical issues, particularly in the context of fundamental statistics content. It involves measuring problem-solving abilities through a pretest and posttest of applying the RME model to individuals. This method in this study is characterized by a structured design, precise sample size, valid instruments for collecting data, and statistical analysis to conclude the efficiency of the RME approach (Yulianti & Amril, 2022). Therefore, data was gathered from structured observations and standardized instruments.

This study was conducted with a population of mathematics students of UIN Syarif Hidayatullah Jakarta with a sample of 10 second semester students who participated in this study, selected through purposive sampling based on their active participation in Basic Statistics learning and their involvement in research activities for 10 days. According to Memon et al. (2025) Purposive sampling involves choosing individuals according to traits that align with the study question. The main goal of including students is to foster their mathematical thinking skills through active engagement in the learning process, which was supported by the implementation of the RME model (Wijaya & Setiawan, 2021). Consequently, these students were chosen because their direct involvement in learning mathematical concepts allowed a deeper exploration of how the RME approach affects problem-solving abilities.

This study uses pretest, posttest, and Likert scale questionnaires distributed via Google Forms. Sutarni & Aryuana (2023) stated that the experiment used pretest and posttest implementation tests to quantify the rise in students' problem-solving skills. Meanwhile, the questionnaire is a research instrument consisting of a list of questions to collect information from respondents (Rudy Setiawan et al., 2022). The Google Form questionnaire was also distributed to participants after implementing the RME model. The quantitative descriptive method was used to examine the gathered data to show how the RME approach affected the students' problem-solving capacity.

The research procedure was carried out through four main stages: preparation, implementation, analysis, and reporting. Instruments, subject selection, and experimental design were prepared in the preparation stage. Instruments like pretest, posttest, and Likert scale questionnaires in Google Forms were developed to ensure their reliability and suitability for the research objectives. The implementation stage includes applying the RME model and collecting data through pretest, posttest, and Likert scale questionnaires distributed using Google Forms. At this stage, participants were also guided in solving contextual mathematical problems that reflect real situations using the

principles of RME. The data analysis stage is executed using quantitative methods. The data is summarized utilizing descriptive statistics like mean and standard deviation. An independent sampling t-test was employed in quantitative descriptive analysis to identify significant differences. The findings were tested to ascertain how students' problem-solving abilities had changed before and after treatment.

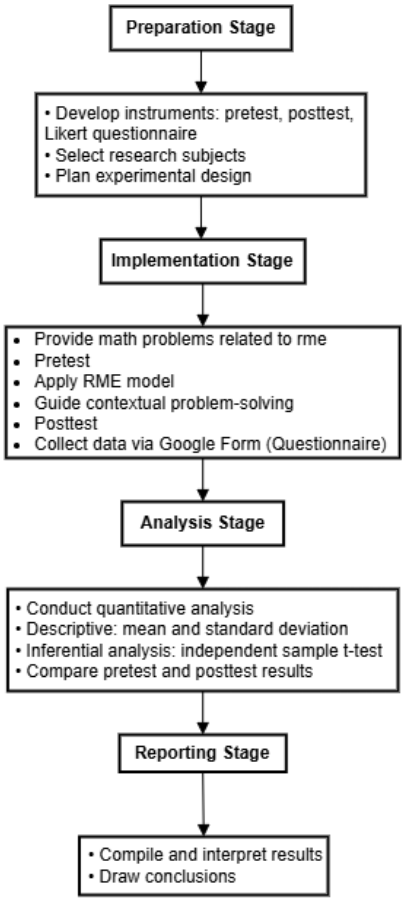


Figure 1. Research Procedure

RESULTS AND DISCUSSION

This research examines how students in the mathematics curriculum at Syarif Hidayatullah State Islamic University Jakarta's RME method impacts their problem-solving ability and thinking critically. In particular, this study looks at how students, particularly in beginning statistics classes, resolve mathematical issues relevant to daily life. The study used the Google Form instrument data collection through experiments and questionnaires. Students' pre-and posttest scores were compared as part of the experiment, which involves solving basic statistical questions in the classroom using the RME technique. Meanwhile, the questionnaire was compiled to determine students' opinions on the effectiveness of the RME method approach. The questionnaire consisted of 10 statements arranged based on a Likert scale (agree, neutral, disagree), which focused

on aspects of involvement, conceptual understanding, learning motivation, and students' critical thinking abilities.

Considering the outcomes of the pre-and posttests given to 10 students, there was an increase in the average score from 77.4 to 87.8. In addition, the standard deviation decreased from 1.78 to 1.69, indicating a more consistent understanding of students after implementing the RME approach. All students who experienced improved scores can support the idea that the RME approach improves students' knowledge of statistical material. The results of the independent sample t-test showed a statistically significant increase with a significance value of 0.000 ($p < 0.05$). So, this study proves that using mathematical concepts with real-world situations can improve students' understanding of statistics and encourage more significant learning outcomes. Table 1 displays the findings of the comparison between the pretest and posttest.

Tabel 1. Comparison of Pre-test and Post-test Results

No	Respondent	Pre-test score	Post-test score	Information
1.	Aissyah Arthalia	76	88	Increase
2.	Eka Komaria Safitri	77	89	Increase
3.	Karina Salsa	75	87	Increase
4.	Kartika Dwi Saputri	78	87	Increase
5.	Nurlela	80	90	Increase
6.	Najma Fawza	76	88	Increase
7.	Nur Tazkiyah At Tamaamiyyah	77	89	Increase
8.	Malika Hasana Sausan	79	87	Increase
9.	Mutiara azzahra	76	90	Increase
10.	Rifa Nailah Yusriani	80	90	Increase

Table 2 shows descriptive statistical information on student scores before and after applying the RME technique. The mean score, standard deviation, and number of students displaying the outcomes of the comparison of pupils' abilities to solve mathematical problems are all included in this data.

Table 2. Findings from the RME Method's Descriptive Statistics on Pre-Test and Post-Test Data

Group Statistics

	After using the RME method	N	Mean	Std. Deviation	Std. Error Mean
Test result before and after using the RME method	Pretest	10	77.4000	1.77639	.56174
	postest	10	87.8000	1.68655	.53333

Table 3 shows the results of the Independent Sample T-Test according to the Levene Test value of 0.832 (more than 0.05) which indicates that the difference between the pre-test and post-test groups is the same. Thus, the results in the "Equal Variance

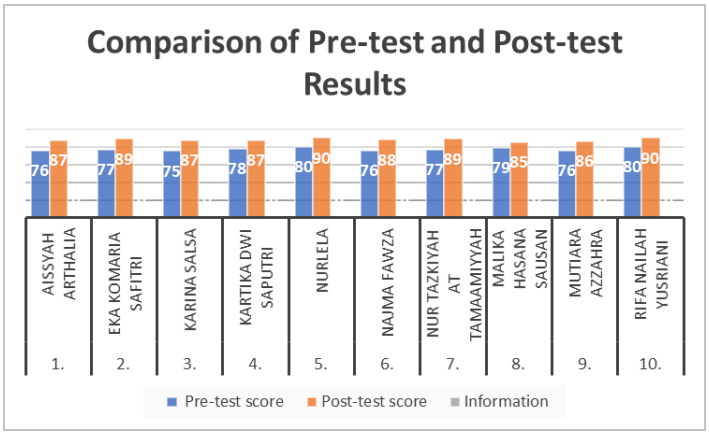
Assumption" row apply. then obtained a significance value (2-tailed) of 0.000 (less than 0.05) which indicates that the pre-test and post-test results are significantly different. The Realistic Mathematics Education (RME) approach has improved student learning outcomes.

Table 3. Independent Sample T-test Results

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Test result before and after using the RME method	Equal variances assumed	.046	.832	-13.426	18	.000	-10.40000	.77460	-12.02737	-8.77263
	Equal variances not assumed			-13.426	17.952	.000	-10.40000	.77460	-12.02768	-8.77232

The graph below contrasts the pretest and posttest results of ten students. All students' scores increased after the RME technique guided the learning process. This increase demonstrates how the RME learning technique improves students' comprehension of mathematical ideas.



Graph 1. Comparison of Pre-Test and Post-Test Result

Table 4 summarizes the respondent's responses implementing the RME approach in statistics learning. Data were collected to evaluate how students responded to various aspects of RME-based learning, focusing on engagement, understanding, and real-life application. Data were obtained from a Likert-scale questionnaire distributed to 10 students after implementing the RME approach. This data collection aligns with the research objective to assess the effectiveness of RME in improving student's learning experience.

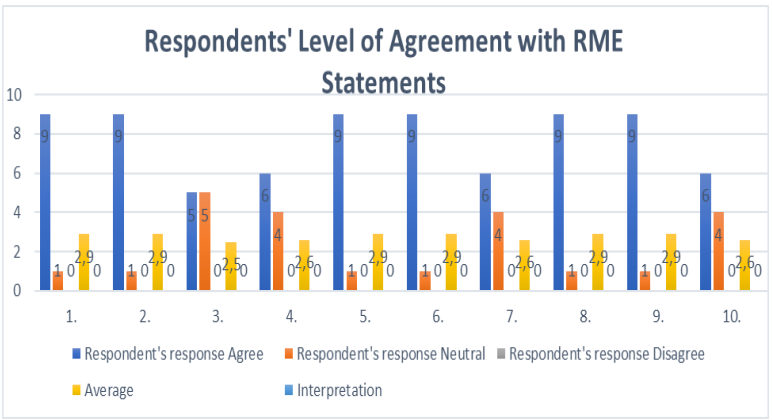
Table 4. Respondents' responses to RME

No	Statement	Respondent's response			Average	Interpretation
		Agree	Neutral	Disagree		
1.	I believe that learning statistics becomes more meaningful when	9	1	0	2,9	Positive response

	it is related to real life situations.					
2.	I find it easier to understand statistical concepts when real life examples are provided.	9	1	0	2,9	Positive response
3.	The RME approach makes me feel more engaged in the learning process.	5	5	0	2,5	Positive response
4.	Learning with the RME approach is more enjoyable compared to traditional learning methods.	6	4	0	2,6	Positive response
5.	I believe that learning statistics through RME encourages me to think critically.	9	1	0	2,9	Positive response
6.	RME helps me recognize the connection between mathematics and real-world applications.	9	1	0	2,9	Positive response
7.	I find the RME approach suitable for implementation in Basic Statistics courses.	6	4	0	2,6	Positive response
8.	I feel more motivated to learn when the content is presented in a real life context.	9	1	0	2,9	Positive response
9.	Solving problems based on real-life contexts increases my confidence in my statistical abilities.	9	1	0	2,9	Positive response

10.	I would like to see the RME approach applied in other mathematics courses as well.	6	4	0	2,6	Positive response

The graph shows the level of respondent agreement with the RME statements. Most respondents showed good understanding, as indicated by their high interpretation scores on all statements.



Graph 2. Respondents' Level of Agreement with RME Statements

According to the questionnaire findings, most students responded favourably to using RME. As many as 80% of respondents stated that learning becomes more meaningful and easier to understand if contextualized with the real world. In addition, as many as 90% of respondents think that the RME approach encourages them to think critically to find their understanding strategies based on the context of the problem, and all respondents (100%) stated that RME helps them understand the relationship between mathematics and everyday life. Regarding learning experience, 6 out of 10 students said the learning method was more enjoyable and easier to understand than conventional learning methods. Therefore, 50% of respondents also felt more involved in learning. Most students (90%) also felt more motivated and did not feel bored when the learning material was delivered in everyday life. In addition, 10 students stated that contextual problem-solving increased their confidence in dealing with statistical problems. This study shows that the RME method approach not only improves understanding and effectiveness in the learning process but also that linking mathematics to real contexts in everyday life is very effective in motivating and increasing students' understanding of mathematical concepts and self-confidence.

Overall, data from the experimental instruments and questionnaires support the idea that students receive the Realistic Mathematics Education approach very well. As many as 90% of students stated that this approach is suitable for application in Basic

Statistics courses, and 70% suggested that RME should also be used in other mathematics courses. Thus, the RME learning method has proven effective in creating relevant, enjoyable learning experiences and encouraging better problem-solving and the ability to think critically in students.

The results of this study prove that the research objectives regarding the effectiveness of the Realistic Mathematics Education (RME) approach in improving students' problem-solving and critical thinking skills can be proven well. The findings show that most students responded positively to implementing RME, with 80% stating that learning becomes more meaningful when associated with real-life contexts and 90% feeling encouraged to think critically and find problem-solving strategies based on their understanding. All respondents also stated that RME helped them understand the connection between mathematical concepts and everyday life. In addition, RME increased students' motivation to learn, sense of engagement, and confidence in dealing with fundamental statistical problems, emphasizing that this approach provides effectiveness in thinking and problem-solving. Thus, the findings support and prove that the RME approach can develop students' conceptual understanding, independence of thought, and courage in dealing with mathematical problems at the higher education level by the formulated research objectives.

A solid theory underpins the progression of the Realistic Mathematics Education (RME) method; several educational theories and the views of prominent figures provide a conceptual basis for this development method. The following are some theories that support the RME approach. Guided Rediscovery (Hans Freudenthal) Freudenthal introduced the concept of "guided rediscovery," where students are guided to "rediscover" mathematical concepts through a process similar to the initial discovery but with proper guidance. This principle is the core of RME, where students are encouraged to develop mathematical understanding through meaningful and contextual experiences, with guidance from the teacher (Freudenthal, 2006). In line with this view, Didactic Situation Theory (Guy Brousseau) developed a theory of didactic situations that emphasizes the importance of creating learning situations where students can actively discover and construct mathematical concepts through interaction with a specially designed environment. RME combines the principles of this theory by creating a learning context that allows students to explore and discover mathematical concepts independently (Mathematiques, 2002). This idea is consistent with mathematical theory as a human activity, which was progressed by Dutch mathematician and educator Hans Freudenthal, who founded the Realistic Mathematics Education (RME) approach. Freudenthal emphasizes that studying maths must be connected to real-world situations for it to have meaning, where students actively construct and rediscover mathematical concepts

through firsthand experience as part of organizing knowledge and problem-solving activities rather than merely passively absorbing abstract concepts (Gravemeijer & and Terwel, 2000).

Another theory that supports RME is the iceberg theory, which illustrates that what is seen in mathematics, such as formulas and symbols, is only a small part of the overall understanding. In the Realistic Mathematics Education (RME) approach, students can start from real situations, use their strategies, and are gradually directed to formal concepts. This shows that meaningful mathematics learning must start from concrete experiences, not directly to abstractions (Heuvel-Panhuizen, 2001). This is reinforced by the Contextual Learning Theory, which emphasizes the importance of connecting learning materials with students' real-life contexts to make learning more meaningful and relevant. It aligns with RME, which uses real-world contexts as a starting point for mathematical exploration, allowing students to comprehend math concepts through situations they know and experience (Brown & Redmond, 2017). In addition, constructivist theory (Jean Piaget & Jerome Bruner) states that individuals construct knowledge through interactions with the environment and previous experiences. This method strongly emphasizes the value of conceptual knowledge through autonomous investigation and discovery in the context of mathematical education. It Aligns with RME, which adopts the principle of constructivism by encouraging students to build mathematical understanding through real-world contexts and meaningful activities (Bada & Olusegun, 2015).

Several mathematics learning theories do not support the RME approach because they tend not to relate to students' real experiences in understanding concepts. The focus is more on delivering material directly and mechanically so that student's participation in the mathematical thought process is declining. The following are some theories that do not support the RME approach. Behaviorism theory focuses on stimulus-response and reinforcement. In mathematics learning, behaviourism often focuses on memorizing procedures, repetitive exercises, and structured learning from teacher to student. This theory is contrary to RME because RME emphasizes the discovery and construction of concepts by students themselves through real contexts.

In contrast, behaviorism emphasizes the direct transfer of knowledge and repetition (Skinner, 1965). In line with the Tabula Rasa Theory, the Tabula Rasa Theory does not support RME because this theory sees students as "blank papers" that must be filled with knowledge by the teacher. In RME, students are considered to have informal learning that can be the basis for building new mathematical understanding through meaningful activities (Piaget, 1971). In addition, the Teacher-Centered Theory also does not support RME. In this theory, the teacher is the center of all information, and students

are passive recipients. This theory does not support RME because RME encourages students to play an active role in exploration, discussion, and contextual problem-solving. The teacher's job is to facilitate learning, not as a single center of authority (Noddings, 1992).

CONCLUSION

According to the data analysis, the Realistic Mathematics Education (RME) approach successfully enhances students' critical thinking and problem-solving abilities in the Mathematics Education Study Program at UIN Syarif Hidayatullah Jakarta about Basic Statistics content. The pretest and posttest research results show an enhancement in mean scores from 77.4 to 87.8 and a decrease in the standard deviation from 1.78 to 1.69, indicating more consistent understanding among students after implementing the RME approach. All respondents experienced an increase in scores. Furthermore, The improvement in scores between the pretest and posttest was statistically significant, according to the independent t-test results, which had a significance value of 0.000 ($p < 0.05$). Levene's Test value of 0.832 (> 0.05) shows equal variance, supporting the use of the "equal variance assumed" line in the Independent Sample T-Test. The significance value ($0.000 < 0.05$) indicates a significant difference between pretest and posttest scores, suggesting improved learning outcomes through the RME method. Questionnaire data also supported these findings, showing that 80% of students found learning more meaningful when contextualized, 90% felt encouraged to think critically and independently, and 100% stated that RME helped relate mathematics to everyday life. Additionally, students reported increased motivation, confidence, and engagement in learning.

The tiny sample size of just 10 students is one of the study's shortcomings, though, and it may restrict how broadly the results can be applied. A bigger and more varied sample should be used across different mathematics courses or educational institutions in future studies to strengthen and validate the results. With the study's expanded scope, a more thorough grasp of the RME approach's overall effectiveness and long-term effects on students' mathematics comprehension and critical thinking abilities may be possible. Given the current research, RME should be used more extensively in higher education mathematics instruction.

ACKNOWLEDGEMENT

The author would like to thank Dr. Wahyunengsih, M.Pd, for her instruction and direction during the compilation process. Additionally, we thank my friends who have

been ready to help implement this research. This article can support the growth of mathematics education.

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