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How does Realistic Mathematics Learning Shape Learners' Problem Solving and Critical Thinking Skills?

Fadila Amir[1*], Fery Muhamad Firdaus[2], Amir Pada[3]

[1] Universitas Negeri Yogyakarta, Yogyakarta, Indonesia; Fadilaamir.2022@student.uny.ac.id
[2] Universitas Negeri Yogyakarta, Yogyakarta, Indonesia; fery.firdaus@uny.ac.id
[3] Universitas Negeri Makassar, Makassar, Indonesia; amirpadda30@gmail.com

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ABSTRACT

Education is vital for fostering problem-solving and critical thinking skills in students, which are essential for thriving in a globalized world. This study investigates the impact of the Realistic Mathematics Education (RME) approach on enhancing these skills among primary school students. Utilizing a quasi-experimental design with a pretest-posttest control group, the research involved 44 second-grade students, split evenly between classes II A and II B. Data analysis was conducted using descriptive and statistical techniques, employing SPSS 25.0 for Windows to evaluate the effects of the RME approach. The significance value for both problem-solving and critical thinking abilities was 0.000, indicating a substantial impact of the RME approach on these skills. The findings suggest that integrating realistic learning with other methodologies, such as project-based learning or developing media based on realistic principles, could further enhance educational outcomes.

Corresponding Author:
Fadila Amir
Universitas Negeri Yogyakarta, Yogyakarta, Indonesia; Fadilaamir.2022@student.uny.ac.id

1. INTRODUCTION

Education is one of the main things that humans need to continue to develop and compete with the global world. Education can develop human potential to the fullest. This potential lies not only in knowledge but also in skills and character. Education is a means to help guide children by developing and directing all the potential that children have to achieve all their life goals. Education consists of the engagement between instructors and learners to achieve educational goals that take place in a certain environment (AP & Mahyuddin, 2022; Inah, 2015). Education inherently involves the interaction between teachers and learners. This interaction occurs through learning activities tailored by the Instructor to address the diverse needs of students. Learning is a deliberate effort by the teacher to assist students in expanding their knowledge, shaping their character, and enhancing their skills. Learning involves any intentional effort by educators that prompts students to engage in learning activities (Ammy, 2021). Classroom learning activities led by teachers encompass various subjects that students must learn and master, including mathematics.

Every student needs to learn to face and solve problems in everyday life, problem-solving skills help them cope better with everyday challenges. Problem-solving skills is a crucial skill for students to develop because it is highly beneficial in addressing and overcoming various challenges encountered in daily life. Problem-solving ability is an important process in overcoming obstacles that arise to achieve the desired

goal. This ability is a fundamental foundation during the educational process, especially in the context of mathematics learning, where learners are often faced with various challenges that require problem-solving to overcome them (Sumartini, 2016; Suryani, Nizar, Yuniar, & Mega, 2020). In this case, they can solve problems in various ways, according to the objectives to be achieved. Problem solving ability is a very relevant ability for a learner, considering that in his daily life, he often faces situations that can be considered as problems. Effective mathematical problem-solving skills will enable learners to overcome problems that arise in everyday life based on the experience and understanding they have gained (Nasution, M. L., Yerizon, Y., & Gusmiyanti, 2018; Widyastuti & Airlanda, 2021). Problem solving emphasizes the methods and strategies students use to resolve an issue, rather than focusing on the final outcome. Students' critical thinking skills can theoretically enhance students' proficiency in mathematical problem-solving (Kusmanto, 2014; Nisa & Wandani, 2023; Prismana, Kusmayadi, & Pramudya, 2018). From these viewpoints, a conclusion can be drawn that mathematical Problem-solving ability is a fundamental skill that learners must possess to tackle everyday challenges. In mathematics education, problem-solving skills are closely linked to students' critical thinking abilities. These two skills are interconnected.

Every student needs to have the ability to organize, evaluate, and interpret information critically. Critical thinking ability is the formation of logical aspects such as the ability to provide argumentation, syllogism, and proportional statements, (Cahyono, 2015). Webster expresses critical thinking by stating that "Critical" means applying or practicing careful and objective judgment, so critical thinking is defined as thinking that requires precision in making decisions (Ayudya & Rahayu, 2020). Students are said to think critically if students can test their experiences, evaluate their abilities and ideas, and consider arguments before getting justification (Atmoko, 2014). So in its implementation, critical thinking involves students capacity to comprehend problems, formulate strategies, and analyze assumptions as part of the problem-solving process. As an issue, students must develop critical thinking skills in learning from the observation process to the conclusion (Sari & Suryadi, 2019). This opinion emphasizes that critical thinking skills are needed by every learner, therefore learners who have good critical thinking skills will be wiser and more precise in solving problems, learners who have critical thinking skills in dealing with problems will first make observations, then look for a basis or foundation in making decisions, then analyze and ultimately get the most effective solution to the problem.

Problem-solving skills are important as they help in understanding other subjects in school Mathematics is a subject that students are required to study at every educational level. Starting from the lower grades, this subject is applied with a focus on material that is still simple in nature. In the context of studying mathematics, students have the opportunity to develop their knowledge through literacy and numeracy skills. Both aspects must be combined harmoniously because they are the foundation of science that is essential in human life (Dinata, Miatu Habbah, Lathifah, & Noviyanti, 2022). In mathematics education, students are encouraged to bridge their understanding by linking abstract concepts to real-life problems, which is a key characteristic of mathematical learning. One of the attributes of learning mathematics is abstract. This abstract quality is what leads many students to encounter challenges in mathematics lessons, not only that, students also complain that mathematics lessons are boring, uninteresting, and have too many formulas (Marta, 2018). Mathematics learning is defined in an attempt to enhance students' grasp of mathematical concepts, problem-solving, and skills needed in everyday life and academic life. (Hwang, Wang, & Lai, 2021). Learning mathematics is very useful for developing students' abilities or skills in solving problems.

Variations in teaching style can exacerbate difficulties in understanding mathematics, especially when students are fearful of the subject (Sembiring, Hadi, & Dolk, 2008; Zubainur, Johar, Hayati, & Ikhsan, 2020). This is due to the abstract nature of mathematics material, making traditional teaching approaches less effective (Romberg, 2016). Several studies also explore research related to the effectiveness of interactive methods in enhancing mathematical understanding. Research by (Sukmawati, 2017) indicates that interactive learning using a drill strategy has an impact on enhancing comprehension of mathematical concepts. Research by (Aini, Nuritasari, & Tafrilyanto, 2022) has shown that the JARILIPAN

interactive method can aid students in understanding algebraic multiplication by contextualizing learning within real-world applications in mathematics.

Unsatisfactory understanding of mathematics and low learning outcomes can be attributed to several factors. One significant factor is the tendency of teachers to dominate the learning process through the application of rigid and traditional teaching methods. This approach emphasizes mastery of concepts and skills rather than building students' ability to solve problems. Secondly, teachers tend to deliver only mathematical theories and definitions without giving students a deeper understanding through real examplesStudents are frequently evaluated based on a series of exercises and questions without necessarily assessing their depth of understanding (Zubainur et al., 2020). Teaching often becomes a mechanical process, and teachers adhere strictly to the steps outlined in the textbook, overlooking students' comprehension and individual learning needs. As a result, learning mathematics becomes less meaningful. Challenges in primary school mathematics learning often revolve around students' proficiency in solving mathematical problems. Therefore, students need to understand the basic concepts of mathematics well before facing various challenges. Students who struggle with learning mathematics exhibit several noticeable characteristics. They often make mistakes in counting, have difficulty understanding geometry concepts, and face obstacles in solving mathematical story problems (Husna, MZ, & Vebrianto, 2021; Utari, Wardana, & Damayani, 2019). In this, the teacher's implementation of the learning process plays a crucial role. If learning is designed with the right approach, adjusted to the characteristics of students, and according to their level of understanding, the subject matter presented will be easy to understand. If students learn mathematics in the right way, then students will experience an increase in reasoning ability.

Research by (Ahdhianto, Marsigit, Haryanto, & Nurfauzi, 2020) attempted to evaluate the disparity in critical thinking and problem-solving scores between the application of problem-based learning methods and conventional teaching approaches. The research results indicated that the experimental group, which utilized problem-based learning, achieved higher posttest scores in critical thinking and problem-solving compared to the control group. Similar results were also found in research (Pramestika, Wulandari, & Sujana, 2020), which demonstrated that problem-based learning supported by concrete media significantly enhanced critical thinking skills in fourth-grade mathematics. Automation in basic mathematical operations, such as multiplication facts, is important for students to be able to focus on higher-level mathematical concepts and problem-solving strategies (Baker & Cuevas, 2018; Sukasno, 2012). Therefore, a teacher needs to determine the right model, method, strategy, and approach to achieve success in learning (Kamal, 2015; Malika, Endjid, & Magdalena, 2023). In contrast to what is found in the field, several challenges need to be understood in learning mathematics. Math learning activities still rely on the role of the teacher. Teachers in this school often deliver material monotonously, consequently, students become passive participants in the learning process. They have limited chances to contribute by offering real-life examples of problems. This results in a deficiency in students' ability to engage actively and participate effectively in the educational process.

Moreover, observations also showed that students' ability to solve mathematical problems and think critically was still far from expectations. They have fundamental difficulties in understanding the basic concepts of arithmetic operations, such as addition and subtraction. Even in converting story problems into mathematical sentences that can be calculated, students also often experience difficulties. Initial trials given to students showed concerning facts, where most students were only able to answer a few questions or even unable to solve them at all. Observations made during 2 hours of lessons obtained the following data. Based on the outcomes of observations on the observation sheet, it is evident that the researcher as a prospective teacher reflects with students on the activities that have been carried out, then the teacher conveys the material for the next meeting to be studied at home and closes the lesson with prayer because the timeliness in organizing learning looks quite good. Then, the results of observations made further indicated that students were proficient in problem-solving and think critically about mathematics by using a realistic mathematics learning model. This can be influenced by Students' comprehension of the material they have learned and can be gauged by their ability to articulate their understanding in their

own words or language, reflecting the content covered in the instruction. At the time of applying the realistic mathematics learning model, the teacher gave an initial test and final test to learners with a total of 3 questions.

Therefore, based on the mean value of 56, standard deviation of 6.23, median of 53, and mode of 53, students' problem-solving and critical thinking skills in mathematics are deemed to be quite proficient. Students' perceptions of mathematics also need to be considered. Many of them continue to view mathematics as a challenging and unenjoyable subject.. They find it difficult to understand mathematics material and it tends to be confusing. To address this gap in mathematics learning, changes in learning approaches, greater support for the development of students' problem-solving skills, and efforts to change students' perceptions of mathematics to be more positive and enjoyable are needed. With appropriate changes in learning methods and a more student-centered approach, there is hope that the quality of mathematics education in these schools can be enhanced..

Some of the problems found in the observations made by researchers at school affect learning activities in the classroom. To focus on the problem, the researcher limited the existing problems to only two aspects, specifically focusing on problem-solving ability and critical thinking ability. Numerous factors can influence the effectiveness of teaching and learning processes conducted by teachers, especially in learning mathematics, one of which is the application of an approach based on the characteristics of mathematics subjects.

Based on the existing problems, the solution to the problem is to apply the Realistic Mathematics Learning (RME) approach. RME utilizes real-life scenarios as a foundation for developing mathematical concepts and ideas. In this approach, students are allowed to interact with real objects or props as part of an effort to improve their understanding of mathematical connections. The application of the Realistic Mathematics Education (RME) approach in early childhood has been demonstrated to positively improve student learning results and deepen the meaning of the learning process (Adjie, Putri, & Dewi, 2020; Fatmawati, 2014).

The Realistic Mathematics Education (RME) approach is one of the established methods in mathematics education, emphasizing concrete relevance to actively involve students in the learning process under the guidance of the teacher. The Realistic Mathematics Education (RME) is an approach that begins with real-world contexts, enabling students to engage meaningfully in the learning process. (Afsari, Safitri, Harahap, & Munthe, 2021; Yuanita, Zulnaidi, & Zakaria, 2018). Realistic Mathematics Education (RME) is an approach that addresses the challenges associated with traditional and abstract methods of learning mathematics (Bray, Aibhín; Tangney, 2016). This approach originates from the evolution of Realistic Mathematics Education (RME) from the Freudenthal Institute, established in 1971 at the University of Utrecht in the Netherlands. In the Realistic Mathematics approach, learning begins with real-world problems, where students take an active role, the teacher acts as a facilitator, students are encouraged to express their ideas freely, and they are given opportunities to communicate their ideas with each other. The Realistic Mathematics Approach starts with students' real problems and emphasizes the process skills of thinking and working in mathematics learning, talking with friends, and collaborating so that students can discover for themselves and ultimately use mathematics for problem-solving individually and in groups (Nababan, S. A., & Tanjung, 2022; Syahputra, 2013).

The purpose of the Realistic Mathematics Approach (RME) to make mathematics education engaging and relevant for students by presenting problems in real-world contexts. The Realistic Mathematics Approach (RME) begins with the selection of problems that are appropriate to students' experience and knowledge (Laurens, Batlolona, Batlolona, & Leasa, 2018). The teacher's role as a mentor in guiding problem-solving processes positively influences students' proficiency in representing mathematical concepts and improving their problem-solving skills (Meika, Suryadi, & Darhim, 2018; Warsito, Darhim, & T, 2018). The Realistic Mathematics Education approach, which involves students in solving everyday problems, is widely considered the most effective method for teaching mathematics. This approach transforms the comprehension of mathematical concepts and their relationships, fosters a shift in learning culture, while maintaining integration with the existing educational framework. Realistic Mathematics

Education emphasizes the importance of linking mathematics with real life, starting from the real-life contexts as the foundation of learning (Mulbar & Zaki, 2018).

This study aims to explore how a realistic mathematics learning model influences students' problem-solving skills and critical thinking abilities in mathematics education. This study's novelty lies in its comprehensive approach, as no previous research has simultaneously investigated the impact of both problem-solving and critical thinking variables in this particular context. As such, this study not only focuses on the influence of each variable but also tries to understand how they interact together in the context of learning mathematics in primary schools.

2. METHODS

This form of research is Quantitative, employing a quasi-experimental method utilizing a Pretest-posttest Control Group Design. The experimental group underwent mathematics instruction using RME, whereas the control group received more traditional mathematics instruction. RME helps students to enhance their understanding of mathematical concepts by linking them to real-world scenarios. RME encourages students to solve mathematical problems in context, which helps develop their problem-solving skills. Before and after the treatment, both groups were measured with pretest and posttest tests to assess their problem solving and critical thinking skills. Data analysis was conducted to compare the differences between the two groups and evaluate the effect of RME on learners' problem solving and critical thinking skills.

Table 1. Pretest-Posttest Control Group Design

Sample	Pretest	Treatment	Posttest
R	O_1	X	O_2
R	O_3	-	O_4

Description:

R : Random sampling
X : Experimental class treatment
O1 : Experimental class pretest
O2 : Experimental class posttest
O3 : Control class pretest
O4 : Control class posttest

The objective of this research is to evaluate the influence of implementing the Realistic Mathematics Education (RME) approach on the problem-solving and critical thinking abilities of primary school students. The study population comprises all students at SDN Golo, with cluster random sampling employed as the sampling technique. Maksum (2012, p. 57) also explains that "In cluster random sampling, what is selected is not an individual but a group or area which is then called a cluster. For example, provinces, districts / cities, sub-districts, etc. It can also be in the form of classes and schools. Based on the results of the sample draw by cluster random sampling, there were two classes selected as samples in this study. Class II A comprised 22 students designated as the experimental group, while Class II B comprised 22 students designated as the control group. The experimental group was instructed using Realistic Mathematics Education (RME), whereas the control group received traditional learning methods.

This research uses descriptive data analysis techniques and statistical techniques using SPSS 25.0 for windows which consists of prerequisite analysis tests, namely, normality tests and hypothesis tests to determine whether there is an impact of the realistic mathematics approach (RME) on problem solving skills and critical thinking skills at SD Golo. Qualitative descriptive analysis is derived from observations conducted on both teachers and students. The following is a table of indicators and how to measure problem solving skills with reference to Polya's (1973) problem solving steps this process involves four main stages, the first is understanding the problem at hand, then developing a plan to

address the issue, implementing the plan, and finally re-evaluating the steps that have been taken. (Heryani & Ramadani, 2019):

Table 2. Problem-Solving Indicator

No	Problem-Solving Component	Indicator
1	Understanding the Problem	Students demonstrate the ability to precisely and comprehensively articulate the given information and the specific question or task presented in the problem.
2	Planning problem solving	Students can write the problem-solving plan correctly as a whole
3	Solving the problem according to the plan	Students correctly execute the problem-solving plan they have devised
4	Rechecking the results obtained	Students re-examine the work and write the conclusion correctly

The critical thinking indicators used refer to the critical thinking indicators put forward by Primasatya & Jatmiko (2018) which consist of four steps: 1) identify problems, 2) collect relevant information, 3) organize alternative problem solving, and 4) make conclusions. Critical thinking indicators are presented in table 4.

Table 3. Critical Thinking Indicator

No	Critical Thinking Component	Indicator
1	Identifying the problem	Students can identify problems
2	Gathering relevant information	Students can find material related to the problem
3	Generating alternative solutions to the problem.	Students can provide alternative solutions
4	Making conclusions	Students can make conclusions

3. FINDINGS AND DISCUSSION

This research involved several stages of analysis. The first stage is descriptive analysis. The second stage involves the prerequisite test of analysis, in the form of normality testing. The third stage involves hypothesis testing. After these stages are completed, the results of the study will be discussed. Each of these stages will be explained in more detail below:

3.1 Results of Descriptive Analysis of Problem-Solving Ability

This data on problem-solving ability was gathered from a total of 44 students, comprising 22 students from the experimental group and 22 learners from the control group. After taking data on the pretest and posttest tests, the data can be presented with central tendency measure data, namely median, minimum score, maximum score, mean and standard deviation. Therefore, it can be inferred that there is variability in the initial problem-solving skill scores of learners. In the experimental group, scores ranged from 58 to 90, accompanied by a standard deviation of 8.28. Meanwhile, in the control group, scores ranged from 50 to 95, accompanied by a standard deviation of 13.08. In addition, the average value obtained for the experimental group was 71.91 while the control group was 68.68, with the median of the experimental class 75 and the control class 67.50.

Then the post-test value of students' problem-solving ability varied, for the experimental class between 70 as the minimum value to 100 as the maximum value, and for the control class between 70 as the minimum value to 99 as the maximum value. The standard deviation for the experimental class was 7.764 and the control class was 9.580. In addition, the mean value obtained for the experimental

class was 85.23 while the control class was 83.55, with the median of the experimental class being 85 and the control class 84.50.

3.2 Results of Descriptive Analysis of Critical Thinking Ability

This data on critical thinking ability was collected from a total of 44 students, including 22 students from the experimental class and 22 students from the control class. After collecting data from pretest and posttest assessments, the data can be summarized using central tendency measures such as median, minimum score, maximum score, mean and standard deviation. Therefore, it can be concluded that there is variability in the pretest scores of students' critical thinking skills, for the experimental class between 50 as the minimum value to 90 as the maximum value and for the control class between 50 as the minimum value to 84 as the maximum value. The experimental class had a standard deviation of 9.694 and a mean value of 70.45, with a median of 71. In comparison, the control class had a standard deviation of 8.291, a mean of 62.50, and a median of 62.50.

The posttest scores of students' critical thinking skills varied, for the experimental class between 70 as the minimum value 95 as the maximum value, and for the control class between 64 as the minimum value and 88 as the maximum value. The experimental class had a standard deviation of 6.443, with a mean value of 82.77 and a median of 85. In contrast, the control class had a standard deviation of 6.139, with a mean of 72.41 and a median of 70.

3.3 Analysis Requirements Testing Results

Prerequisite tests of the analysis were carried out to determine the selection of appropriate statistics. These prerequisite test stages include testing the normality of the data. Normality was evaluated using the Shapiro-Wilk test in SPSS version 25 for Windows to ascertain whether the data adhered to a normal distribution or not. Research results are considered normal if the Asymp. Sig value is greater than 0.05; values of ≤ 0.05 indicate non-normal distribution. The following is a summary of the results of normality testing of problem-solving ability data in Table 5.

Table 4. Normality Test Results of Problem-Solving Ability

Shapiro-Wilk	df	Sig.	Description
Pretest_Experimen	22	0.331	Normally Distributed
Posttest_Experimen		0.795	

Based on Table 5, the normality test results show that the problem-solving ability data in the experimental class both on the pretest and posttest, are normally distributed. The significance value (Sig.) of the Shapiro-Wilk test for both classes is > 0.05 (0.331 for the experimental pretest and 0.795 for the experimental posttest). This means that the data does not show a significant deviation from the normal distribution. Then the following is a summary of the results from the normality test of critical thinking ability data in Table 6

Table 5. Critical Thinking Ability Normality Test Results

Shapiro-Wilk	df	Sig.	Description
Pretest_Experimen	22	0.425	Normally Distributed
Posttest_Experimen		0.650	

According to Table 6, the normality test results indicate that the critical thinking ability data for both the pretest and posttest in the experimental class are normally distributed. The significance value (Sig.) of the Shapiro-Wilk test for both classes is > 0.05 (0.425 for the experimental pretest and 0.650 for the experimental posttest). This indicates that the data does not show the significance of deviation from normal distribution. Based on these data, it can be concluded that problem-solving ability and critical

thinking ability are normally distributed. Therefore, parametric statistics can be used in further hypothesis testing.

3.4 Hypothesis Testing Results

Hypothesis testing was performed to assess the combined impact of Realistic Mathematics Education variables on problem-solving and critical-thinking skills. The Manova test was used to analyze the pretest and posttest results for problem-solving ability and critical thinking across both experimental and control groups of students, here are the summarized results from hypothesis testing of problem-solving and critical thinking abilities in Table 7..

Table 6. Manova Test Results

Variable	*Tests of Between-Subjects Effects* Group	Mean	Sig
Problem-Solving	Experiment	84.39	0.000
	Control	70.30	
Critical Thinking	Experiment	77.59	0.000
	Control	66.48	

According to Table 7, the calculation results for the problem-solving ability variable showed a significance value of 0.000, which is less than 0.05, suggesting that the results are considered significant. Therefore, H_0 is rejected, and H_a is accepted. Similarly, for the critical thinking ability variable, a significance value of 0.000 was obtained, indicating significance as it is less than 0.05. Hence, H0 is rejected, and Ha is accepted. These findings demonstrate a concurrent influence of the Realistic Mathematics Education (RME) approach on both problem-solving and critical thinking abilities.

Mathematics learning requires students to develop skills in problem-solving, mathematical modeling, solution design, and interpretation of results. Mathematics learning is not just an understanding of concepts or procedures but many possibilities that arise from the results of the mathematics learning process. Realistic Mathematics Education is an approach to learning mathematics that prioritizes meaningful contexts or problems as the foundation for mathematical instruction (Das, 2020; Gravemeijer, 2020). The RME concept teaches mathematics in a more contextual and constructivist manner, by providing students with mathematical experiences in the real world and helping students use mathematics as a tool to solve problems in everyday life (Priciliya, Sunardi, Yudianto, & Susanto, 2022; Wahyudi, Joharman, & Ngatman, 2017). The approach to realistic mathematics focuses on how students rediscover concepts or steps obtained in contextual problems (Siregar, Mujib, Siregar, & Karnasih, 2020; Uyen, Tong, Loc, & Thanh, 2021). The application of RME in mathematics learning is believed to help students understand and appreciate the correlation between mathematics and daily life.

Educators should prioritize and improve communication in mathematics instruction to strengthen students' comprehension of mathematical principles and improve their problem-solving abilities. Effective communication in mathematics is crucial for facilitating students' learning process and enhancing their proficiency in solving mathematical problems (Koskinen & Pitkäniemi, 2022; Shidki, Yusoff, Durairaj, Mohamed, & Peng, 2022). Factors influencing mathematical communication encompass the learning environment, students' attitudes, and their language skills. Thus, teachers need to realize that communication in mathematics is not only about students' ability to express their thoughts but also about understanding and overcoming barriers that can hinder the communication process. Efforts to promote mathematical communication require teachers' understanding and skill in overcoming barriers such as language problems and concerns about students' public speaking skills, teachers can utilize interactive and contextualized classroom activities (Kaya, 2016; Koskinen & Pitkäniemi, 2022).

One advantage of realistic mathematics learning is that students engage in solving applied mathematical problems through a realistic learning process. Contextual problems in question are real and concrete problems that are relevant to students' environments and can be observed or understood by them. The advantages of the realistic mathematics approach (RME) include its ability to assist students to better understand mathematics by introducing mathematical concepts through real-world contexts and helping students use mathematics as a tool to solve problems in everyday life (Ilyas, M., & Salwah, 2017; Yuanita et al., 2018). RME can also improve students' problem-solving skills and critical and creative thinking skills. The RME approach can provide many benefits in learning mathematics, including improving mathematical abilities, activating student learning, and developing students' social skills. (Laurens et al., 2018; Yuanita et al., 2018).

The Realistic Mathematics Approach aims to create meaningful and relevant mathematics learning for students. The aim of realistic mathematics learning (RME) is to offer students opportunities to engage with mathematical concepts in real-world contexts, thereby fostering a robust understanding of these concepts (Jeheman et al., 2019a). The purpose of employing the Realistic Mathematics Education (RME) approach is to foster a more contextualized learning environment for mathematics, interesting, effective, and relevant to students' daily lives (Lisnani, Putri & Somakim, 2023). Not only that, but the application of the RME approach aids in cultivating critical, creative, and collaborative thinking skills, as well as communication skills, which are essential for learners in the 21st-century era of globalization and competition. A realistic approach to teaching mathematics aims to develop learners' deeper understanding by focusing on real-world or contextual situations (Stacey, K., & MacGregor, 2016). The advantages of the realistic mathematics approach (RME) include its ability to assist students and actively in finding mathematical concepts through problem-solving in everyday contexts (Öksüz, Eser, Genç, & The, 2022). The context learning strategy used can involve combining mathematical material with the context in which students are located. These strategies use real-life examples to help students understand math concepts and provide context-based tasks to solve problems (Permata, Kusmayadi, & Fitriana, 2018).

In this study, to determine the extent of students' understanding of solving systematic problems, researchers conducted a Manova test, as shown in Table 11, with the results of Sig. (2-tailed) 0.00 < 0.05, based on these data, the hypothesis states that realistic mathematics learning influences on the problem-solving ability and mathematical critical thinking of grade II students of SD N Golo. Thus, the theory studied in 2020 research with the findings of the observation results obtained information that students' proficiency in mathematical problem-solving remains inadequate. This can be seen with the percentage score at the third cycle meeting of 80.12%. From the data obtained, it is known that students are very capable of making their modeling in finding formal solutions, students are very capable of finding their own (constructing) formal solutions, and students are very capable of actively answering oral questions from the teacher (Rizki, Wahyu, & Sangkot, 2020). In the 2022 study, it was found that the calculation of$t$-statistic gave a result of 7.02, clearly exceeding the critical value of$t$-table 2.0017. As a result, $H0$ is rejected, and Ha is accepted. Therefore, it can be inferred that the implementation of realistic mathematics learning significantly enhances the mathematical problem-solving ability of students in the second grade at SDN DUKUH 09 PAGI (Fery. H & Sigid. E. P., 2022).

In the study, the implementation of the RME approach effectively reduced students' perception of mathematics as difficult or boring. Teachers facilitated this approach by presenting real-world problems for classroom discussion. For example, during geometry lessons, students were instructed to draw various shapes using objects found in their surroundings. Additionally, teachers encouraged students to use rulers to measure objects such as books, blackboards, tiles, tables, and windows. Teachers also use everyday materials when implementing RME such as pieces of fruit or paper fractions to aid students in comprehending the concept of fractions. The teacher teaches fractions by asking students to divide the apple into equal parts to understand the concept of fractions.

The results indicated that Students who were exposed to the realistic mathematics education approach showed notable enhancement in their mathematical problem-solving skills, and this suggests

that this approach can be a useful alternative to help students with learning disabilities to be more successful in mathematics. In a study, it was also mentioned that the The Realistic Mathematics Education (RME) approach positively impacts the critical thinking skills of primary school students. The results of the analysis indicated that students' critical thinking abilities in the experimental group exhibited a more substantial increase compared to the control group. The research findings show that realistic mathematics education proves highly effective in enhancing the mathematical problem-solving abilities of students facing learning challenges. Not only that, the RME approach was also shown to boost mathematical confidence, visualization, and problem-solving abilities (Şanal & Elmali, 2023; Yuanita et al., 2018).

In this study, the RME approach encourages students to develop critical thinking skills through a better learning experience than the conventional learning approach. This is supported by learning activities that trigger students to interact in the context of mathematical problems that are more realistic and relevant to everyday life (Cahyaningsih & Nahdi, 2021; Lestari & Surya, 2021). Students who are given RME learning through class discussions can show higher creative thinking behavior than students who undergo conventional teaching. The stages of the creative thinking process found were identifying problems, solving problems, exploring solutions, using levels of abstraction, and assessing results. The research supports the effectiveness of RME in improving students' creative thinking and mathematical problem-solving skills (Darto, 2021; Sitorus & Masrayati, 2016). So it can be concluded that the use of the RME approach can improve the mathematical critical thinking skills of elementary school students and be a good alternative to elevate the standard of learning.

The application of Realistic Mathematics Education (RME) principles in teaching activities can significantly improve students' understanding and engagement with mathematics concepts (Febriani & Sidik, 2020; Nur'aini, Irawati, & Julia, 2016). Thus, the use of real-life contexts in teaching mathematical concepts can be a reference for curriculum developers to insert more real-world problems in mathematics learning. Research by (Laurens et al., 2018) shows that RME helps students see the relevance of mathematics in their daily lives, making the subject more interesting and motivating for them. Overall, results from research in the field of RME can have a great impact on teaching practices, curriculum development, and educational policies, which will ultimately result in better outcomes for students in mathematics learning.

The goal of RME is to offer students with chances to explore and build mathematical principles within real-world contexts, thereby promoting a more profound comprehension of mathematical principles (Ulfah, 2022). Moreover, RME enhances students' comprehension of how mathematics applies to and impacts everyday life (Jeheman et al., 2019b; Lestari & Surya, 2021). Education policymakers need to consider implementing the RME approach in the mathematics curriculum in all schools in Indonesia. In addition to improving student learning outcomes, the RME approach can also assist teachers in developing more innovative and student-centered teaching strategies. Her research recommends that the RME approach be implemented more widely in Indonesian schools to improve the standard of mathematics education and help students develop good mathematical and social skills (Laurens et al., 2018). The implementation of mathematics learning tools utilizing the RME approach can improve students' mathematics skills in elementary schools. Tools such as student worksheets and RME-based mathematics learning modules are considered effective in improving students' mathematics skills. In addition, math skills tests and student response questionnaires can be used as tools to measure student progress in RME-based mathematics learning (Syafriafdi, Fauzan, Arnawa, Anwar, & Widada, 2019; Yuanita et al., 2018).

This study conclusively demonstrated that the Realistic Mathematics Education (RME) Approach positively influences students' critical thinking and mathematical problem-solving skills. Therefore, it is recommended that teachers adopt the RME Approach and encourage active participation and engagement from students in classroom discussions. The RME approach allows students to build an understanding of the topic being taught. They can cultivate their ideas to form concepts at each stage of learning. Many students generate solutions that may vary in approach but lead to the same answer,

fostering confidence in their results and nurturing deeper arithmetic understanding. School administrators should support teachers in addressing negative perceptions of mathematics instruction and learning. The effectiveness of the RME Approach suggests potential for its sustainable application in teaching various subjects to secondary school students. Future research could further investigate the implementation of the RME Approach across different educational levels to enhance understanding of its broader impact.

The main contribution of this research aims to explore different learning methods commonly employed by students in their daily lives and can be a source of inspiration for teachers in improving the effectiveness of learning through their creativity. In addition, the RME approach has been demonstrated to be an effective method for developing critical thinking and problem-solving skills, which in turn can contribute positively to student performance. Several prior studies have investigated how mathematical depiction serves as an intermediary between critical thinking and problem-solving abilities. This study aims to bridge this gap by developing a novel relationship framework using a quasi-experimental research design.

The results of this study underscored the disparities in critical thinking and problem-solving skills between students who participated in the Realistic Mathematics Approach (RME) and those in conventional learning methods. It is recommended that mathematics teachers adopt the RME Approach in classrooms to facilitate a more accessible comprehension of abstract mathematical concepts for students. Teachers are encouraged to demonstrate creativity and innovation in designing learning experiences through this approach. Moreover, educators should cultivate varied learning tools, approaches, or methodologies that better resonate with the subject matter and contextual requirements of their students. In addition, schools need to establish an educational atmosphere that is rich with information on how to solve real-life problems. This can help students develop their critical thinking skills through relevant real-world contexts.

The strength of this research is the realistic mathematics approach (RME) in improving learners' ability to resolve mathematical problems. This research showed that the implementation of RME significantly improved learners' arithmetic problem-solving skills. Not only does it improve problem-solving skills, but it also contributes to the development of learners' critical thinking. Successful problem-solving by learners requires a combination of critical thinking skills and psychological factors, and RME is recognized to make a positive contribution in this aspect. So learning mathematics through RME brings the benefits of systematic, logical, and critical development. The advantages of mathematics that build systematic, logical, and critical thinking skills are the positive impacts of using RME.

One of the study's limitations is its very short duration, which makes it impossible to observe the long-term effects of the application of realistic mathematics learning, so long-term phenomena are not seen during a short period. Not only that, differences in the level of cognitive development of learners based on age affected the results of the research. Mathematical understanding and problem-solving skills can differ between age groups.

4. CONCLUSION

The implementation of RME significantly enhances the problem-solving and critical thinking skills of primary school students. Those engaged in RME learning demonstrated improved abilities to solve mathematical problems using contextualized, real-world scenarios, thereby enhancing their critical thinking skills. This underscores the crucial role of RME in enhancing learners' problem-solving and critical-thinking abilities. Due to limitations in research capacity, the study included only 22 students in the experimental class. Therefore, further research is expected to involve more samples from several schools in order to obtain more accurate results. For teachers, the application of realistic learning can be combined with other variables, such as the application of realistic learning with project-based learning or by developing learning media based on realistic learning, considering the benefits that can be obtained from the application of RME.

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