The Effect of the Realistic Mathematics Education Learning Approach on Students' Conceptual Understanding Ability in Terms of Mathematical Anxiety

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Abstract. This study analyzed the effect of using the Realistic Mathematics Education (RME) approach on students' mathematical understanding abilities in terms of mathematical anxiety using a posttest-only group control design. This study involved all eighth-grade students of SMP Santu Klaus Kuwu Indonesia. The sample selection used purposive sampling. The instruments used were posttest questions on conceptual understanding abilities and non-test instruments in questionnaires to assess mathematical anxiety. Based on the study's results, several important conclusions were obtained, namely that the RME approach significantly affected students' mathematical understanding abilities, with a significance value of 0.000. In addition, mathematical anxiety also had a significant effect on students' mathematical understanding abilities in the experimental and control classes, with a significance value of 0.000. However, the interaction between the application of the RME approach and mathematical anxiety on students' abilities to understand mathematical concepts was not significant, with a significance value of 0.563. Thus, the RME approach effectively improves students' understanding of mathematical concepts regardless of their level of anxiety.

Keywords: Realistic Mathematics Education; Conceptual Understanding; Anxiety

1 Introduction

Conceptual understanding is the basis or main capital in mastering mathematics learning, because by understanding the concept, problems can be solved [1]. The same thing was expressed by [2] who emphasized that conceptual understanding is the basis for higher mathematical concepts and supports the ability to connect between these concepts. In addition, according to [3], students who are able to understand concepts are usually able to describe concepts, identify and implement ideas. Every student needs to have good ability in understanding concepts in order to have good achievement in learning mathematics. This is because the goal of mathematics learning activities is to understand concepts well and correctly [4]. However, many students do not understand the concept of mathematics so they find it difficult to solve routine mathematics problems. Currently, Indonesia is experiencing a crisis in understanding mathematical concepts. These facts can be explained in the following statements: 1. Indonesia is experiencing a mathematics crisis because mathematical understanding has decreased from year to year, there is no increase in understanding along with the increase in

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education level. 2. During the 14 years between 2000 and 2014, the increase in mathematical understanding of Indonesian children only reached 11 percent. 3. Based on IFLS data from 2000, 2007, and 2014 which covered 83% of the population of Indonesian children 1 have a low average competency score in mathematical understanding [5].

Mathematical anxiety is one of the factors that causes low mathematical concept understanding ability of students in Indonesia. Students who have mathematical anxiety are always tense, anxious, or afraid in learning mathematics [6]. The same thing was also expressed by [7] who stated that mathematical anxiety has a negative relationship with students' conceptual understanding. The higher the student's anxiety, the lower the student's ability to understand mathematics. Students who experience this anxiety tend to avoid situations where they have to learn and do mathematics [8]. With this anxiety, students do not focus on learning. This anxiety is in the form of their negative views of mathematics. Mathematics is considered difficult because it is abstract, logical, systematic, and full of confusing symbols and formulas [9].

Based on unstructured interviews with several students at SMP Santu Klaus Kuwu regarding their opinions on mathematics, it was also found that when students are faced with mathematics subjects they feel bored, afraid, confused, and even skip math lessons. There are also students who think that the learning process is monotonous, which means that the learning approach used is still conventional, where this approach applies more lecture methods without providing students with ample opportunities to develop their abilities in explaining the material being studied. So that students feel confused when working on math problems.

From these problems, the initial step that can be taken by educators to reduce or minimize students' anxiety towards mathematics is to use an experience-based learning approach, namely RME. This approach links mathematical material with what students experience in their lives [10]. Several studies have proven that the RME approach can help students understand mathematics. RME is one approach to learning mathematics that focuses on using students' realities and experiences as a basis for learning. According to [11] the RME approach can also help students to integrate and apply certain concepts comprehensively in various disciplines. In addition, the RME approach aims to build students' understanding in understanding mathematical content through the informal knowledge they already have [12]. By implementing this approach, students use all their abilities in the learning process, this is because the material being studied is more closely related to their lives or the concepts being taught are realistic. In line with the opinion of [13] that the RME approach will provide students with full opportunities to discover mathematical concepts with the guidance of educators.

2 Method

This research is an experimental research, namely Quasi Experimental Design. The researcher used a posttest-only control design which can be seen in table 1.

Table 1. Research Design

Sample	**Treatment**	**Anxiety**	***Posttest***
Experimental	X	E_1	O_1
Control	-	K_2	O_2

Description:

X : Treatment using RME
E_1 : Provision of questionnaires (seeing mathematical anxiety) after using the RME approach
B_2 : Provision of questionnaires (seeing mathematical anxiety) after using the conventional approach
O1: Final test to see students' ability to understand concepts after participating in RME learning
O2 : Giving a final test to measure students' success in understanding mathematics

In this study, the researcher took a population of class VIII as many as 5 study groups. While the samples taken were two classes, namely class A as a control class with a total of 23 students who used conventional learning and were given a mathematical anxiety questionnaire and class B as an experimental class with a total of 26 students who used the RME approach and were given a mathematical anxiety questionnaire. The selection of the experimental class and control class was based on class randomization. This is because after the researcher conducted a t-test on the five classes, the results obtained were that all classes were equivalent. So to select a class sample, the researcher used a random class technique or random class selection so that the results obtained were that there were two classes used as research samples, namely class A and class B.

The instrument trial was conducted in class IX A on March 7 to March 10, 2024. After a trial was carried out on the posttest with a total of 5 questions and 20 mathematical anxiety questionnaire questions. From the results obtained, all posttest and questionnaire questions were valid. After the validity test, a reliability test was carried out on the research instruments and the results obtained showed that all the instruments were reliable. Reliability coefficient of posttest data of students' abilities was 0.68 and the reliability coefficient for the mathematical anxiety questionnaire was 0.88. From the criteria or requirements that have been set, the posttest and questionnaire data are categorized as very high reliability. From these results, the test and non-test instruments are suitable for use in research. The data collection technique in this study used five posttest questions on the ability to understand concepts and 20 mathematical anxiety questionnaire questions. Research data must be analyzed to understand the problem being studied and determine whether the research hypothesis can be accepted or rejected. Normality test and homogeneity test are prerequisite tests before conducting a hypothesis test. In this study, the homogeneity test uses the chi square test formula, the homogeneity test with the f count formula and the hypothesis test uses a two-way ANOVA test with the help of SPSS 26.

3 Results and Discussion

Researchers tested the normality of data on students' post-test questions in solving mathematics problems, especially in understanding the concepts needed in each problem worked on in the 2 classes.

Table 2. Results of the Post-Test Normality Test

Class	X^2_{Count}	X^2_{table}	**Conclusion**
Experimental	6.1296	11.0705	Normally Distributed
Control	5.2316	9.48772	Normally Distributed

Based on the data in Table 2. the calculation results in the control class and the experimental class were obtained, $X^2_{Count} < X^2_{table}$ namely 6.1296 <11.0705, then H_0 was accepted. This means that the posttest data on the ability to understand concepts in the control and experimental class is normally distributed, while the normality test of the posttest data for the control class is obtained X^2_{table} = 5.2316 and from the critical value table of the normality

test with Chi-Square is obtained X^2_{table} = 9.4877. This means posttest data of the control class is normally distributed. The researcher also analyzed the questionnaire data that had been filled out by the students. The results of the questionnaire normality test were analyzed with the help of the Microsoft Office Excel 2007 application.

Table 3. Questionnaire Normality Test Results

Class	X^2_{Count}	X^2_{table}	Conclusion
Experimental	6.1205	11.0705	Normally Distributed
Control	7.7518	9.48772	Normally Distributed

From the data in Table 3. it can be concluded that the mathematical anxiety questionnaire for the experimental class and the control class after the normality test was carried out proved that $X^2_{Count} < X^2_{table}$. In the experimental class is 6.1296 <11.0705 and the control class, is 7,7518<9,487729, it meaning that the mathematical anxiety questionnaire data for the experimental class and the control class was normally distributed.

3.1 Data Homogeneity Test

Data homogeneity test is conducted to see whether the data we are studying comes from a homogeneous or the same population. In this study, the homogeneity test used is the F-test using the Microsoft Office Excel 2007 application. The following is a statistical hypothesis for the homogeneity test. The following are the results of the post-test data test of the ability to understand mathematical concepts, which can be seen in Table 4.

Table 4. Results of the Posttest Homogeneity Test

Class	N	F_{Count}	F_{table}	Conclusion
Experiment Control	25 25	1.612	1.9837	Homogeneous

Based on the data in Table 4. the calculation results in the control class and the experimental class were obtained $F_{Count} < F_{table}$ then H_0 was accepted. This means that the posttest data on students' mathematical concept understanding abilities in the control and experimental class was homogeneously distributed. Meanwhile, the results of the homogeneity test of the mathematical anxiety questionnaire in the control and experimental classes can be seen in Table 5.

Table 5. Results of the Questionnaire Homogeneity Test

Class	N	F_{Count}	F_{table}	Conclusion
Experiment Control	25 25	1.340	1.9837	Homogeneous

Based on the data in Table 5. the calculation results in the control class and the experimental class were obtained $F_{Count} < F_{table}$ then H_0 was accepted. This means that the data from the students' mathematical anxiety questionnaire in the control and experimental classes were distributed homogeneously.

3.2 Discussion

Based on the results obtained after the researcher gave pretest questions on mathematical concept understanding ability and distributed mathematical anxiety questionnaires to students.

The instrument was distributed to the two classes that had been used as research samples. The results obtained can be seen as follows.

Table 6. Post-test Data Results for Experimental Class and Control Class.

Statistic	Class	
	Experiment	**Control**
Average	80.5385	72.087
Standard Deviation	5.8394	7.91956

In table 6, there is a significant difference in the average success of students after studying the material through the current learning approach with the conventional approach. Students' mastery of mathematics through the new learning model is significantly higher than the ability of students who follow regular learning, which is 80.5385> 72.087. The learning process in the RME class is more enjoyable, not monotonous, students are free to find answers, and communicate answers to the problems that have been given. In the conventional approach, the learning process is monotonous or learning is one-way. Therefore, the RME approach contributes more to improving students' conceptual understanding abilities compared to the conventional learning approach. Meanwhile, in this study, the researcher also measured the level of student anxiety towards mathematics.

Table 7. Description of the Mathematical Concepts Reviewed from Anxiety

Statistics	Experiment	Control
	Anxiety (A1)	**Anxiety (B2)**
Number of Students	26	23
Average	67.28261	77.69231
Standard Deviation	10.36721	12.00361
Average Problem Solving Ability	80.5385	72.087

Based on the data presented in Table 7. both classes (A and B) have mathematics anxiety with different average values. Mathematics anxiety that obtained an average of 67 was obtained in both classes obtained mathematics anxiety with an average of 78. While in the previous table it is explained that the average ability to understand mathematical concepts of the two classes is 80 and 72. Based on these data, it can be concluded that the experimental class that was given the RME approach treatment obtained a lower average anxiety value than the experimental class and had a positive effect on students' ability to understand mathematical concepts as indicated by the posttest value in the experimental class being higher than the posttest value in the control class.

The formulation of the research problem, "Is there a difference in the use of the RME approach to the mathematical concept understanding ability of class VIII students of SMP Santu Klaus Kuwu?" is answered with this title. The results obtained after data analysis using the two-way ANOVA test can determine the formulation of the research problem.

Table 8. Data on the Influence of RME on Concept Understanding Ability

Tests of Between-Subjects Effects					
Dependent Variable: Conceptual understanding ability Matematika					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	871.712[a]	1	871.712	18.354	.000
Intercept	284288.202	1	284288.202	5985.584	.000
Ekspe-Konven	871.712	1	871.712	18.354	.000
Error	2232.288	47	47.495		
Total	290400.000	49			
Corrected Total	3104.000	48			

Based on Table 8. it can be seen that the significance value = 0.000 is obtained because0.00 < 0.05 it means H_{0a} was rejected and H_{1a} was accepted, this means that the use of RME has a positive contribution to students' ability to master mathematics. The renewal of learning methods has a significant influence on students' ability in understanding mathematical concepts. One of the reasons for RME is the focus on real-life situations in learning mathematics. Students are not only required to understand and remember concepts, but also to be bound in their own theoretical areas so that they are able to relate what they learn to their experience situations. Students are also brought through mathematical ideas by finding and developing mathematical concepts through mathematics with a research or discussion style. [14] emphasized that students who learn with the RME approach show a significant increase in their ability to apply mathematical concepts. The results of this study indicate that students who learn with the RME approach tend to be successful in understanding the material given by the teacher and are able to use their knowledge in new situations [15]. Thus, RME provides a strong foundation for students to not only succeed in mathematics, but also in various aspects of life that require logical and analytical thinking.

Second, Is there a difference in mathematical anxiety on the mathematical concept understanding ability of grade VIII students at SMP Santu Klaus Kuwu?" has been answered. Can be seen in Table 9.

Table 9. Data on the Effect of Mathematical Anxiety on Conceptual Understanding Ability

Tests of Between-Subjects Effects					
Dependent Variable: Mathematical Anxiety Questionnaire					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1014.784[a]	1	1014.784	8.322	.006
Intercept	254022.784	1	254022.784	2083.166	.000
Math Anxiety	1014.784	1	1014.784	8.322	.000
Error	5731.216	47	121.941		
Total	259755.000	49			
Corrected Total	6746.000	48			

Based on Table 9. it can be seen that the significance value = 0.000 is obtained because 0.000<0.05 it means H_{0B} was rejected and H_{1B} was accepted. Because it was accepted, there is an influence of mathematical anxiety on students' a bility to understand mathematical concepts in the experimental class and the control class. Mathematical anxiety has a significant influence on students' ability to understand mathematical concepts. This anxiety can hinder the learning process and reduce academic performance in mathematics. When students feel anxious, they tend to have difficulty concentrating and processing information effectively. As a result, they may not be able to understand or remember mathematical concepts well. In addition, [16]

explains that anxiety can cause students to avoid math tasks or feel stressed when facing exams, which in turn reduces their opportunities to practice and deepen their understanding of mathematical material. Furthermore, mathematical anxiety can create a negative cycle in which bad experiences with mathematics reinforce fear and self-doubt [17]. When students experience failure or difficulty in mathematics, they may feel even more anxious, which then reduces their motivation to learn and try again [18]. This cycle can lead to further decline in mathematical concept understanding. To address this issue, it is important for educators to create a supportive learning environment, use anxiety-reducing teaching approaches, such as Realistic Mathematics Education (RME), and provide adequate emotional and academic support to students.

Next question, Is there an interaction between the implementation of the Realistic Mathematics Education (RME) approach and mathematical anxiety on the mathematical concept understanding ability of grade VIII students at SMP Santu Klaus Kuwu?" has been answered. The results of the analysis can be seen in Table 10.

Table 10. Data on the Influence of RME with Mathematical Anxiety on Conceptual Understanding Ability

Tests of Between-Subjects Effects

Dependent Variable: Posttest and Questionnaire

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2446.000[a]	32	76.438	1.859	.000
Intercept	215945.833	1	215945.833	5250.96	.000
Ekspe-Konven	383.167	1	383.167	9.317	.000
Kecemasan Math	1318.606	23	57.331	1.394	.000
Ekspe * Konven	285.111	8	35.639	.867	.563
Error	658.000	16	41.125		
Total	290400.000	49			
Corrected Total	3104.000	48			

Based on Table 10. it can be seen that the significance value = 0.563 is obtained, because 0.563>0.05 it means H_{0AB} was accepted and H_{1AB} was rejected. Because it was accepted, there is no interaction between the application of the Realistic Mathematics Education (RME) approach and mathematical anxiety on students' ability to understand mathematical concepts. Realistic Mathematics Education (RME) has a positive influence on students' ability to understand mathematical concepts, especially when viewed from the aspect of mathematical anxiety. RME integrates mathematical concepts with real and contextual situations, making the material more relevant and easier for students to understand. When mathematics is taught in a more concrete way and directly related to everyday life, students tend to feel more comfortable and confident [19]. This helps reduce their mathematical anxiety, because they can see the practical application of what they are learning. [20] stated that RME encourages collaborative learning and group discussions, which also contribute to reducing mathematical anxiety. Through collaboration with peers, students can share knowledge, discuss problems, and provide support to each other. This creates a supportive learning environment where students feel freer to express ideas and ask questions without fear. Thus, students who are usually anxious about mathematics can experience an increase in conceptual understanding, because they are more engaged and motivated to learn. Overall, RME can reduce mathematical anxiety and improve students' mathematical concept understanding abilities by creating a more meaningful and supportive learning experience.

4 Conclusion

Based on the results of this study, it can be concluded that the Realistic Mathematics Education (RME) approach has a significant influence on students' mathematical concept understanding ability. This approach can improve students' mathematical concept understanding better than the conventional approach. In addition, this study also shows that mathematical anxiety has an important role in the mathematics learning process. Students who have lower levels of mathematical anxiety tend to have better conceptual understanding. Conversely, students with high mathematical anxiety tend to have difficulty understanding mathematical concepts even when using the RME approach. The RME approach has been proven effective in reducing students' mathematical anxiety, because this approach prioritizes problem solving that is relevant to students' daily lives, so that they feel more comfortable and interested in learning mathematics. Therefore, it can be suggested that teachers pay more attention to the mathematical anxiety factor in choosing a learning approach, as well as integrating the RME approach in mathematics learning to optimally improve students' conceptual understanding.

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