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The Effect of Realistic Mathematics Education Approach on Students' Conceptual Understanding

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Ahmad Nizar Rangkuti *)
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail: nizarahmad1304@uinsyahada.ac.id

Mariam Nasution
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail:mariam@uinsyahada.ac.id

Almira Amir
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail:almiraamir@uinsyahada.ac.id

Irwan Saleh Dalimunthe
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail: irwansaleh@uinsyahada.ac.id

Samsuddin
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail: samsuddin@uinsyahada.ac.id

Muhammad Amin
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail: muhammad.amin7010@gmail.com

Dame Siregar
UIN Syekh Ali Hasan Ahmad Addary
Padangsidimpuan, Indonesia
E-mail: damesiregar03@gmail.com

Mhd. Rafi'i Ma'arif Tarigan
STIT Hamzah Al-Fansuri Sibolga Barus, Indonesia
Email**:** rafiimagister8@gmail.com

Abstract: This research was conducted in Grade VI at SD 200223 Sibulan-bulan Padangsidimpuan during the academic year 2023/2024, focusing on the topic of fractions. The aim of this study was to determine the effect of the Realistic Mathematics Approach on students' understanding of concepts in Grade VI at SD 200223 Sibulan-bulan. The study utilized a Post-Test-Only Control Group design and was of quasi-experimental nature. It involved an experimental group receiving the Realistic Mathematics Education Approach treatment and a control group not receiving such treatment. Both groups were selected randomly. The research findings indicate that students' understanding of mathematical concepts was better when using the Realistic Mathematics Approach compared to conventional learning methods. Based on the hypothesis testing results, it was found that t-count > t-table (2.23 > 1.98) and the Sig. value = 0.018, indicating that there is a positive effect of the Realistic Mathematics Education Approach (RME) on students' conceptual understanding. Based on the above findings, it is recommended that the learning process in schools use the Realistic Mathematics Education Approach, as it can improve students' conceptual understanding and mathematical abilities

Abstrak: *Penelitian ini dilaksanakan di kelas VI SD 200223 Sibulan-bulan Padangsidimpuan pada tahun ajaran 2023/2024 dengan fokus pada materi pecahan. Tujuan dari penelitian ini adalah untuk mengetahui pengaruh pendekatan Pendidikan Matematika Realistik terhadap pemahaman konsep siswa di Kelas VI SD 200223 Sibulan-bulan. Penelitian ini menggunakan desain grup kontrol Post-Test-Only dan merupakan jenis eksperimen semu. Penelitian ini melibatkan kelompok eksperimen yang menerima perlakuan pendekatan Pendidikan Matematika Realistik dan kelompok kontrol yang tidak menerima perlakuan tersebut. Dua kelompok ini dipilih secara acak. Hasil menunjukkan bahwa secara Secara deskriptif nilai rata-rata pada kelas kontrol adalah 60,55 mengalami peningkatan pada kelas eksperiment menjadi 65,26 yang menunjukan bahwa Pemahaman konsep siswa menggunakan Pendekatan*

*) *Corresponding Author*

Pendidikan Matematika Realistik lebih baik dari pembelajaran konvensional. Dari hasil pengujian hipotesis yang telah dilakukan, diperoleh bahwa $t_{hitung} > T_{tabel}$ (2,23>1,98) dan nilai Sig. = 0,018 yang menunjukkan bahwa terdapat pengaruh yang positif pendekatan Pendidikan Matematika Realistik (RME) terhadap pemahaman konsep Siswa. Berdasarkan temuan penelitian di atas disarankan agar pelaksanaan proses pembelajaran di sekolah menggunakan pendekatan pendidikan matematika realistik karena dapat meningkatkan pemahaman konsep dan daya matematika siswa.

Keywords: Conceptual Understanding, Mathematics Learning, Realistic Mathematics Education Approach

INTRODUCTION

In accordance with the Indonesian Regulation No. 19 Article 19 paragraph (1) on National Education Standards, that Process Standards, the learning process in educational units must be organized in an interactive, inspiring, challenging, and motivating manner to actively engage learners. Additionally, it must provide ample space for creativity, initiative, and independence in accordance with the talents, interests, and physical and psychological development of students (Ramadhan & Yanuarti, 2020; Sakdiah & Syahrani, 2022)

The development of science and technology is increasing massively. In response to this, humans are required to be adaptive, supported by the ability to think critically and cooperatively. With these skills, various kinds of rapidly moving information from different sources can be filtered and utilized appropriately for life needs (Jeheman et al., 2019; Tiyana & Elfrianto, 2023; Yahaya & Salam, 2014).

Mathematics is an essential subject at every level of education. The complexity of thinking and learning, combined with the relatively difficult and abstract nature of mathematics (Warmansyah, 2019) makes learning more challenging compared to theoretical and empirical sciences and requires diverse efforts in teaching. Hadi and Kasum (2015) emphasized that a fundamental understanding of mathematical concepts is crucial for solving mathematical and real-world problems relevant to mathematics.

One of the goals of mathematics learning is for students to have the ability to understand mathematical concepts, explain the relationships between concepts, and apply these concepts in a flexible, accurate, efficient, and precise manner when solving problems, as we all know the important role it plays in supporting human processes in navigating life. (Tanjung, 2019).

If students have a good conceptual understanding, they will be able to record, comprehend, apply, and modify concepts to solve various mathematical problems (Lisnani, 2019; Nababan & Tanjung, 2022; Sopiyuloh et al., 2024).

Understanding concepts in learning mathematics meaningfully is crucial, as teachers expect that the comprehension achieved by students is not limited to connecting concepts. Conceptual understanding is a vital part of both the learning process and problem-solving, in academic settings and real life. The ability to grasp concepts serves as the foundation for thinking and problem-solving. Concepts are the building blocks of thought and the basis for higher mental processes to formulate principles and generalizations. Indicators of concept understanding include: (1) correctly mentioning and explaining concepts, (2) appropriately applying concepts, and (3) providing suitable examples of a concept (Yunita, 2016).

The results of the Midterm Examination of 95 students in class VI showed that 43 students met the minimum completion criteria, indicating that 60% of students did not meet these criteria. Furthermore, almost 70% of students have been unable to solve problems oriented towards conceptual understanding. The low mathematics learning achievement provides an overview of the low understanding of mathematical concepts (Jeheman et al., 2019).

Previously, the orientation of Indonesian education tended to position students as objects, teachers as the highest authority, with subject-oriented material and centralized management. In the new paradigm, however, the orientation of education is more focused on the learning process rather than teaching (teaching to learning), with more flexible management structures. Students are seen as having more freedom, and education is understood to have a relationship and interaction with life (Ridha et al., 2021).

One solution to these problems is learning mathematics using the Realistic Mathematics Education Approach (RME), which aims to make students active and communicative in the learning process. Through active student involvement, it is expected that students' concept understanding skills will be well trained (Heryan & Zamzaili, 2018).

This approach aligns with Hutagalung's (2017) study, which found a causal relationship between students' low understanding of mathematical concepts and their low learning achievement. Since the role of the teacher is central to achieving conceptual understanding, contemporary mathematics teaching should view mathematics not as rote material, but as an opportunity to understand concepts (Darmawan, 2022; Jehadus, 2018; Mueller et al., 2014; Purba, 2023; N. F. Siregar, 2021).

In mathematics education, concepts should not be memorized. elementary mathematics includes topics such as the surface area of cubes and blocks, starting with defenitions, properties, nets, surface area, volume, circumference, and their elements. Learning strategies that integrate learning aids can be effective and well-received by students. (Nurrita, 2018).

Such learning makes students active participants in constructing formal mathematical knowledge. Although students have the potential, they need teachers' guidance to rediscover formal mathematical knowledge. Guiding the construction process involves investigating students' thought processes to provide appropriate scaffolding, rather than dictating commands.

Mathematical objects, including concepts, are abstract, making them challenging to learn. Teachers must find the right approach to make learning more relatable to students' daily activities. One effective approach is the Realistic Mathematics Education Approach *(RME)* (Herawaty et al., 2019; Ulya et al., 2024) The RME (Realistik Mathematics Education) approach can be an altehrnative to improve students' understanding of mathematical concepts (Izzati, 2017; Muhtadi, 2017; Simanullang, 2020).

The goal of RME (Realistic Mathematics Education) is to provide students with the opportunity to rediscover and reconstruct mathematical concepts by connecting these concepts to the real world, allowing students to develop a strong understanding of mathematical concepts. RME operationally provides an understanding of the relevance and usefulness of mathematics (the material being taught) in and/or for everyday life. All of these concepts will be independently constructed and developed by the students. Additionally, problem-solving does not have to be singular or the same between one student and another. Several previous studies have shown that RME is effective in improving students' understanding of mathematical concepts (Ahmad & Asmaidah, 2017; Alamiah & Afriansyah,

2017; Lisnani, 2019; Muhtadi & Sukirwan, 2017).

Previous research has been conducted on similar cases, as in Yulianty's, which revealed that there is a difference in the ability to understand mathematical concepts between students taught with the realistic mathematics approach and those taught with conventional methods after controlling for students' initial abilities (Yulianty, 2019). Ningsih also reported that the increase in conceptual understanding among students taught using the realistic mathematics approach was higher than among students taught through conventional methods, and there was no interaction between the teaching model and students' initial mathematical abilities in improving conceptual understanding (Ningsih, 2017). Furthermore, Hasanah's study found that the application of the realistic mathematics approach, assisted by the use of knowledge-based snakes and ladders, improved students' understanding of mathematical concepts by presenting realistic problems relevant to everyday life, encouraging students to discuss and solve contextual problems. The discussion results were then presented, leading students to discover mathematical concepts. The learning activities that applied the Realistic Mathematics Education Approach increased students' engagement in lessons, as they felt they were discovering new things compared to previous learning experiences, which actively involved them in the Realistic Mathematics Education Approach (U. Hasanah et al., 2023). The conventional learning model, which is easy to implement in schools, served as a control for the effects of the RME application in this study.

Based on the description above, the purpose of this study is to determine the Influence of Realistic Mathematical Education Approach on Students' Conceptual Understanding in Grade VI SD 200223 Sibulan-bulan.

METHOD

This study used a Post-Test-Only Control Group Design, a type of quasi-experiment. It involved two groups: an experimental group that received treatment and a control group that did not. Two groups were randomly selected for the study. The experimental group was taught using the Realistic Mathematics Education Approach (RME), while the control group was taught using a conventional approach. The research design is shown in Table 1 below:

Table 1. Research design

Class	Treatment	Posttest
VI A	Control	O_1
VI B	Experiment	O_2

This study involved grade VI students of SD 200223 Sibulan-bulan for the academic year 2023/2024. The researchers utilized two classes: an experimental class and a control class. Before conducting random sampling, the researchers conducted a class equivalence test. This process indicated that class VI A, consisting of 34 students, served as the control class, while class VI B, consisting of 35 students, served as the experimental class.

Data were collected by administering a pretest to measure students' understanding of mathematical concepts; implementing the RME (Realistic Mathematics Education) approach in the experimental class; and gathering data after the experimental class received the treatment, while the control class was given a posttest to measure students' understanding of mathematical concepts.

The data analysis was conducted using descriptive statistics to determine the mean, median, and standard deviation, as well as the categorization of conceptual understanding. Additionally, inferential analysis was conducted, beginning with prerequisite tests such as the normality test and homogeneity test, followed by a t-test. The descriptive calculations aimed to

describe the conditions before and after the treatment for both classes based on each variable. The inferential calculations were used to draw conclusions based on the data and information obtained during the research activities.

To simplify and achieve more accurate results, data analysis was conducted using SPSS software, with the criteria that if $-t_{table} \leq t_{count} \leq t_{table}$, then H_0 is accepted.

The study employed an essay test as the instrument to measure students' understanding of mathematical concepts. Data analysis in this study utilized a comparative test formula (t-test), which compares post-test scores between the control and experimental classes. To facilitate and obtain more accurate results, data analysis was conducted using SPSS, with the criterion that if $-t_{table} \leq t_{count} \leq t_{table}$, then H_0 (null hypothesis) is accepted.

RESULTS AND DISCUSSION

The data collected comprised the post-test results of the experimental and control classes after treatment. Subsequently, prerequisite tests were conducted using tests for data normality and homogeneity. The normality test of the data was performed to determine whether the sample data originated from a population with a normal distribution. Researchers employed the chi-square test technique with a significance level of $\alpha = 0.05$. (Fatimah et al., 2021; Halawati, 2019) Table 2 indicates that the data on students' mathematics learning interest in the experimental and control groups come from populations with a normal distribution.

Table 2. Recapitulation of normality test results

Group	X_{count}	X_{table}	Description
Control	-8,07	7,71	Normal
Experiment	6,83	7,71	Normal

The homogeneity test determines whether two sample groups originate from populations that are uniform. Homogeneity testing indicates that the data are homogeneous if sig. > 0.05. (Purna et al., 2021). Table 3 below shows the results of the homogeneity test for post-test scores between the experimental and control classes.

Table 4. Recapitulation of Homogeneity Test Results

Levene Statistic	df1	df2	Sig.
.065	1	52	.417

Table 4 above shows that the significance value of 0.065 is greater than 0.05. This means that the post-test data from both the experimental and control classes originate from the same population.

The previous description indicates that the data analysis test requirements have been met. The calculation result does show that the data, consisting of post-test scores from the experimental and control classes, are normally distributed and homogeneous. The next step in the data analysis is hypothesis testing. Parametric statistical t-tests are used for hypothesis testing. The hypotheses for this research are as follows:

1. H_0: Students' understanding of concepts using the Realistic Mathematics Education Approach is not better than conventional learning.
2. H_1: Students' understanding of concepts using the Realistic Mathematics Education Approach is better than conventional learning.

Based on these research hypotheses, the statistical hypotheses can be formulated as follows:

$H_0: \mu_1 \leq \mu_2$
$H_1: \mu_1 > \mu_2$

Where:

μ_1: Mean score of students' concept understanding in the experimental group.

μ_2: Mean score of students' concept understanding in the control group.

Based on the parametric statistical test results, the findings are as shown in Table 5 below:

Table 5. Recapitulation of parametric statistical t test results

Data	Average	t_{count}	T_{table}	Sig.
Experiment	65.26	2.32	1,98	0,018
Control	60.55			

The average score for mathematical concept understanding in Table 5 shows that the experimental class had an average of 65.26, while the control class had an average of 60.55. According to the results of the hypothesis test, H_0 was rejected and H_1 was accepted. Thus, the average score of students' mathematical concept understanding in the experimental class was 65.26.

Table 5 also shows that the significant value was 0.018, and since the significance value is less than 0.05, H_0 was rejected and H_1 was accepted. The results indicate that students' understanding of mathematical concepts is better when using the Realistic Mathematics Education Approach compared to conventional learning. Based on the hypothesis testing results, it can be concluded that there is a positive effect of the Realistic Mathematics Education Approach (RME) on students' conceptual understanding in the 6th grade of SD 200223 Sibulan-bulan.

The difference in learning activity orientation leads to varying outcomes in both classes. This indicates that RME prioritizes student activities, as evidenced by their ability to discover, process, and report data from various sources, as well as present their findings.

The research findings are consistent with studies conducted by Ridha (2021) and Siregar (2021), which show that the RME approach is more effective in developing students' understanding of mathematical concepts (Ridha et al., 2021; K. Siregar et al., 2021). Previous studies by Putra and Widyastuti & Pujiastuti found that students have better mathematical abilities with Realistic Mathematics Education learning compared to conventional learning (Putra, 2016; Widyastuti & Pujiastuti, 2014) That ability is the ability to understand concepts. Therefore, the application of the Realistic Mathematics Education Approach affects how students understand mathematical concepts.

RME learning begins with studying students' everyday experiences (contextual problems).(Adriwati et al., 2023; Jeheman et al., 2019; Sari et al., 2022; N. F. Siregar, 2021) This will enable students to understand and solve lessons using their prior knowledge or experience. The second stage is the use of models. At this point, participating in active activities will help them discover various ideas or concepts based on real-life situations. These models serve as a means to achieve a more formal understanding of the concepts.

Based on this, mathematics learning at the elementary school level is expected to involve rediscovery. Rediscovery is finding an informal solution method during classroom learning. Therefore, mathematics education should relate to the real-life experiences of students. Learning should begin with the immediate, real, and realistic environment, making it easier for students to understand the material presented, as mathematical concepts originate from everyday phenomena. Teachers, who play a crucial role in the teaching and learning process, must consider appropriate strategies or learning models in elementary mathematics education to ensure students are enthusiastic and motivated to learn (Fitriana & Aprilia, 2021; Narayani, 2019; Siswadi & Saminah, 2020; Susanti, 2020).

The Realistic Mathematics Education Approach requires students to solve contextual problems given by the teacher, which focuses students' attention because it encourages them to think independently and fosters curiosity. During the learning process using the Realistic Mathematics Education Approach, students are observed to be enthusiastic and attentive. Students' concentration and feelings can be seen from their enjoyment of the tasks given and their eagerness to complete them. The chosen learning material, which is about fractions, is relevant to the students' everyday needs, as fractions are closely related to their daily lives. Therefore, learning that is connected to students' needs will naturally motivate them to learn (Aziz et al., 2022).

The Realistic Mathematics Education Approach is a teaching method that must start with something tangible, enabling students to engage meaningfully in the learning process. According to this approach, a mathematics class is not a place where mathematical content is transferred from teacher to student, but a place where students rediscover mathematical ideas and concepts through the exploration of real-world problems. Here, mathematics is seen as a human activity that originates from problem-solving. Therefore, students are not viewed as passive recipients but should be given the opportunity to rediscover mathematical ideas and concepts under the teacher's guidance. The Realistic Mathematics Education Approach is based on the philosophy that mathematics must be connected to things that are real to students and should be viewed as an activity in everyday life (Sutarto et al., 2016).

In a student-focused learning environment, students have the opportunity to experiment, discover ideas, and develop various ways to solve problems. It is expected that students will contribute fully, thereby limiting teacher authoritarianism. Interactivity occurs between students and teachers and among students themselves. Through this interaction, students receive validation, clarification, and projection of their findings. Additionally, they reflect independently to produce formal results. In the fifth stage, or the closing stage, students are asked to integrate the material they have learned with other subjects. This is known as *intertwining* (Agusta, 2020).

Student exploration activities are not evident in classes with conventional teaching methods. In their role as knowledge providers, teachers are responsible for creating a learning environment that enhances memory retention (Tanjung, 2019). Students usually behave passively and only follow instructions or information given by the source of knowledge, whether orally or in writing. When the teacher lectures to the audience about the material being discussed, students' lack of understanding is evident. Only a few students ask questions, while the others remain silent. Practice problems given in class are only completed by a few active students. Classroom learning is neither enjoyable nor engaging. The teacher simply presents the material gradually, giving students the opportunity to take notes and receive practice problems. Additionally, students appear unenthusiastic about completing the practice problems given; they tend to wait for answers from smarter peers or further explanations from the teacher, making it difficult for them to grasp the concepts of the material presented. Consequently, students' mathematical understanding is lacking.

Based on the discussion above, it can be concluded that the use of the Realistic Mathematics Education Approach in mathematics learning affects how students understand mathematical concepts. In other words, students who learn mathematics in class through this approach understand concepts better than those in conventional learning settings.

CONCLUSION

The research findings and discussions indicate that students' conceptual understanding improves significantly when applying Realistic Mathematics Education compared to conventional methods, particularly in the topic of fractions. Therefore, it is hoped that teachers will adopt Realistic Mathematics Education in their teaching practices. This approach not only enhances students' enthusiasm for learning but also aids in their comprehension of mathematical concepts. Full student engagement in Realistic Mathematics Education can positively impact their understanding of responsibility and work ethic. Descriptively, the average score in the control class was 60.55, increased in the experimental class to 65.26, which showed that students' understanding of concepts using the Realistic Mathematics Education Approach was better than conventional learning. From the results of the hypothesis testing that has been carried out, it is obtained that the tcount >Ttable (2.23>1.98) and the value of Sig. = 0.018 which shows that there is a positive influence of the Realistic Mathematics Education (RME) approach on students' understanding of concepts.

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