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IMPLEMENTATION OF REALISTIC MATHEMATICS EDUCATION (RME) IN FRACTION LEARNING TO IMPROVE ELEMENTARY SCHOOL STUDENTS' CONCEPTUAL UNDERSTANDING

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ABSTRACT

Mathematics learning in elementary schools often faces challenges in improving students' conceptual understanding, especially in fractions. A fifth-grade teacher at Sd Negeri 61 Banda Aceh City, Mrs. N, said in an interview session that during the teaching and learning process in the classroom, teachers still tend to use lecture methods as is generally used so that the teaching and learning process in the classroom is conventional and lacks creativity during learning, students are unable to implement it into real life. The Realistic Mathematics Education (RME) approach provides a solution by connecting mathematical concepts with real-life contexts, making it easier for students to understand and apply fraction concepts more meaningfully. This study aims to analyze the implementation of the RME model in fraction learning and its effect on elementary school students' conceptual understanding. The research method used is a quasi-experimental study with a pretest-posttest control group design. The research subjects consisted of fifth-grade elementary school students who were divided into an experimental group (with RME) and a control group (with conventional methods). The research instruments included conceptual understanding tests, observations, and interviews to obtain quantitative and qualitative data. The results showed that students who learned with the RME approach experienced a more significant increase in conceptual understanding compared to students who learned using conventional methods. RME-based learning can help students construct fraction concepts through exploration of contextual situations, group discussions, and reflection on problem-solving strategies. Therefore, using this approach can be an effective strategy in improving the quality of fraction learning in elementary schools.

Keywords: Realistic Mathematics Education (RME), Fractions, Conceptual Understanding, Elementary School

INTRODUCTION

Mathematics is one of the subjects that plays an important role in the world of education, especially in elementary school. Mathematics learning is not only aimed at teaching students how to count, but also to develop conceptual understanding, logical thinking, and problem solving skills (Kasmini et al., 2024). One concept in mathematics that is often a challenge for elementary school students is fractions. The concept of fractions is part of numbers that are closely related to everyday life, such as in measurement, division, and proportion (Suryaningtyas et al., 2020). Vvarious studies

show that many students have difficulty understanding the concept of fractions because of their abstract nature and differences from integers (Kartini et al., 2022). Several factors that make it difficult to learn fractions include a less contextual learning approach, teaching methods that emphasize memorizing formulas rather than understanding concepts, and the lack of use of teaching aids that can help students understand fractions visually and concretely. In traditional learning approaches, students are often taught to memorize the rules of fraction operations without understanding the concepts behind the rules. As a result, they have difficulty applying the concept of fractions in problem solving and everyday life. To overcome this problem, a learning approach is needed that can connect the concept of fractions with students' real experiences and help them build a deeper understanding (Sari & Subekti, 2023).

One approach that can be used to improve students' conceptual understanding of fractions is Realistic Mathematics Education (RME) (Angraini & Muhammad, 2023). Realistic Mathematics Education (RME) is a learning approach developed in the Netherlands and is based on the principle that mathematics learning should be contextual, interactive, and based on exploration and reflection (Ayu & Syariffuddin, 2021). This approach emphasizes that students must be helped to build their own understanding through real experiences and meaningful situations. In Realistic Mathematics Education (RME), learning is not only centered on the teacher, but rather prioritizes the active role of students in discovering, exploring, and constructing mathematical concepts (Putri & Admoko, 2022). The main principle in RME is the use of real world contexts as a starting point for learning. In the context of fraction learning (Kusuma et al., 2020). Students can be introduced to concepts through everyday situations, such as dividing a cake, measuring the length of an object, or understanding parts of a group of objects. Students not only memorize fraction rules but also understand their meaning in everyday life. In addition, this approach also emphasizes the use of visual representations, such as diagrams, area models, and number lines to help students understand the concept of fractions more concretely before moving on to symbolic representations (Purnamatati et al., 2023).

Previous studies have shown that the RME approach can improve students' conceptual understanding in various mathematical topics, including fractions. A study conducted by Gravemeijer and van den Heuvel-Panhuizen (1991) stated that the RME approach is effective in helping students understand mathematical concepts better than conventional methods. In addition, research conducted in Indonesia also shows that the application of Realistic Mathematics Education (RME) can improve learning outcomes and student motivation in learning mathematics in elementary schools. The availability of learning resources and learning aids that support the Realistic Mathematics Education (RME) approach is also an important factor in the success of implementation. The use of teaching materials that are in accordance with the principles of Realistic Mathematics

Education (RME), such as context-based textbooks and manipulative teaching aids, can help students understand the concept of fractions better. Therefore, the development of teaching materials and learning aids that support the Realistic Mathematics Education (RME) approach is one of the steps that need to be considered in efforts to improve the quality of fraction learning in elementary schools (Kusuma et al., 2020).

Based on this background, this study aims to analyze the implementation of the Realistic Mathematics Education (RME) approach in fraction learning and its influence on elementary school students' conceptual understanding (Ayu & Syariffuddin, 2021). This study will examine how the application of Realistic Mathematics Education (RME) can help students understand the concept of fractions more deeply, and how this approach can improve their ability to solve problems related to fractions. In addition, this study will also explore the challenges and obstacles faced in the implementation of Realistic Mathematics Education (RME), as well as strategies that can be used to overcome these challenges. Expected to contribute to the development of more effective mathematics learning methods that are in accordance with the characteristics of elementary school studentsThe findings of this study are expected to provide insights for educators, researchers, and policymakers in developing more innovative learning strategies based on student needs. Through the development of teaching materials and training programs for teachers in implementing the Realistic Mathematics Education (RME) approach in the classroom, students can significantly improve their mathematics learning outcomes. The implementation of the Realistic Mathematics Education (RME) approach is crucial for fraction learning; this strategic step can also improve the quality of mathematics education in elementary schools (Setiawan et al., 2024).

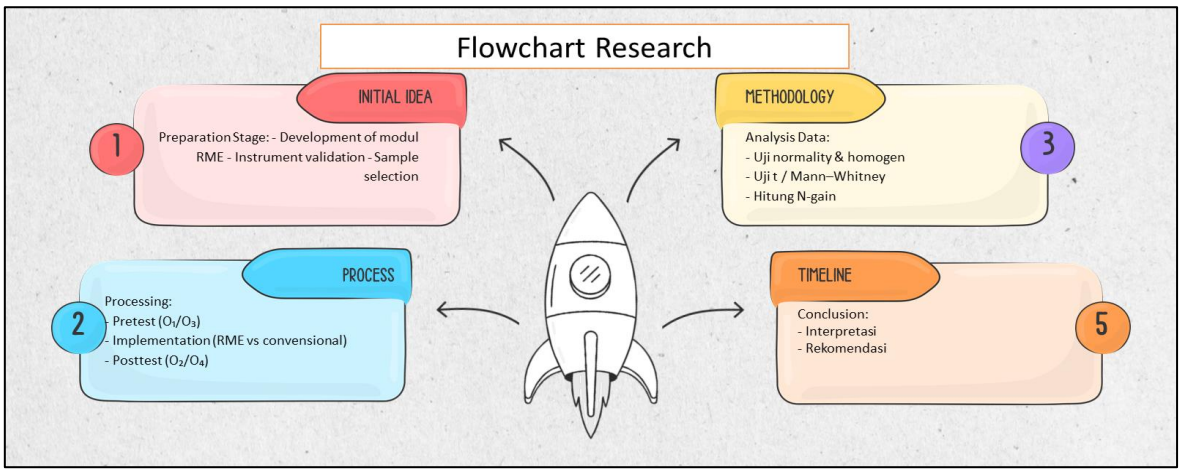
RESEARCH METHOD

The research method used in this study is a quasi-experiment with a pretest-posttest control group design (Hikmawati, 2020) dalam (Sugiyono, 2018). This method was chosen because the study aims to test the effectiveness of the Realistic Mathematics Education (RME) approach in improving students' conceptual understanding of fractions. In this design, there are two groups that are the subjects of the study, namely the experimental group that receives learning with the Realistic Mathematics Education (RME) approach and the control group that receives conventional learning. Both groups were given a pretest before learning to measure their initial understanding, then given different treatments according to their groups, and after that given a posttest to measure the increase in their conceptual understanding after learning took place.

The population in this study were 30 fifth grade students of Elementary School Neg 61 Banda Aceh City. The research sample was selected by purposive sampling based on certain criteria, such as schools that have not formally implemented Realistic

Mathematics Education (RME) and the equality of academic ability between the two groups being compared. To measure students' conceptual understanding of fractions, this study used several instruments, namely a fraction conceptual understanding test, an observation sheet of student activities during learning. The conceptual understanding test consists of a pretest and posttest containing multiple-choice questions and essays based on problem solving in a real context. The observation sheet is used to observe student involvement in the RME-based learning process, regarding the application of this approach.

Data analysis in this study was conducted using a quantitative approach. Quantitative data obtained from the pretest and posttest were analyzed using the t-test or Mann-Whitney test, depending on the data distribution, to see if there were significant differences between the experimental and control groups. In addition, the increase in students' conceptual understanding was also analyzed using the N-gain score calculation (Sugiyono, 2019). This research was conducted in several stages. The first stage is preparation, which includes the preparation of learning devices based on Realistic Mathematics Education (RME), validity and reliability testing of research instruments, and selection of research subjects. The second stage is implementation, which begins with giving a pretest to both groups, followed by implementing learning using different methods according to each group. The experimental group was taught using the Realistic Mathematics Education (RME) approach, while the control group was taught using conventional methods. After the learning process was completed, a posttest was given to both groups. The last stage is data analysis, where the results of the pretest and posttest were analyzed statisticaly. as shown in the research flow diagram below.



Figure; 1. Flowchart Research

RESULTS AND DISCUSSION

Results

The results of this study present an analysis of the effectiveness of the Realistic Mathematics Education (RME) approach in improving elementary school students' conceptual understanding of fractions. Data obtained came from pretests and posttests of student activity.

Validation Results

The development stage aims to produce learning products that have been validated and revised, so they are suitable for testing on students. The products developed include learning devices, learning media, and evaluation instruments. Validation was carried out by expert validators in Design, Material, Media, and Language. With the results of the Design expert validator getting an average of 94% with the results of the criteria being suitable for development and use in schools, Material Based on the assessment results from the media expert validator getting an average of 96% with the results of the criteria being suitable and can be calculated based on indicators. Based on the assessment results from the media expert validator getting an average of 96% with the results of the criteria being suitable and can be calculated based on indicators. The validation process has been improved and states that the design of developing fraction learning based on rme to improve students' creative thinking skills is suitable. Based on the assessment results from the language expert validator getting an average of 100% with the results of the criteria being suitable and can be calculated based on indicators. The validation process has been improved and states that the design for developing fraction learning based on rme to improve students' creative thinking skills is feasible and can be implemented into teaching modules and can be developed in other elementary schools

Student Activities in RME Learning

The learning process showed that students were more active in discovering and constructing fraction concepts. Student activities in groups included:

1. Real-Life Context Exploration : Students were given everyday life-based problems, such as dividing a cake or measuring the length of a string in fractional units. They understood the concepts more easily because the material was connected to their experiences.
2. Discussion and Reflection : Students discussed fraction problems in groups and shared their solution strategies. This activity enhanced their conceptual understanding through social interaction and mathematical communication.
3. Use of Visual Representations : Area models, number lines, and diagrams were used in RME learning. Students demonstrated better understanding when

fraction concepts were visualized before being translated into abstract mathematical symbols.

The results of the questionnaire assessment, the teacher's response was 94% and the student's response was 91%. This means that the development of a fraction learning design based on RME to improve students' creative thinking skills is worthy of being implemented and used in learning mathematics on fraction material in the classroom.

Table 1. Teacher and Student Response Questionnaire

Teacher Response	Student Response	Category
94%	**91%**	**Eligible**

The improvement in student learning outcomes from the beginning of learning before using the learning design was 72% of students completing the course and increased after the learning design was used in learning, namely increasing to 82%. Thus, the learning design can be used and is effective in improving student learning outcomes. Student learning outcomes, from the beginning of the learning process before using the learning design, with 71% of students completing the course, and this increased to 82% after the learning design was used in the learning process. Therefore, the learning design can be used and is effective in improving student learning outcomes.

Table 2. Table of Post-test and Pre-test Values

Number of Students	Pretest Average	Posttest Average	Difference (Δ)	Percentage Increase (%)	N-Gain Score	Improvement Category
30	72	82	30,6	13,9%	0,36	High

Table 3. N-Gain Score

Number of Students	Pretest Average	Posttest Average	Max Score	Difference (Δ)	Percentage Increase (%)	N-Gain Score	Improvement Category
30	72	82	100	10	13,9%	0,36	Medium

The Realistic Mathematics Education (RME) approach is more effective in improving students' conceptual understanding of fractions than conventional methods. Students' conceptual understanding improved significantly. Realistic Mathematics Education (RME) is an education focused on learning mathematics that is contextual and relevant to real life. (Gravemeijer & Terwel, 2000) in their research explain RME, developed by Hans Freudenthal in the Netherlands in the late 1970s. RME aims to make mathematics more meaningful and understandable to students through exploration,

discovery, and the use of concrete representations. This education has been adopted in many countries and has contributed significantly to the development of mathematics education, including in Indonesia. With proper implementation, RME can help students develop a better understanding of mathematics and prepare them to face challenges in the real world.

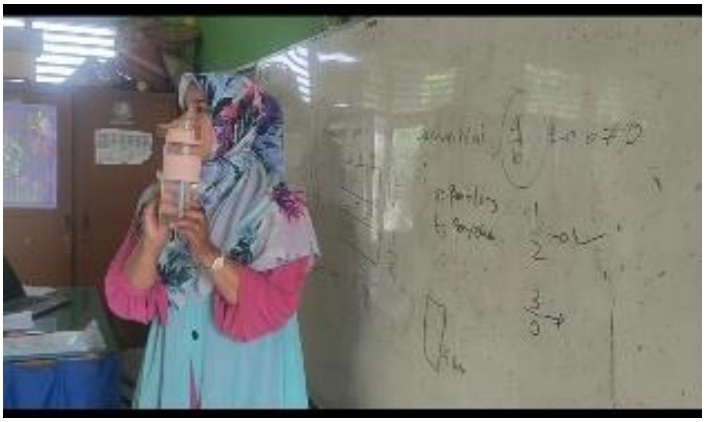


Figure 1. The teacher uses a bottle as a context.

The image shows a teacher holding a concrete medium in the form of a cylinder shaped The image above shows a teacher displaying a concrete cylinder-shaped object at the front of the class while explaining the concept of fractions written on the board. This object serves as a tool to bridge students' understanding from real-world experiences to abstract mathematical concepts, particularly in the areas of addition and subtraction of fractions.

In the Realistic Mathematics Education (RME) approach, learning about fractions begins with contextual problems relevant to students' lives. For example, the teacher relates the cylinder to real-life situations, such as dividing drinks or food into containers. The cylinder can be likened to a single unit that is then divided into equal parts, making it easier for students to grasp the meaning of fractions.

This activity reflects the principles of Realistic Mathematics Education (RME):

1) Concrete Model → Abstract Model
   The teacher displays parts of a cylinder as representations of fractions (e.g., 1/2, 1/3, or 1/4). When two parts are combined, students can directly observe the process of adding fractions with the same denominator, while when one part is removed, students understand the process of subtracting fractions.
2) Interactivity
   The teacher asks students a question:"If we have 2/4 of a drink, and then add another 1/4, how many parts do we have now?"

This question invites students to think, discuss, and find answers based on concrete representations.

3) Guided Reinvention

From observing concrete media, students are guided to rediscover the rules for adding and subtracting fractions. They realize that fractions with the same denominator can be directly added or subtracted, while fractions with different denominators must first be made the same.

Learning about fractions using concrete, cylinder-shaped media provides a meaningful experience for students. Observations show that students are more enthusiastic when the teacher presents visual aids that can be touched and seen directly. This creates a more interactive classroom environment, as students not only listen to the teacher's explanation but also actively observe, experiment, and provide answers based on real-life experiences.

Student responses indicated that using concrete media helped them understand the meaning of fractions. Before using the media, some students still had difficulty visualizing how fractions work in addition and subtraction. However, after seeing the cylinder section cut or reassembled, students more easily grasped the concept, for example, that 2/4 plus 1/4 equals 3/4. This activity also encourages discussion among students. They compare answers, recalculate, and justify their results. This discussion aligns with the principle of interactivity in RME, where learning involves not only acquiring knowledge but also building understanding through conversation and collaboration. From a teacher's perspective, the tube medium has proven effective in facilitating students' guided reinvention. Students are not directly given the formula, but are guided to discover for themselves that adding fractions with the same denominator can be done by adding the numerators, while keeping the denominator constant. Similarly, in subtracting fractions, students can grasp the concept by subtracting a portion from the whole.

Figure 2. Chocolate practice using origami.

In the image above, a teacher and a student are seen standing at the front of the class, holding a rectangular piece of origami paper used as a model for a chocolate bar. The student is asked to demonstrate how to divide the chocolate into equal parts, while the teacher provides instructions and examples of proper division. Meanwhile, other students sitting on the benches also held their own origami papers to imitate the process of distributing the chocolates. This way, students not only listened but also actively participated in the learning activity.

This activity reflects the principles of Realistic Mathematics Education (RME) that is 1) Contextual: The chocolate division problem is taken from a real-life situation close to the students' lives. 2) Concrete Model: Origami is used as a visual representation of the chocolate, so students can actually see the process of dividing into fractions. 3) Interactivity: The teacher and students work together to demonstrate, discuss, and draw conclusions. 4) Guided Reinvention: Through the origami division process, students gradually discover the concept of fractions**.** Thus, learning fractions through chocolate division simulations becomes more meaningful, fun, and easier for students to understand.

Figure 3. Students working on group assignments

The image shows two students working on a task of gluing triangular/slice-shaped origami pieces onto a pizza-like structure. This activity is designed to foster understanding of the concepts of addition and subtraction of fractions through a Realistic Mathematics Education (RME) approach. This activity not only teaches fraction operations, but also trains counting skills, mathematical communication, and creativity through the use of origami media.

From the experience of manipulating pizza slices, students naturally "rediscovered" the concept of fraction operations. They realized that adding fractions with the same denominator simply means adding the number of slices, while subtracting means reducing the number of slices. This activity not only teaches fraction operations, but also trains counting skills, mathematical communication, and creativity through the use of origami media.

Discussion

The results of this study indicate that the RME approach can be a solution for improving students' conceptual understanding of fractions. Implications of this study include:

1. The Importance of Contextual Learning: Students more easily understand abstract concepts when they are linked to their real-life experiences.
2. The Role of the Teacher as a Facilitator: In the RME approach, teachers need to provide provocative questions that encourage students to think critically and explore concepts on their own.
3. The Use of Visual Representations: Concrete models such as diagrams, number lines, and area models can improve students' understanding of fractions.

The availability of learning resources and teaching aids that support the Realistic Mathematics Education (RME) approach is also an important factor in successful implementation. The use of teaching materials that are in accordance with the principles of Realistic Mathematics Education (RME), such as context-based textbooks and manipulative teaching aids, can help students understand the concept of fractions better Therefore, the development of teaching materials and teaching aids that support the Realistic Mathematics Education (RME) approach is one step that needs to be considered in efforts to improve the quality of fraction learning in elementary schools

The availability of learning resources and teaching aids that support the Realistic Mathematics Education (RME) approach is a crucial factor for its successful implementation (Nasir et al., 2019). The use of teaching materials aligned with the principles of RME such as context-based textbooks and manipulative teaching aids can significantly enhance students' understanding of fraction concepts (Putri, 2019). Consequently, the development of teaching materials and instructional aids that integrate the RME approach represents an essential step in improving the quality of fraction learning in elementary schools (Yusari et al., 2024).

In practice, the integration of RME-based resources allows students to relate abstract mathematical concepts to their daily experiences. For instance, fractions can be introduced through real life contexts such as sharing food, measuring ingredients, or partitioning objects, which makes the learning process more meaningful and engaging. Manipulative teaching aids such as fraction circles, number lines, or digital simulations further strengthen conceptual understanding by providing visual and tactile representations that bridge the gap between concrete experiences and abstract reasoning. Moreover, the development of these resources supports differentiated instruction, enabling teachers to accommodate diverse student learning styles and levels of mathematical readiness. Thus, the systematic provision of RME-oriented teaching materials not only improves students' cognitive comprehension of fractions but also fosters active participation, problem-solving skills, and positive attitudes toward mathematics.

CONCLUSION

Based on the analysis, it can be concluded that the implementation of Realistic Mathematics Education (RME) significantly improves elementary school students' conceptual understanding of fractions. This approach is more effective than conventional methods because it allows students to explore fraction concepts in real contexts, interact with peers, and use visual representations to aid their understanding. Implementing RME requires teacher readiness, sufficient time, and supportive learning media. Therefore, teacher training and the development of RME-based teaching materials are needed to improve the effectiveness of mathematics learning in elementary schools.

The implementation of a Realistic Mathematics Education (RME)-based fraction learning design has proven effective in improving elementary school students' conceptual understanding. Through contextual problems, guided reinvention, and the use of models as bridges between concrete and abstract concepts, students were able to construct their own mathematical knowledge meaningfully.

Thus, it can be concluded that RME-based fraction learning design provides a significant contribution to enhancing students' conceptual understanding. The integration of real-world contexts with mathematical concepts makes learning more engaging and effective. Future studies are suggested to expand the application of this approach to other mathematical topics and grade levels to further validate its effectiveness.

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DECLARATION

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Conflict of Interest	The entire process, starting from the planning stage, data collection, classroom implementation, data analysis, up to the preparation of the manuscript, was carried out independently and transparently by the authors.
Additional Information	Therefore, the authors confirm that the research findings and conclusions reported in this article are presented objectively, free from any form of conflict of interest, and intended solely to contribute to the development of knowledge in the field of elementary mathematics education.

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