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The Effectiveness of Using a Realistic Mathematical Approach in Improving Students' Critical Thinking Skills in School Base

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ABSTRACT

This study aims to evaluate the effectiveness of the Realistic Mathematics Education (RME) approach in improving the critical thinking skills of elementary school students. Evaluation is carried out through a systematic literature review of national and international scientific articles. This study found that the RME approach has a significant positive impact on improving students' critical thinking skills. This approach relies on real-world contexts that are relevant to students' lives, making math material more meaningful and easy to understand. This makes learning more contextual and applicable in daily life. The results showed that RME was able to improve various critical thinking indicators, such as analytical ability, evaluation, interpretation, and inference, compared to conventional approaches. In addition, RME also encourages active student involvement in the learning process, strengthens conceptual understanding, and builds problem-solving skills. By involving group discussions, mathematical modeling, and reflection, RME not only improves learning achievement but also fosters independent thinking and critical attitudes in dealing with contextual math problems. Thus, these findings reinforce the urgency of implementing RME as a practical and relevant learning approach to be applied at the basic education level.

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1. INTRODUCTION

Education is actually a way to pass on values that serve as a guide and direction in daily life. These values are the basis for the formation of students' character and insight in facing social dynamics and future challenges. Through education, we can distinguish between past, present, and future generations, whether they are more advanced or of declining quality. Until now, education has no limitations in defining the meaning of education as a whole because of its complex nature, such as its goal, which is human. This complex nature is often known as the science of education. Education is a continuation of the educational process itself. Educational science focuses more on educational theory that emphasizes science-

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based thinking. Both education and educational science are interrelated in terms of practice and theory. The rapid advancement of science and technology requires education to play a role in preparing human resources who have high abilities and intelligence [1][2]. Thus, the role of education has become increasingly strategic in equipping the young generation with 21st-century skills.

One of the subjects that plays a role in education is mathematics, because mathematics is a part of human life. Mathematics is a way to find answers to problems facing humans, how to use information, use knowledge of shapes and sizes, use knowledge of counting, and, most importantly, think for yourself in seeing and using relationships. This ability reflects a high-level thinking process that is indispensable in daily life and the world of work. So that learning Mathematics can support students in honing their logical, critical, analytical, systematic, and creative thinking skills [2][3]. Thus, the mastery of mathematics is not only oriented to academic results, but also to the process of cognitive development of students.

In mathematics learning, in addition to achieving the goals set in each material, students also need to be equipped with specific skills so that they can develop and solve arguments in certain problem-solving situations. One of the skills that needs to be developed to achieve this goal is the ability to think critically [4]. However, students' critical thinking skills have not been trained in mathematics lessons because the teaching carried out by teachers is still conventional. Therefore, teachers need to deliver the material in the right way, so that students can get meaningful lessons and understand well what is being learned [5]. This emphasizes the need for innovation in mathematics learning methods that are more contextual and student-centered.

A student can think critically with the following characteristics: (1) searching for meanings that involve mental processes to understand an experience, (2) analyzing facts, generalizing, organizing ideas, drawing conclusions in solving problems, and (3) being active, systematic in understanding and evaluating arguments. In critical thinking skills, it is expected that there will be a serious effort to validate assumptions by looking for substantial evidence and the resulting conclusions. Thus, critical thinking skills are an essential foundation in rational decision-making and problem-solving. One of the mathematics learning methods that can support students in improving their critical thinking skills is the Indonesian Realistic Mathematics Education approach [5][6].

The Realistic Mathematics Education (RME) approach is essentially the use of reality and the environment that students understand. This aims to help the mathematics learning process so that it can achieve the goals of learning mathematics better than before [7]. RME is a form of learning that uses real objects, utilizes contextual problems, uses mathematical models, activities that build material by students themselves, and is student-centered by involving interaction between students [8].

These characteristics suggest that RME is highly aligned with constructivism-based and active learning approaches. This approach relies on reality and a familiar environment for students to facilitate the learning process in achieving the goal of mathematics education,

which is to improve abilities. Thus, the RME approach to teaching children with learning difficulties repeatedly, primarily through Single Subject Research (SSR), can provide more opportunities for children with learning difficulties to learn optimally at school [9]. In addition to being beneficial for regular students, this approach is also inclusive and adaptive to diverse learning needs.

Realistic mathematics has the following operational steps: (1) assigning problems by teachers; (2) solve problems by students in their way; (3) students who have different solutions to the problem present the results; (4) other students respond to their friend's work; (5) choose the best results; (6) ending the learning with reflection [10]. These measures encourage the formation of collaborative and reflective learning communities, which strengthen the critical thinking process.

The purpose of this study is to assess how practical the Realistic Mathematics approach is in improving critical thinking skills among elementary school students. This study specifically wanted to find out how much the application of this approach affected the improvement of students' critical thinking skills. In addition, this study also aims to find out the extent to which the Realistic Mathematics approach can improve students' critical thinking skills compared to conventional learning methods. With the results of these findings, it is hoped that RME can become a strategic alternative in mathematics learning to create a generation of learners who think critically and adaptively.

2. METHOD

The type of research used in this study is literature study research with data collection methods, library studies, or literature studies. This approach was chosen because it is in accordance with the research objectives that focus on the analysis of theories and previous findings. The literature study method is a series of activities related to library data collection methods, reading and recording, and managing research materials [11]. The data used includes articles from national and international journals. The sources were selectively selected based on academic eligibility criteria and relevance to the research topic. The selection of literature is based on the following inclusion criteria: a) related to the Realistic Mathematics approach and critical thinking skills of elementary school students; b) has gone through a peer-review process or comes from a recognized academic institution.

With this method, researchers can conduct research by recognizing, analyzing, assessing, and interpreting all the results that other researchers have obtained. By identifying or evaluating the correct and systematic article, the researcher will conduct a review. The researcher will conduct this review by systematically identifying several journals according to predetermined procedures, following the research of Triandini, Jayanatha, Indrawan, Putra, and Iswara (2019) using the Systematic Literature Review [12]. The application of this method allows researchers to compile a targeted and in-depth synthesis of the literature. This stage of literature study itself has a similar preparation stage to other studies. However, the methods and sources of data collected in this study are different. This research was carried out by taking information from the library, reading articles, notes, and process materials from the research related to the variables being investigated [13]. Thus, this

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literature study method is able to provide a strong theoretical foundation and support the conceptual validity of the research.

3. RESULTS AND DISCUSSION

Realistic Mathematics Education, or RME, is a theory about learning mathematics. One way in this approach is to use the "real world" as a context. The material taught in learning must be relevant to the daily life of students [11]. This approach is based on the principle that mathematical comprehension is stronger when it is associated with the real experiences that students have.

First, this approach helps students understand the relationship between math and their daily lives, making complex concepts more transparent and more relevant. This is important because it bridges the gap between abstract mathematical concepts and their application in everyday life. Second, it makes students aware that they can build and develop mathematical understanding independently, which helps them take ownership of the learning process. This independence of learning encourages active student engagement and reinforces a sense of responsibility for one's knowledge. Third, improve students' critical thinking skills in mathematics, preparing them to analyze and evaluate problems effectively.

These critical thinking skills are essential in dealing with complex challenges that require logic-based problem-solving. Finally, it improves students' ability to solve problems and connect mathematical concepts, encouraging them to use mathematics in a variety of situations in meaningful ways [14]. This ability supports the formation of numeracy competencies that are relevant to the needs of the 21st century. In addition to these cognitive benefits, the Realistic Mathematics approach also has a significant impact on student activities in the classroom, including in terms of motivation and learning achievement. Activities carried out during the learning process include reading and understanding the problems listed on the student's worksheet, listening carefully to the teacher's explanation, recording information from the teacher's explanation, completing problem-solving tasks in the worksheet, and discussing answers with friends and teachers.

The active involvement of students in these activities creates a collaborative and interactive learning atmosphere. In addition, other activities involved are taking notes from books or friends, asking questions, exchanging ideas, and drawing conclusions. All of these activities, considered together, contribute positively to the effective use of time and meet the requirements to achieve learning objectives. Thus, the implementation of RME not only strengthens students' mathematical competence but also builds a productive and enjoyable learning environment.

3.1. The Effectiveness of Realistic Mathematical Approaches in Improving Abilities Critical Thinking of Elementary School Students

The effectiveness of the Realistic Mathematical Approach (RME) in improving the critical thinking skills of elementary school students has been widely studied by researchers. Although there are some technical and pedagogical obstacles in practice, this approach still

shows a positive impact on students' ability to solve mathematical problems. Based on the analysis of various scientific articles, the Realistic Mathematics approach has been proven to be successful in developing students' critical thinking skills. This can be seen from the higher average scores in the class that used the experimental approach compared to the control class. In addition, there was a significant increase in scores on critical thinking indicators such as interpretation, analysis, evaluation, and inference. This approach is considered more effective than conventional methods because it encourages students to be active, collaborative, and connect mathematical concepts with real-life contexts [15][16].

During the learning process, students actively build an understanding of the concept of opportunity through the experience and knowledge they already have. This activity reflects the main principle of constructivism theory, which is the foundation of the PMR approach, which is that students are active subjects in the learning process. In its implementation, students show a more severe attitude in listening to the material and completing the assignments given. On the other hand, teachers also experience an improvement in the quality of teaching, both in conveying learning objectives, motivating students, guiding activities, delivering material systematically, and in evaluating and giving awards [17][18]. Thus, RME contributes not only to student achievement but also to the quality of teacher professionalism in the classroom.

Although both the RME and the contextual approach use real problems as a starting point for learning, the results show that the RME provides more significant outcomes. This is because RME emphasizes a deeper and more continuous process of knowledge construction and requires the active involvement of students in the mathematical thinking process. This aspect of active participation is what makes RME superior in honing high-level thinking skills. In addition, the results of this study are also in line with previous studies. For example, Smith et al. (2021) concluded that the RME approach is consistently able to improve students' critical thinking skills in mathematics learning. Meanwhile, Wahyuni (2020) shows that contextual approaches are effective in deepening students' conceptual understanding [19][20]. This conformity reinforces the validity of the findings and confirms the advantages of the RME approach.

Overall, the RME approach is not only able to improve students' learning achievement, but also gives them critical thinking skills and sensitivity to mathematical problems that arise in everyday life. This shows that RME plays an essential role in shaping the 21st-century character and competencies needed by students. Therefore, teachers and schools must consider the use of more relevant, contextual, and meaningful teaching methods such as RME in the classroom learning process. By integrating this approach, the teaching and learning process becomes more transformative and oriented towards the development of critical thinking skills in a sustainable manner.

3.2. How Realistic Math Approaches Affect Students' Critical Thinking Skills in Math Learning

Realistic contexts in math learning play an important role in sparking students' curiosity and reflective thinking. The Realistic Mathematics Approach (PMR) uses problems originating

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from students' daily lives as a starting point for learning, so that the material learned becomes more relevant and meaningful for them. With this approach, students don't just learn math as a collection of formulas, but as a tool to understand and solve real problems they face on a daily basis.

Through this method, students will more easily understand the close relationship between mathematics and daily life. Thus, their interest in math lessons will increase. In addition, the use of concrete and contextual media in PMR helps students understand mathematical concepts gradually, ranging from concrete (*enactive*), visual representation (*iconic*), to abstract symbols. This stage supports the development of students' critical and reflective thinking skills in understanding and applying mathematical concepts [21][22]. This approach indirectly trains the gradual and logical way of thinking that is the foundation of critical thinking.

The influence of this approach on students' critical thinking skills can be explained in the following seven points:

1) Modeling and Representation Help Developmental Analysis

Students use representational models in the form of tables, diagrams, or verbal statements to bridge concrete information into abstract forms. This indicates the existence of analytical processes and information synthesis, which are strong indicators of critical thinking skills. This activity reflects the ability to process information in depth and formulate relevant mathematical arguments. Analysis indicators function to find the relationship between the question and the concept in the problem presented, so that it can provide the correct explanation. In this indicator, students can already understand the relationship between the concepts listed in the issues faced.

The results showed that the average success of the analysis indicators in the experimental class reached 3.20. This result is in accordance with research conducted by Rosmalinda, which states that students with high critical thinking skills are able to answer questions by providing explanations about the modeling they made correctly. In line with Munira's (2020) research, it was explained that students with moderate critical thinking skills are also able to create mathematical models correctly [23]. These findings confirm that visual representations in PMR significantly support the understanding and analysis process.

2) Group Discussion Strengthens Student Evaluation and Argument

Through group discussions and presentations, students learn to critique ideas, respond to peer opinions, and provide solutions based on mathematical reasoning. This activity strengthens the evaluative dimension of critical thinking. By actively participating, students not only absorb knowledge but also practice the ability to assess and filter information. Students in the experimental class show enthusiasm and active involvement in the learning process because the material taught is related to daily life, making it easier to understand.

This approach is characterized by group discussions, collaboration between students, and problem-solving in context. On the other hand, the control class looked more passive, where students listened more to the teacher's explanations and showed a lack of active participation during learning. This finding is in line with the opinion of Hartono (2008:7), who stated that the Realistic Mathematics approach through the presentation of contextual problems can improve conceptual understanding, encourage students to understand the relationship between mathematics and the real world, and build critical thinking skills. Thus, involvement in discussions encourages students to think critically collectively and reflectively [24].

3) Students are able to develop solutions based on strategies developed by themselves

In the PMR approach, students are encouraged to build understanding and problem-solving strategies based on their own experiences, rather than just copying. This process trains students to formulate solutions independently, adapting techniques to the characteristics of the problem at hand. This improves their ability to plan and strategize critically, rather than follow routine procedures.

The critical thinking skills assessment aims to offer solutions that are expected to solve the problem at hand. The study's analysis showed that the average success rate of students in the experimental class was 2.86. This is in line with Rosmalinda's (2021) research, which revealed that students with moderate critical thinking skills can write strategies correctly to solve problems and perform calculations accurately [23]. This strategy-based problem-solving activity builds students' confidence in compiling logical and relevant mathematical arguments.

3.3. The extent to which a realistic mathematical approach can improve students' critical thinking skills compared to conventional learning methods

The shift from traditional approaches to learning mathematics that are abstract to more contextual methods has shown great potential in developing higher-level thinking skills. The Realistic Mathematics Education (RME) approach has the unique ability to improve problem-solving skills in elementary school students, as illustrated in the results of the study. Based on Piaget's theory of cognitive development, elementary school-age children are in a concrete operational stage, so they can more easily understand material through direct experience**.** Against this background, the RME approach becomes particularly relevant because it presents mathematics through real-life situations that are meaningful to students [25].

Thus, an RME framework based on real-life contexts is able to increase students' cognitive engagement. RME connects mathematical concepts with real-life situations that are familiar to students, so that they can be mentally manipulated and applied concretely in problem-solving. Compared to traditional learning methods that focus on the role of teachers, PMRI's approach has proven to be more effective in building students' critical thinking skills. In a conventional learning system, students tend to

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memorize formulas and pursue the result, without understanding the thinking process behind it. As a result, they become passive and unaccustomed to thinking reflectively and analytically.

Several previous studies also reinforce these findings. Meirisa, Rifandi, & Masniladevi (2018) stated that the use of PMRI significantly affects the improvement of students' critical thinking skills. In addition, Afriansyah, Herman, Turmudi, & Dahlan (2021) showed that the mathematics learning outcomes of prospective teachers who participated in RME-EM-based learning were much better than those who participated in conventional learning, especially in the aspect of critical thinking. This shows that the characteristics of PMRI are able to encourage teachers and students to think more actively, reflectively, and contextually [12].

3.4.Advantages of the RME Approach over Conventional Learning

Better academic achievement indicates a more complex thought process. In traditional classes, students generally learn by memorizing and imitating problem-solving steps. In contrast, RME requires students to understand concepts in depth and apply them in real-world contexts. This condition has been proven to improve post-test scores and improve students' overall learning outcomes, because students are actively involved in building their understanding.

Relevant context enhances analytical skills and the ability to conclude. By presenting contextual issues such as the case of credit sales, RME helps students identify essential factors, analyze relationships between variables, and formulate logical reasoning. These activities not only encourage conceptual understanding but also reinforce weak analytical thinking skills in traditional approaches. Argumentation and evaluation skills are enhanced through discussion and collaboration. Through group discussion and presentation activities, students practice developing arguments, providing mathematical reasons, and evaluating solutions proposed by peers. This dialogue space allows students to critically test and reflect on their ideas, which is rarely found in one-way learning.

The role of teachers as facilitators encourages students' independent thinking. In the RME approach, the teacher is not only a source of information but also a facilitator who directs students to explore solutions independently. This transformation of the teacher's role has a positive impact on increasing students' responsibility in the learning process and developing a reflective and critical attitude toward understanding mathematical concepts.

4. CONCLUSION

Based on the results and discussion, the Realistic Mathematics Education (RME) approach has proven to be effective in improving students' critical thinking skills, especially at the elementary school level. This effectiveness can be seen from the increase in essential indicators of thinking, such as interpretation, analysis, evaluation, and inference skills, which are more prominent compared to conventional approaches. This approach prioritizes the use

of real-world context as a starting point for learning, which makes math material more relevant, meaningful, and easy for students to understand. The relationship between mathematical concepts and daily experiences makes the learning process more internalized and meaningful for students.

This not only enhances conceptual understanding but also encourages students to think reflectively, analytically, and evaluatively. The RME approach opens up space for students to process independently and actively in building knowledge through real, directed experiences. In addition to improving learning outcomes and critical thinking skills, this approach also has a positive impact on the dynamics of learning activities, increases active student involvement, and changes the role of teachers to facilitators who guide the process of constructing students' knowledge in a more dialogical manner.

When compared to conventional approaches, PMR shows more significant results in terms of concept mastery, problem-solving, and high-level thinking skills. This striking difference shows that RME is able to answer the challenges of mathematics learning, which has tended to be procedural and less contextual. Thus, it can be concluded that the Realistic Mathematics approach is a superior learning method and is highly recommended to be applied in mathematics learning in elementary schools. The application of RME not only fosters deep understanding but also strengthens critical thinking skills and problem-solving abilities in real-life contexts on an ongoing basis.

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