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Realistic Mathematics Education (RME) Learning Model Improves Conceptual and Procedural Understanding of Junior High School Students

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ABSTRAK

Saat ini masih banyak siswa yang merasa perlu lebih percaya diri dalam mempelajari matematika. Sebagian besar siswa lemah dalam pemahaman konseptual dan pengetahuan prosedural.Penelitian ini bertujuan untuk menganalisis pengaruh Realistic Mathematics Education *(RME) terhadap pemahaman konseptual dan prosedural siswa.Jenis penelitian yang digunakan adalah eksperimen semu* (Quasi Experiment)*. Desain penelitian ini adalah* non-equivalent pot-test-only control group design*. Populasi penelitian ini adalah seluruh siswa kelas VII yang berjumlah 133 siswa. Pengambilan sampel menggunakan teknik* simple random sampling*. Total sampel yaitu 58 siswa. Metode yang digunakan untuk mengumpulkan data adalah tes. Instrumen yang digunakan untuk mengumpulkan data adalah soal tes. Teknik yang digunakan untuk menganalisis data adalah analisis statistik deskriptif dan statistik inferensial. Hasil penelitian yaitu terdapat perbedaan antara siswa yang mengikuti model pembelajaran* Realistic Mathematics Education *(RME) dengan siswa yang tidak mengikuti model pembelajaran* Realistic Mathematics Education *(RME) terhadap kemampuan konseptual dan prosedural pada siswa. Disimpulkan bahwa model pembelajaran* Realistic Mathematics Education *(RME) dapat meningkatkan kemampuan konseptual dan prosedural pada siswa sekolah menengah pertama.*

ABSTRACT

Currently, there are still many students who feel they need to be more confident in studying mathematics. Most students are weak in conceptual understanding and procedural knowledge. This research aims to analyze the effect of the realistic mathematics education (RME) approach on students' conceptual and procedural understanding. The type of research used is a quasi-experiment (Quasi Experiment). The design of this research is a non-equivalent pot-test-only control group design. The population of this study was all class VII students, totaling 133 students. Sampling used a simple random sampling technique. The total sample is 58 students. The method used to collect data is a test. The instrument used to collect data is test questions. The techniques used to analyze data are descriptive statistical analysis and inferential statistics. The research results show differences between students who follow the realistic mathematics education (RME) learning model and students who do not follow the realistic mathematics education (RME) learning model regarding students' conceptual and procedural abilities. It was concluded that the realistic mathematics education (RME) learning model can improve conceptual and procedural abilities in junior high school students.

1. INTRODUCTION

Mathematics is one of the main subjects in junior high school. Mathematics taught to students is expected to provide life skills, which are, of course, very much needed in children's daily lives (Dwi Sari & Setiawan, 2020; Risdayanti & Abrar, 2022; Sholikhah et al., 2018). Mathematics has many important benefits for middle school students. Some of the benefits include developing problem-solving abilities, increasing logical thinking abilities, and applying mathematical concepts in everyday life (Gitriani et al., 2018; Kurniasari, 2019; S. Sulastri et al., 2017). Research also shows that learning mathematics through

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problem-solving can improve students' ability to understand mathematical concepts (Purwasi & Fitriyana, 2019; Salma Aprianka, 2020). Learning mathematics can also help students develop critical and analytical thinking skills, which are important skills for success in the future (Dwianjani & Candiasa, 2018; Gitriani et al., 2018; Kurniasari, 2019; S. Sulastri et al., 2017). Therefore, understanding and mastering mathematics at the junior high school level is very important to equip students with the skills needed in life.

However, the current problem is that there are still many students who feel they need to be more confident when studying mathematics. This was revealed by previous research findings, which stated that there are still many students who get low mathematics learning scores (Rabbani et al., 2022; Salma Aprianka, 2020). Other research reveals that students' low mathematics learning outcomes are caused by students finding it difficult to learn and considering learning mathematics to be very difficult (Ayyubi et al., 2018; Dwianjani & Candiasa, 2018; Purwasi & Fitriyana, 2019). Other research also reveals that low mathematics learning outcomes are caused by less varied learning activities and a lack of supportive learning media (Hanifah et al., 2019; Partayasa, 2020).

Based on observations in Surabaya city schools, most students are weak in conceptual understanding and procedural knowledge. Students' weak conceptual understanding is reflected when students successfully solve mathematical problems that are the same as those demonstrated by the teacher, but when given problems that are slightly changed, students have difficulty solving them. This shows that students are only able to memorize and remember the formulas and processes involved without understanding mathematical concepts. Meanwhile, students' weak procedural knowledge is reflected when students succeed in solving mathematical problems that are the same as those exemplified by the teacher, but when given a problem, whether it is the same as the example or slightly modified, students always ask the teacher about the order of each step taken to solve the problem. . This shows that students do not understand the techniques or procedures for solving problems correctly and students still have a dependency on the teacher in solving problems. This problem is one of the causes of students' learning difficulties, especially in mathematics subjects.

Efforts to increase conceptual understanding and procedural understanding of Mathematics subjects certainly require active participation not only from teachers, but also active participation from students (Arifin & Herman, 2017; Gunawan et al., 2019; Zineb et al., 2022). For this reason, there is a need for learning capital that involves students directly, so that learning becomes meaningful. Because meaningfulness will impress students, so that the lesson will have a longer memory period (retention spam) compared to rote learning. The learning that can lead to this is Realistic Mathematics Education (RME) learning (Darto, 2021; Nurjamaludin et al., 2021; Septia, 2021). RME learning must be linked to reality and mathematics is a human activity. This means it must be close to children and relevant to everyday situations (Nuraina et al., 2021; Rahmawati Suwanto & Wijaya, 2021). Mathematics as a human activity means that humans must be given the opportunity to rediscover mathematical ideas, concepts and procedures.

The RME approach is an approach that assumes the need for a connection between mathematics and reality that exists and can be found in everyday life (Astuti, 2018; Ekowati et al., 2021; Primasari & Zulela, 2019). These realistic problems do not mean problems that are always concrete and can be seen by the eye but include things that are easy for students to imagine. In addition, students must be given the opportunity to rediscover and construct mathematical concepts and procedures with the guidance of adults or teachers (Ahadi et al., 2021; Dewi & Izzati, 2020). Problems like this need to be resolved, solutions need to be found so that students are able to act, behave better and implement their understanding in their daily activities. Furthermore, it is a shared responsibility to do so, however, teachers have the opportunity to teach teaching material and implement it in students' daily lives or activities through a learning design in a good and positive direction.

Another factor that must be considered in learning mathematics is students' reasoning abilities. Students' reasoning abilities are an important role in the smooth running of a learning activity because it describes students' readiness to receive the lessons that will be delivered (Fuadi et al., 2016; Santosa et al., 2020). It is important for teachers to know students' reasoning abilities before starting learning, because in this way it can be seen whether students have reasoning abilities which are a prerequisite for participating in learning, students know what material will be presented (Agustin, 2019; Muslimin & Sunardi, 2019; Sariningsih & Herdiman, 2017). Good input is expected to produce good output, so that having adequate reasoning skills will really support the learning process and students' achievement of conceptual understanding and procedural understanding of mathematics (Fuadi et al., 2016; Santosa et al., 2020; Sariningsih & Herdiman, 2017). The inclusion of student characteristic variables in this research as moderator variables is also intended to increase the internal validity of this research design.

Several studies have been conducted on RME Learning (Darto, 2021; Nuraina et al., 2021; Nurjamaludin et al., 2021; Pakhrurrozi, 2021; Rahmawati Suwanto & Wijaya, 2021; F. Sulastri et al., 2021; Supriyanto et al., 2020; Witha et al., 2021; Zubaidah Amir et al., 2021). The research researched so far has only been on the RME Learning approach in improving mathematics learning outcomes on one type of learning outcome only. Research on the RME Learning approach in increasing students' achievement of conceptual understanding and procedural understanding of mathematics has not been widely researched, even though conceptual understanding and procedural understanding in abstract mathematics are arranged in stages and sequentially starting from the basic level, conceptual understanding and procedural understanding (Mulyono et al., 2018; Sari et al., 2020). This is also in accordance with the RME and Lecture Learning approach model which is applied through reasoning skills. Based on the problems above, none of the research conducted has been tested to apply the RME and Lecture Learning approach which is applied through reasoning abilities to students' conceptual understanding and procedural understanding of mathematics in class VII in the city of Surabaya. The aim of this research is to analyze the influence of the realistic mathematics education (RME) approach on students' conceptual and procedural understanding.

2. METHOD

This type of research is quasi-experimental (Quasi Experiment) (Widiantini et al., 2017). Quasi-experiments do not allow for controlling external variables that influence the implementation of the experiment. The research design used in this study was a non-equivalent pot-test-only control group design. In this research, there is an experimental class and a control class. In the experimental class, treatment was given using the Realistic Mathematics Education (RME) learning model. Meanwhile, the control class received treatment by not using the Realistic Mathematics Education (RME) learning model. The population of this study was all class VII students, totaling 133 students. Sampling in this research used a simple random sampling technique. Simple Random Sampling is randomly taking sample members from a population without paying attention to the strata in the population (Handika et al., 2021). The total sample for this research was 58 students. The method used to collect data is a test. The test method is used to collect data after students are given treatment to test the effectiveness of the Realistic Mathematics Education (RME) learning model. The instrument used to collect data is test questions. The test question grid is presented in Table 1.

Table 1. Research Instrument Grid

No.	Indicator	No. Items	Number of Items
1	Ability to present mathematical statements verbally, in writing, drawings, sketches or diagrams	1,2	2
2	Ability to make allegations	3,4,5	3
3	Ability to determine patterns	6,7,8	3
4	Ability to perform mathematical manipulation	9,10, 11	3
5	Ability to provide reasons for several solutions	12,13	2
6	Ability to check the validity of an argument	14	1
7	Ability to draw conclusions or make generalizations	15	1

The techniques used to analyze data are descriptive statistical analysis and inferential statistics. Descriptive statistical analysis determines the high or low quality of students' conceptual and procedural understanding. This technique calculates the mean, median, mode, and standard deviation. Inferential statistical analysis is used to process data to test research hypotheses. The prerequisite tests in this research consist of a normality test of data distribution, a variance homogeneity test, and a correlation test between dependent variables. Hypothesis testing uses two analyses, namely the first and second hypotheses using the Anava test and the third hypothesis using the Manova test.

3. RESULT AND DISCUSSION

Result

The aim of this research is to analyze the influence of the realistic mathematics education (RME) approach on students' conceptual and procedural understanding. The results of this research are as follows. The description of the data that follows the Realistic Mathematics Education (RME) learning model for students' conceptual understanding is that the maximum student score is 94. The minimum student score is 56. The average student score is 83.7, the median is 86.4, and the mode is 88. The results of This research are as follows. The description of the data that follows the Realistic Mathematics Education (RME) learning model for students' procedural understanding is that the maximum student score is 97. The minimum student score is 70. The average student score is 89.8, the median is 90.4, and the mode is 92.8. Description of data that does not follow the Realistic Mathematics Education (RME) learning model for students' conceptual understanding: The maximum student score is 88. The minimum student score is 56. The average student score is 74, the median is 70.5, and the mode is 70. The description of the data obtained does not follow the Realistic Mathematics Education (RME) learning model for students' procedural understanding; the maximum student score is 87. The minimum student score is 60. The average student score is 74.8, the median is 72.3, and the mode is 72. Next, a normality test is carried out. Research data. The normality test results are presented in Table 2.

Table 2. Normality Test Results

No.	Data Group	X^2 Count	X^2 Table	Output
1	Conceptual understanding of the experimental group	5.9	7.814	Normal
2	Procedural understanding of the experimental group	5.4	7.814	Normal
3	Conceptual understanding of the control group	5.4	7.815	Normal
4	Control group procedural understanding	3.9	7.815	Normal

The calculations based on the Chi-Square formula showed that the normality test results for conceptual understanding in the experimental group were 5.9, so the data was normal. The results of the procedural understanding normality test in the experimental group were 5.4, so the data was normal. The control group's conceptual understanding normality test results were 5.4, so the data was normal. The normality test result for the control group's procedural understanding was 3.9, so the data was normal. The homogeneity test results are presented in Table 3.

Table 3. Results of Homogeneity of Variants Test with F-Test

No.	Data Group	Variant	X^2 Count	X^2 Table	Output
1	Conceptual understanding of the experimental group	93.2	1.19	1.891	Normal
2	Procedural understanding of the experimental group	78.5	1.19	1.891	Normal
3	Conceptual understanding of the control group	49.8	1.12	1.891	Normal
4	Control group procedural understanding	44.4	1.12	1.891	Normal

The homogeneity test results show that the experimental group's conceptual and procedural understanding data is 1.19, $F_{count} < F_{Table}$, so the data is homogeneous. The homogeneity test results in the control group were 1.12, $F_{count} < F_{Table}$, so the data was homogeneous. The correlation test results between the dependent variables in the experimental group were 0.17 (calculated $r_{xy} = 0.17$ < table $r_{xy} = 0.388$), so the conceptual and procedural understanding variables were not correlated. The product moment test result in the control group was 0.17, so conceptual and procedural understanding variables were not correlated. Based on this, it can be concluded that the data can be continued with hypothesis testing.

The results of hypothesis test I are using the one-way variance analysis formula (Anava A). The results of data analysis showed that the F_{count} was 22.7 while the F_{Table} was 4.01. The results of this analysis show that $F_{count} > F_{Table}$ so that there is a difference between students who follow the realistic mathematics education (RME) learning model and students who do not follow the realistic mathematics education (RME) learning model regarding conceptual understanding. The results of hypothesis test II are F_{count} 70.44 while F_{Table} 4.01. The results of this analysis show that $F_{count} > F_{Table}$ so that there is a difference between students who follow the realistic mathematics education (RME) learning model and students who do not follow the realistic mathematics education (RME) learning model regarding procedural understanding. Hypothesis Test III uses Manova with the help of SPSS. The results of the Manova test analysis are presented in Table 4.

Table 4. Summary of Multivariate Tests

Effect	Value	Value	F	Hypothesis df	Error df	Sig
Intercept	Pillai's	0.99	5292.948[a]	2.000	55.000	0.000
	Wilks' Lambda	0.00				0.000
	Hotelling's Trace	192.4				0.000
	Roy's Largest Root	192.4				0.000
RME	Pillai's	0.59	40.257[b]			0.000
	Wilks' Lambda	0.40				0.000
	Hotelling's Trace	1.46				0.000
	Roy's Largest Root	1.46				0.000

The results of the data analysis show that the significance value is 0.000. Because the significance value obtained is 0.000 > 0.05, it can be concluded that there is a simultaneous difference between the realistic mathematics education (RME) learning model and students who are not taught using the realistic mathematics education (RME) learning model.

Discussion

The data analysis results show simultaneous differences in the realistic mathematics education (RME) learning model with students who are not taught using the realistic mathematics education (RME) learning model. This is caused by several factors, namely as follows. First, the realistic mathematics education (RME) learning model can improve students' conceptual understanding. The RME approach supports students' mathematics learning, which can build conceptual understanding in students (Mulyati, 2021; Rizqi et al., 2021; Wesna et al. , 2021). In order for students to be able to build a logical application of the RME Approach, students must be able to connect the schema of related concepts by exploring knowledge about previous concepts related to the problem to be solved (Hasunah, 2021; Lestari & Syafri, 2021; Sukmaningthias et al., 2021). Based on theoretical studies regarding students' conceptual understanding and procedural understanding of mathematics by applying the RME approach, it can be concluded that it is better than applying the lecture method learning in this research. Students who are familiar with the RME Approach in this way can remember and connect related mathematical concepts completely (Ariningsih et al., 2023; Laurens et al., 2018; Ridha et al., 2021).

Second, the realistic mathematics education (RME) learning model can improve students' procedural understanding. Creating procedural understanding in students requires good knowledge of mathematical concepts (Armanza & Asyhar, 2020; Mulyono et al., 2018). Thus, students who have good conceptual readiness and procedural understanding will be able to connect the problems they face with previous knowledge (Putri & Prihatnani, 2020; Rizal dkk., 2022a, 2022b). The RME approach is applied with high reasoning abilities, which will increase Conceptual Understanding and Procedural Understanding. This is reinforced by previous findings, namely that for learning to occur, students must take action on new information and connect new Conceptual Understanding and procedural understanding with reasoning abilities (Claudia, 2017; Mulyono et al., 2018). RME learning aims to equip students with knowledge that can be applied (transferred) flexibly from one problem to another and from one context to another (Cindyana et al., 2022; Salma Aprianka, 2020). This is what forms procedural understanding in students.

Third, the realistic mathematics education (RME) learning model can improve students' conceptual and procedural understanding. Students' conceptual and procedural understanding of mathematics requires them to build logical understanding by connecting what they already know and have learned, starting from what is asked (Claudia, 2017; Susiloningsih, 2019; Zahroh et al., 2022). When viewed from the concept understanding indicators, the level of concept understanding includes the ability to interpret, give examples, classify, summarize, and draw conclusions. Compare and explain (Nurdin et al., 2019; Yulianty, 2019). Supporting factors that can be used as a reference for student learning achievement are understanding concepts (Alawiya et al., 2022; Izzah & Fitriyani, 2019). Students with low conceptual and procedural understanding experience difficulties in learning in schools that still use traditional methods.

Previous research findings also confirm that the RME learning model can make it easier for students to learn mathematics (Salma Aprianka, 2020; S. Sulastri & Kusmanto, 2016). Other research also states that implementing the RME model can significantly improve student learning outcomes (Ananda, 2018; Ardina et al., 2019; Yudianto et al., 2021). From the opinion above, it can be concluded that in order for learning to occur which can improve learning outcomes, there needs to be an approach with the RME learning model (Mafidah, 2021; Ndiung et al., 2021; Yudianto et al., 2021). It was concluded that the realistic mathematics education (RME) learning model can help students learn mathematics. The limitation of this research is that the application of the realistic mathematics education (RME) learning model was only carried out in class VII junior high school students and only measured students' conceptual and procedural understanding. This research implies that the realistic mathematics education (RME) learning model that teachers apply in mathematics learning activities increases a pleasant learning atmosphere and motivates students to learn. This causes students' conceptual and procedural understanding to increase.

4. CONCLUSION

The data analysis results show simultaneous differences in the realistic mathematics education (RME) learning model with students who are not taught using the realistic mathematics education (RME) learning model. It can be concluded that the realistic mathematics education (RME) learning model can improve conceptual and procedural understanding of mathematics in junior high school students. The realistic mathematics education (RME) learning model helps students learn, making it easier to understand mathematics learning.

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